CIP 2019

VIII Iberian Conference on Perception

San Lorenzo de El Escorial

20th - 22nd June

ABSTRACT BOOK

Index

Welcome to the 8th Iberian Conference on Perception

On behalf of the Organizing Committee, we would like to invite you to attend the 8th Iberian Conference on Perception that will be held in June, 20-22nd, 2019, in San Lorenzo de El Escorial, Spain.

This conference is focused on Perception, emphasizing different aspects like: Motion Perception, Spatial Vision, Stereopsis, colour Perception, Perception and Action, Attention and Cognition, Auditory Perception, Multisensory Integration and Reading/Speech Perception.

In this sense, the conference will include two keynote lectures from internationally renowned scientists, symposia, talks and poster sessions.

All abstracts will be published in the Journal: The Spanish Journal of Psychology (Cambridge University Press).

Regarding the venue, this year the conference will be held in the Real Centro Universitario Escorial-María Cristina, in the town of San Lorenzo de El Escorial, which is about 45 Km north from Madrid, Spain.

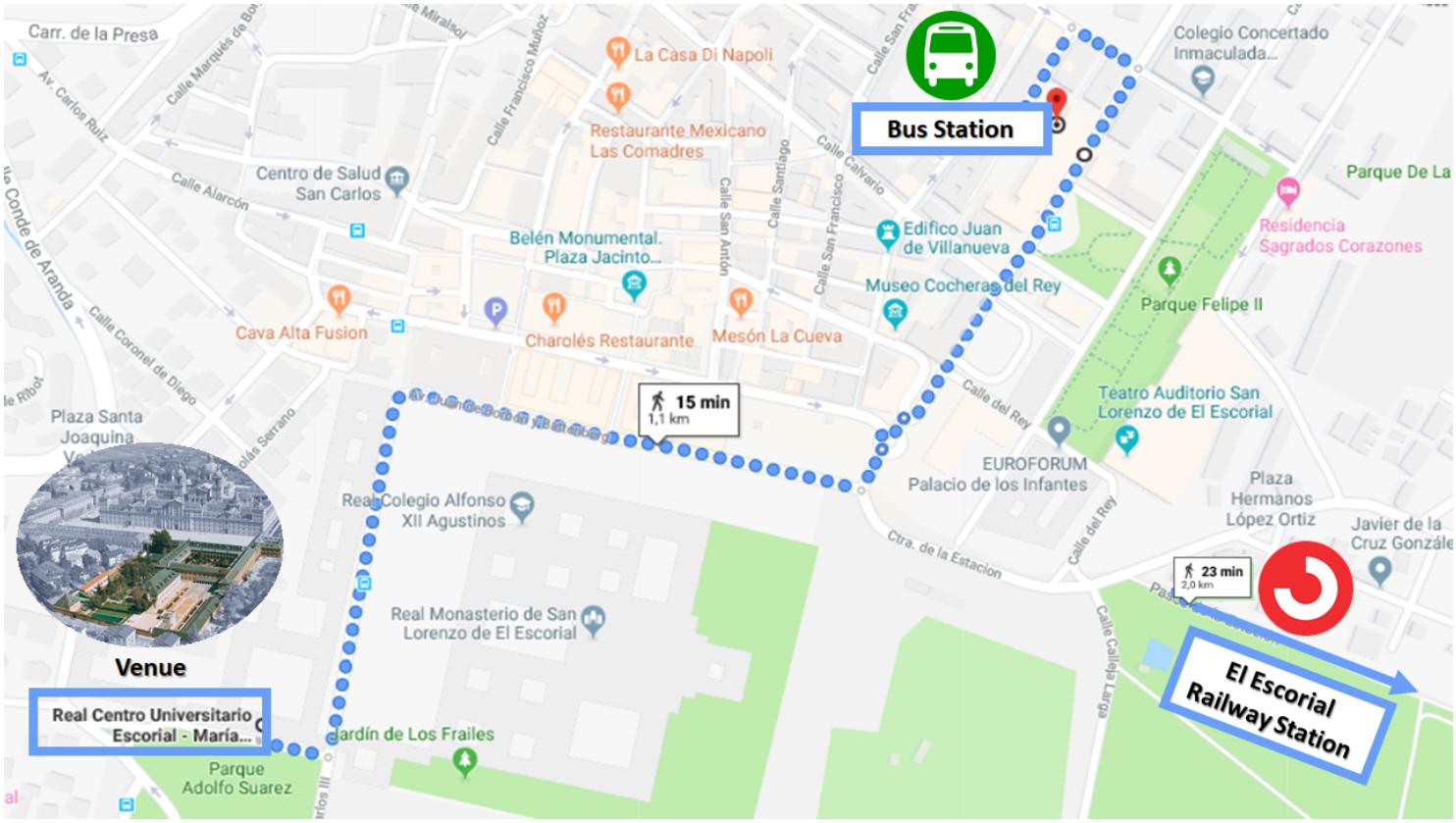
Finally, the conference rate will include, registration, coffee breaks, lunch, and a guided visit to the The Royal Seat of San Lorenzo of El Escorial, which has been declared a UNESCO World Heritage Site.

On behalf of the Organizing Committee

Dr. Ignacio Serrano-Pedraza

Dr. Julio Lillo Jover

Map



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Website & Social Media

Please, check our **website eventos.ucm.es/26555**

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@cipviii
#CIPVIII

How to get there?

You can reach the Escorial – María Cristina Royal University Centre:

By Cercanías train

RENFE information, telephone: 902-24 02 02.

From Madrid:
- Atocha
- Chamartín
- Nuevos Ministerios
- Príncipe Pío

From El Escorial:
- El Escorial Station

From El Escorial train Station to San Lorenzo Bus Station: C-8A line.

Train frequencies: from 15 minutes to 1 hour.

Trip time: 1 hour approx. (it depends on the Station).

Please, check the map https://www.crtm.es/media/393460/cercanias.pdf , information about your route: http://www.renfe.com/viajeros/cercanias/madrid/ and the fares https://www.crtm.es/billetes-y-tarifas/billetes-y-abonos/cercanias-renfe.aspx?idPestana=3&lang=en

Maybe it is better to buy a Tourist card, please check it: https://www.crtm.es/billetes-y-tarifas/otras-tarjetas/turistica.aspx?lang=en

It is very useful to combine subway and train. You can check the subway map here: https://www.planometromadrid.org/mapas-metro/plano-metro-madrid-2018-01.png and information about your route: https://www.metromadrid.es/en

By Suburban buses: 661 or 664

From Madrid:
- Moncloa, c/ Princesa. Moncloa subway station.

From San Lorenzo de El Escorial:
- c/ Juan de Toledo. Information: 91-896 90 28.

Information: https://www.crtm.es/tu-transporte-publico/autobuses-interurbanos.aspx?lang=en

Bus frequencies: 10-15 minutes.

Trip time: 40-50 minutes approx.

By Taxi:

The official app is TXMAD

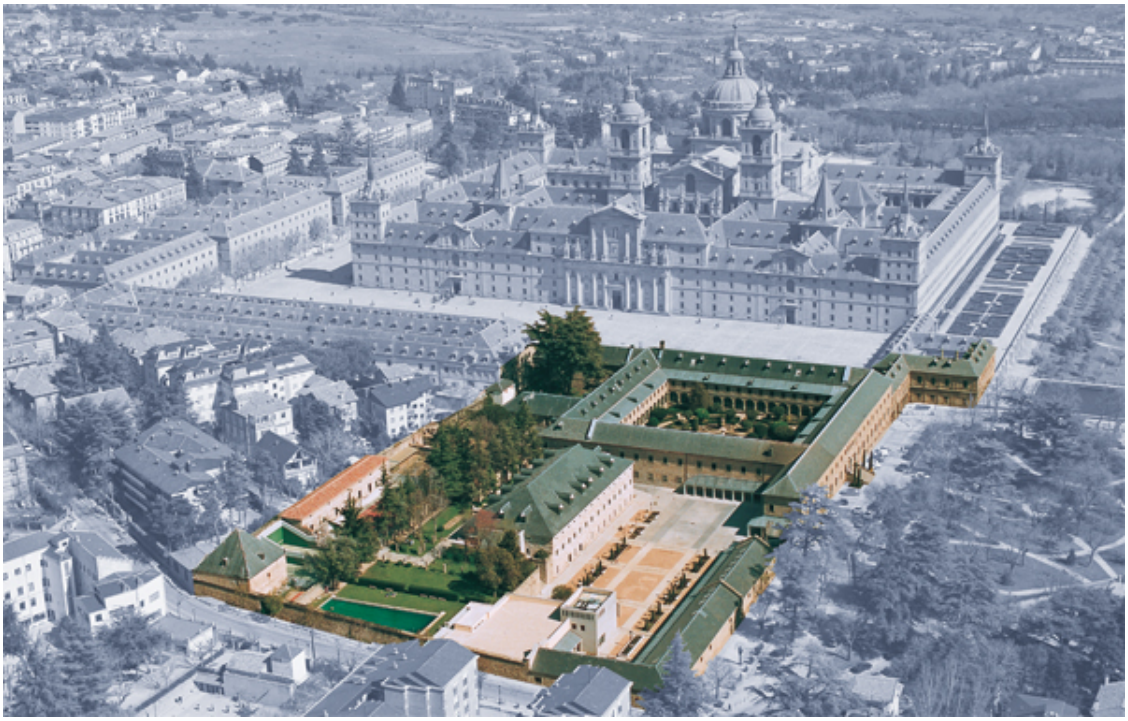
You can download from:

- Apple Store: IOS-TXMAD
- Google Play: Android-TXMAD

By car:

From Madrid: follow the N-VI to the 18.5 km exit to the Rozas– El Escorial (M-505 road), or the 47 km exit to San Lorenzo del Escorial (M-600 road).

There are parking spaces at the Venue. Please contact the organization if you are getting there by car.



Presenter instructions

Regular talk:

- Each talk is 12 minutes followed by a 3 minutes of questions.

Symposium:

- Each symposium is 20 minutes followed by a 2:30 minutes of questions.

Regular talk & Symposium:

- A Mac or PC from the organization can be used for the presentations. You can also use your Mac or PC laptop.
- The aspect ratio of the projector screen is 4:3, so we recommend using 4:3 slides.
- Please arrive 30 min before your talk session in order to check your presentation.

Poster presentation

- Poster boards are 190 cm tall x 100 cm wide. We recommend you to print your posters in A0 size (120 cm tall x 90 cm wide).

Program

	20-June-2019	21-June-2019	22-June-2019	
8:30-9:00	Registration	Registration	Registration	8:30-9:00
9:00-9:30		Talks. Vision	Talks. Perceptual Grouping & Haptics	9:00-9:30
9:30-10:00				9:30-10:00
10:00-10:30	Opening lecture. Jenny Bosten	Symposium. Colour Perception	Symposium. Optics & Perception	10:00-10:30
10:30-11:00				10:30-11:00
11:00-11:30	Posters & coffee break			11:00-11:30
11:30-12:00		Coffee break	Coffee break	11:30-12:00
12:00-12:30	Symposium. Computational Perception	SEPEX Conference. Jenny Read	Talks. Colour Perception & Attention	12:00-12:30
12:30-13:00				12:30-13:00
13:00-13:30		Lunch break	Business meeting	13:00-13:30
13:30-14:00	Lunch break		Lunch break	13:30-14:00
14:00-14:30				14:00-14:30
14:30-15:00		Talks. Face Perception & Word Recognition		
15:00-15:30	Talks. Audition & Aesthetics			
15:30-16:00		Coffee break		
16:00-16:30	Coffee break	Symposium. Motion Perception		
16:30-17:00	Symposium. Eye Movements, Perception & Action			
17:00:17:30				
17:30:18:00				
18:00-18:30		Visit to the Royal Seat of San Lorenzo de El Escorial		
18:30-19:00				
19:00-19:30				
19:30-20:00				

Program

20th June

8:30 – 10:00 Registration

10:00 – 11:00 Opening lecture: Jenny Bosten

11:00 – 12:00 Posters & coffee break

- P1.01 **Effect of force related auditory feedback on hand held object weight perception** (Jai Prakash Kushvah, Thorsten Plewan & Gerhard Rinkenauer)
- P1.02 **Visual search strategies in a dual-target search task** (Fatima Alvarez & M. Pilar Aivar)
- P1.03 **Modelling symmetry perception with banks of quadrature convolutional Gabor kernels** (C. Alejandro Parraga, Xavier Otazu & Arash Akbarinia)
- P1.04 **Previous fixations do not facilitate search when a distractor becomes a target** (Elena Sanz Sanz & M. Pilar Aivar)
- P1.05 **Searching for cookies: finding transformed objects** (Sergio Sánchez Hurtado, Elena Álvarez Arias & Eli Brenner)
- P1.06 **The stereoscopic anisotropy in elderly population** (Aracelis Aguilera Francisco & Ignacio Serrano-Pedraza)
- P1.07 **Time-frequency filtering with zeros of the psychophysical wavelet transform magnitude** (Vicente Sierra-Vázquez)
- P1.08 **Visual Awareness at stimulus energy and feature levels** (Mikel Jiménez, Cristina Villalba-García, Dolores Luna, José A. Hinojosa & Pedro R. Montoro)
- P1.09 **Metacognition of the strength of a belief: patriotism** (José Manuel Gavilán Ibáñez & Jose Antonio Aznar-Casanova)
- P1.10 **The influence of Parvocellular and Magnocellular streams on fine stereopsis** (Juan José Herrera-Morueco, Isabel Salmerón-Aguirre, Marcos Bella-Fernández & Ignacio Serrano-Pedraza)
- P1.11 **Determining the underlying mechanisms for detecting the orientation of stereo corrugations by measuring individual differences** (Ichasus Llamas-Cornejo, Omar Bachtoula, Douglas Boegaerts, Jenny C.A. Read, David Peterzell & Ignacio Serrano-Pedraza)

12:00 – 13:30 Symposium: Computational Perception
Organizer: Xavier Otazu

- S1.01 **Visual stress and efficient encoding of natural scenes** (Olivier Penacchio)
- S1.02 **Computational modeling of visual attention: What do we know from physiology and psychophysics?** (David Berga & Xavier Otazu)
- S1.03 **Paradox in Deep Neural Networks: Similar yet Different while Different yet Similar** (Arash Akbarinia & Karl R. Gegenfurtner)
- S1.04 **A Neurodynamical Approach to Brightness Perception: From Aftereffects to the Symmetry Perception** (Matthias S. Keil)

13:30 – 15:00 Lunch

15:00 – 16:00 Talks: Audition & aesthetics
Moderator: Humberto Moreira Villegas

- T1.01 **Effects of the Contralateral Medial Olivocochlear Reflex on High-Frequency Psychoacoustical Tuning Curves** (Luis Enrique López Bascuas, Almudena Eustaquio-Martín, Miriam Marrufo-Pérez & Enrique A. López-Poveda)
- T1.02 **Musical–visual Aesthetic Sensitivity** (Ana Clemente & Marcos Nadal)
- T1.03 **Mindset affects differently preference for symmetry and preference for curvature** (Enric Munar, Erick Chuquichambi & Jaume Rosselló-Mir)
- T1.04 **What does viewing behaviour can tell us about preference for curvature?** (Erick Gustavo Chuquichambi Apaza, Guido Corradi, Jaume Rosselló-Mir & Enric Munar Roca)

16:00 – 16:30 Coffee break

16:30 – 18:00 Symposium: Eye Movements, Perception & Action
Organizer: Cristina de la Malla

- S1.05 **Saccadic gain controlled by a visual discrimination task** (Sohir Rahmouni, Anna Montagnini & Laurent Madelain)
- S1.06 **Perception and eye and arm movements are closely linked** (Cristina de la Malla)
- S1.07 **Continuous control of human movements** (Eli Brenner)
- S1.08 **What eye movements tell us about visual search strategies** (M. Pilar Aivar, Elena Sanz, Fatima Álvarez & Sandra Miguel)

21st June

8:30 – 9:00 Registration

9:00 – 10:00 Talks: Vision
Moderator: Raúl Luna del Valle

- T2.01 **Humans trust central vision more than peripheral vision in the light and the dark** (Alejandro Hernán Gloriani & Alexander C. Schütz)
- T2.02 **Accuracy and precision of time-to-contact estimates based knowing size and gravity** (Borja Aguado & Joan López-Moliner)
- T2.03 **Vision Models Fine-Tuned by Cinema Professionals for High Dynamic Range Imaging in Movies** (Marcelo Bertalmío)
- T2.04 **The Reverse Pulfrich Effect: Misperception of Motion in Depth** (Víctor Rodriguez-Lopez, Johannes Burge & Carlos Dorronsoro)

10:00 – 11:30 Symposium: Colour Perception
Organizer: Julio Lillo Jover

- S2.01 **Robust colour constancy in red-green dichromacy** (Leticia Álvaro, Julio Lillo, Humberto Moreira, João M.M. Linhares & Sérgio M.C. Nascimento)
- S2.02 **Developing a test for measuring red-green residual activity based on confusion lines** (Julio Lillo, Humberto Moreira, Leticia Álvaro, João M.M. Linhares & Sérgio M.C. Nascimento)
- S2.03 **The colours of paintings from pre-primary children** (Sérgio M.C. Nascimento, Catarina F. M. Herdeiro & João M.M. Linhares)
- S2.04 **Evaluation of colour difference formulas for gonioapparent materials** (Esther Perales, Bàrbara Micó-Vicent, Khalil Huraibat & Valentín Viqueira)

11:30 – 12:00 Coffee break

12:00 – 13:00 SEPEX Conference: Jenny C.A. Read

13:00 – 14:30 Lunch

14:30 – 15:30 Talks: Face perception & word recognition
Moderator: David Travieso

- T2.06 **Situated faces: processing of facial expressions of emotion is modulated by situational context** (Luis Aguado Aguilar, Teresa Diéguez Risco & Jose Antonio Hinojosa)
- T2.07 **The role of perceptual history and its interaction with stimulus valence on face emotion recognition** (Andreia Verdade, João Castelhano, Teresa Sousa & Miguel Castelo-Branco)
- T2.08 **The role of perceptual salience of suffixes in visual word recognition** (Miguel Lázaro, Elisa Pérez & Rosario Martínez)

15:30 – 16:00 Coffee break

16:00 – 17:30 Symposium: Motion perception
Organizer: Ignacio Serrano-Pedraza

- S2.05 **An individual differences approach yields three motion sensing mechanisms spatially tuned to fine-, middle-, and coarse scales** (Raúl Luna del Valle, Carlos Ibáñez & Ignacio Serrano-Pedraza)
- S2.06 **Motion surround suppression is stronger for binocular than for monocular perception** (Sandra Arranz-Paraíso, Jenny C. A. Read, & Ignacio Serrano-Pedraza)
- S2.07 **Are there sex differences in visual motion processing?** (Omar Bachtoula González, Sandra Arranz-Paraíso, Raúl Luna del Valle & Ignacio Serrano-Pedraza)
- S2.08 **A plausible model for perceived risk from visual motion** (Joan López-Moliner & Cristina de la Malla)

18:00 – 20:00 Visit to the Royal Seat of San Lorenzo de El Escorial

22nd June

8:30 – 9:00 Registration

9:00 – 10:00 Talks: Perceptual grouping & Haptics.
Moderator: Luis Enrique-López Bascuas

- T3.01 **Study on the dissociations between measures of perceptual grouping: An integrative approach** (Cristina Villalba-García, Mikel Jiménez, Dolores Luna, Jose Antonio Hinojosa & Pedro R. Montoro)
- T3.02 **Neural responses underlying the interaction between competing perceptual states** (Teresa Sousa, Alexandre Sayal, João V. Duarte, Gabriel N. Costa, & Miguel Castelo-Branco)
- T3.03 **Determination of a haptic map of the torso and the back for improving immersion in virtual reality environments** (Gonzalo García-Valle, Sandra Arranz-Paraíso, José Breñosa-Martínez, Ignacio Serrano-Pedraza & Manuel Ferre-Pérez)
- T3.04 **Wayfinding with a sensory substitution device** (David Travieso, Lorena Lobo, Patric Nordbeck, Vicente Raja, Anthony Chemero, Michael A. Riley & David M. Jacobs)

10:00 – 11:30 Symposium: Optics & Perception
Organizer: Carlos Dorronsoro

- S3.01 **Optical and neural contributions to vision** (Susana Marcos, Clara Benedí-Garcia, Carlos Dorronsoro, Enrique Gambra, Eduardo Martínez-Enríquez, Aiswaryah Radhakrishan, Lucie Sawides & Maria Viñas)
- S3.02 **Adaptation to Retinal Blur** (Lucie Sawides, Maria Viñas, Carlos Dorronsoro & Susana Marcos)
- S3.03 **Visual Impact of the Chromatic aberrations of the eye** (Maria Viñas, Clara Benedi-Garcia, Sara Aissati, Ana Maria Gonzalez, Carlos Dorronsoro, Susana Marcos)
- S3.04 **Visual simulators and programmable blur** (Carlos Dorronsoro, Maria Vinas, Lucie Sawides, Enrique Gambra, Aiswaryah Radhakrishnan, Clara Benedi-Garcia, Sara Aissati, Vyas Aknodi, Daniel Pascual & Susana Marcos)

11:30 – 12:00 Coffee break

12:00 – 13:00 Talks: Colour perception & Attention
Moderator: Julio Lillo Jover

- T3.05 **Chromatic Structure of Graffiti** (Claudia Feitosa-Santana, Carlo Gaddi & Sérgio Nascimento)
- T3.06 **No chromatic-chromatic interaction in colour assimilation** (Xavier Otazu Porter & Xim Cerda-Company)
- T3.07 **Measuring bottom-up visual attention in eye tracking experimentation with synthetic images** (David Berga, Xavier Otazu, Xosé R. Fdez-Vidal, Víctor Leborán & Xosé M. Pardo)
- T3.08 **The effect of top-down attention in occluded object recognition** (Zahra Sadeghi)

13:00 – 13:30 Business meeting

13:30 – 14:30 Lunch

Keynote speakers: 10:00-11:00 20th of June 2019

Prof. Jenny Bosten Faculty of Psychology, University of Sussex, UK

Jenny Bosten completed her PhD on contrast and constancy in visual perception at the University of Cambridge with John Mollon in 2009. She was a Research Fellow at Gonville and Caius college from 2008 where she remained affiliated with John Mollon's lab, as part of the team to conduct the first genome-wide association study into visual perception. Between 2010 and 2012 she intermitted her fellowship to work as a research associate in Donald MacLeod's lab at UC San Diego, investigating colour vision, fading and adaptation. After another stint in Cambridge Jenny was hired in 2015 as a lecturer at the University of Sussex (senior lecturer from 2018) where she has continued to work on colour vision, including in collaboration with Anna Franklin on an ERC-funded project on natural scene statistics, and on ways to exploit virtual reality for optometric assessment. Jenny was awarded the AVA David Marr medal for early career research in vision science in 2018.

Anomalous trichromacy: cones, compensation, carriers and countermeasures.

In anomalous trichromacy the spectral sensitivities of the two cone types sensitive in the long and medium wavelength part of the spectrum overlap to a much greater degree than in normal colour vision. Consequently, discrimination of colour differences in that part of the spectrum should be (proportionately to the increase in spectral overlap) reduced from normal. This straightforward expectation masks the empirical complexities of anomalous colour vision. For example, the available evidence suggests that the relationship between spectral genotype and colour discrimination is rather weak. A number of factors may contribute to weaken the relationship, some dependent on the researcher and some on the observers. Observer variation in optical density may be a significant factor, but also the potential presence of colour signals from alternative sources such as dynamic signals caused by the interaction of reflected light, eye movements and the macular pigment. Another potential source of variance which I will focus on is putative 'postreceptoral compensation', which could affect colour discrimination if it occurs upstream of the predominant source of performance-limiting noise. Anomalous trichromacy, in all its complexity, is a surprisingly common minority phenotype, affecting about 7% of men. What might be the drive that maintains the genetic polymorphism in the population is an open question. It has long been suggested that anomalous trichromats may be able to see through camouflage, and indeed, there is evidence that they can distinguish some surface metamers for normal trichromats. Alternatively, the advantage may be to carriers of anomalous trichromacy, whose fourth retinal cone type may afford them an extra dimension of colour vision. Though anomalous trichromacy may have an evolutionary 'niche', for many purposes in the modern world it confers an impairment. There is growing interest in notch filter 'aids' for anomalous trichromacy that claim to alleviate its effects. I will present models and experimental results that address these claims and will speculate on why, despite a good theoretical grounding for the filters, studies to date have found that they have no significant effect on anomalous colour vision.

Keynote speakers: 12:00-13:00 21st of June 2019

Prof. Jenny C.A. Read

Institute of Neuroscience, Newcastle University, UK

Jenny Read is Professor of Vision Science at Newcastle University's Institute of Neuroscience. She has a first class degree in physics (1994), a doctorate in theoretical physics (1997) and a Masters in neuroscience (1999), all from Oxford University, UK. From 1997-2001 she was a Wellcome Training Fellow in Mathematical Biology at Oxford University, then from 2001-2005 a postdoctoral fellow at the US National Eye Institute. She returned to the UK in 2005 with a University Research Fellowship from the Royal Society, Britain's national science academy. Her lab works on many aspects of visual perception, especially stereoscopic or "3D" vision. Current projects include modelling how visual cortex encodes binocular information, developing a new stereo vision test for children (http://research.ncl.ac.uk/asteroid/), and uncovering how insects see in stereoscopic 3D (http://www.jennyreadresearch.com/research/m3/). More information and all publications are available at http://www.jennyreadresearch.com

Measuring stereo vision in children: challenges and solutions.

Stereoacuity is an important measure of binocular visual function, used in the management of binocular visual disorders such as strabismus and amblyopia. These are usually diagnosed and treated in children. Obtaining accurate measures of any visual ability in children is difficult, and assessing stereo vision presents particular challenges, e.g. the need to present a 3D image and the possibility of monocular cues, enabling a patient to pass the test despite having impaired binocular function. Here, I will discuss the clinical value of stereoacuity and psychophysical techniques for measuring it accurately. I will discuss current commercially available stereotests, and present a new stereotest we have developed, in the form of a game on a 3D tablet computer, which aims to solve many of the problems associated with current tests.

SEPEX CONFERENCE

sepex
sociedad española de psicología experimental

20th June

Abstracts

20th of June 2019

11:00-12:00 Posters

P1.01 **Effect of force related auditory feedback on hand held object weight perception.**

Jai Prakash Kushvah kushvah@ifado.de, Thorsten Plewan & Gerhard Rinkenauer.
Leibniz Research Centre for Working Environment and Human Factors.

Perceived heaviness during hand-object interactions is affected by object shape. For example, the shape-weight illusion indicates that an object feels heavier than an equally weighted object of a different shape. Ongoing convergence and perceptual integration of distinctive sensory channels allow performance optimization. Therefore, the current study investigated whether grip force related auditory feedback alters the perceived heaviness of differently shaped objects. Twenty-two participants performed a two-alternative-force-choice task to discriminate the perceived heaviness of equally weighted but distinctively shaped objects. A test object and a reference object were lifted one by one using the precision grip. Object shape manipulation was implemented by changing the angles between two flat grip surfaces in relation to the vertical plane (0°, +15° and -15°). Grip-force related feedback was provided using an audio device. The weight of the reference object (0°) was kept constant while the test object's weight was varied on a trial-by-trial basis using an adaptive staircase algorithm. Object shape (A=0° vs B=+15° vs C=-15°) and feedback (without vs with feedback) were varied in a factorial design. Point of subjective equality (PSE) and force amplitudes associated with the reference and test objects were obtained as dependent measures. Repeated-measures ANOVAs revealed significant differences in terms of PSE and force amplitudes related to the test object, indicating a weight-illusion. PSE scores differed with shape of the test object (C>A>B) and force coordination was also affected by object shape (B>A>C). Moreover, a significant variation of force amplitudes applied to the test objects was induced by auditory feedback (force: without feedback> with feedback). At the same time, auditory feedback had no effect on the weight-illusion as PSE scores were not systematically modulated. Taken together, auditory feedback synchronized with grip force improved the force coordination as grip-lift efforts were reduced without affecting explicit perceptual judgments.

P1.02 **Visual search strategies in a dual-target search task.**

Fatima Alvarez fatima.alvarez@uam.es & M. Pilar Aivar.
Facultad de Psicología, Universidad Autónoma de Madrid.

Visual search is often studied with tasks that require finding a single target item. Having to deal with two targets instead of one makes dual-target visual search more demanding, which may lead to changes in the strategies used by the participants to perform the task. To analyse this issue, we performed a dual-target search experiment in which we employed a novel configuration of items. Two coloured target letters were presented on the left side of the screen and a set of 6 coloured letters was presented on the right side. In each trial participants had to decide whether any of the target letters was present in the set. The target items and the search set remained on the screen, enabling search and verification strategies. Four search conditions were used: no target present, only target 1 present (T1), only target 2 present (T2) and both targets present (BT). Participant performed a total of 120 trials (30 trials of each condition, randomly mixed) while reaction times and eye movements were recorded. Results showed that there were significant differences in RT between conditions and also depending on the position of the target item in the set. RT were higher for the NT condition and lower for the BT condition. RT were also higher when the target position in the set was further away from the fixation point. For all conditions average fixation duration was shorter when looking at the left side of the screen (target items). Fixation distribution was also similar in all conditions: more fixations landed on the second target (closer to the fixation point) and on the central elements of the search set. These suggests that participants were using a similar search strategy in all conditions and that they tried to scan efficiently, avoiding long saccades and multiple fixations.

P1.03 **Modelling symmetry perception with banks of quadrature convolutional Gabor kernels.**

C. Alejandro Parraga[1] aparraga@cvc.uab.es, Xavier Otazu[1] & Arash Akbarinia[2].
[1] *Computer Vision Centre / Computer Sci. Dept., Univ. Autònoma de Barcelona*
[2] *Department of General Psychology, Justus-Liebig Universität Giessen.*

Although the task of detecting symmetrical objects seems effortless for us, it is very challenging for computers. Indeed, the exact mechanism of symmetry detection in primates is not well understood: symmetrical shapes activate specific higher-level cortical areas (Sasaki et al.; 2005) and psychophysical experiments suggest symmetry perception is influenced by low-level mechanisms (Treder, 2010). Here we look for plausible low-level mechanisms that might form the basis for symmetry perception using a simple model containing banks of: (i) odd-symmetric Gabors (resembling edge-detecting V1 neurons); and (ii) larger odd- and even-symmetric Gabors (resembling higher visual cortex neurons), that pool signals from the 'edge image' (Akbarinia et al, ECVP2017). When convolved with these kernels across several spatial scales, symmetric objects produce a minimum in one and a maximum in the other (Osorio, 1996), and the rectification and combination of these signals create lines which hint of mirror symmetry in natural images. Our results suggest that such multiscale combination might form the basis for the HVS's symmetry detection and representation.

20th June

P1.04 **Previous fixations do not facilitate search when a distractor becomes a target.**

Elena Sanz Sanz elena.sanzsanz@estudiante.uam.es & M. Pilar Aivar.
Facultad de Psicología, Universidad Autónoma de Madrid.

In a previous study we found that searching for different targets in the same set of 72 items did not facilitate search for other items within the same set. In this study we analysed whether this was still the case when all the targets shared one feature. In each trial a target letter was presented at fixation, followed by the search display. The search display was made of 72 coloured letters (12 letters x 6 colours) and was the same for all searches (repeated visual search). Twelve different letters of the same colour (orange) were used as targets. Location was constant for each target, but targets differed in eccentricity. Over the experiment, each target was searched for 6 times (72 trials in total). We compared the results of two groups of participants. For the first group all 12 letters were targets in each block of trials. For the second group one of the letters, 'W', became a target only in the last two blocks of trials. Our goal was to determine if previous fixations on this letter while searching for other orange letters facilitated search. Our results showed that RT decreased significantly with target repetition for all letters. Critically, when we compared RTs for the first search of the letter 'W' in each case we found that RTs were similar. This was the case even though the second group of participants had already performed 55 trials before searching for the W and had made, on average, 8 fixations on that letter during those trials. Our results suggest that just fixating an element when it is not a target is not enough to produce a memory trace. Facilitation only appears when the same item is searched for repeatedly.

P1.05 **Searching for cookies: finding transformed objects.**

Sergio Sánchez Hurtado[1] sergio.sanchezh@estudiante.uam.es, Elena Álvarez Arias[1] & Eli Brenner[2].
[1] *Facultad de Psicología, Universidad Autónoma de Madrid.*
[2] *Vrije Universiteit Amsterdam.*

When we observe an object, we focus on its different characteristics. Usually, some of them are more important than others, which makes it easier to be detected. Some authors consider that one of these relevant characteristics might be the transformations that an object has been subjected to. This study aims at analysing this issue. We performed two experiments in which we employed a visual search task. In the first one, participants had to find a transformed object among other objects with a similar shape. Our goal was to determine whether a transformation is a distinctive characteristic, able to produce saliency. In the second experiment, the task was to find an occluded object among others with adjacent occluders. Our goal, in this case, was to analyse whether the processing of a transformation is similar to amodal completion. In both experiments, the number of total distractors was maintained constant, although we varied the number of distractors of each type that were presented. Our assumption was that different types of objects would be perceived very differently, even if they had a similar shape. Specifically, we hypothesized that transformed objects would produce a bigger distractor effect because of their saliency. Both visual search tasks were performed by 12 participants and reaction times to find the target were measured. Our results showed that transformed objects were found faster than the other objects, even though they all shared a similar shape. We also found that reaction times were higher for occluded objects. Then, the difference between biting and occluding may be that biting transforms the object itself whereas occlusion only transforms its image. Therefore, these results suggest that transformed objects produce saliency whilst perceiving them cannot be explained as a case of amodal completion.

P1.06 **The stereoscopic anisotropy in elderly population.**

Aracelis Aguilera Francisco[1] & Ignacio Serrano-Pedraza[2] iserrano@ucm.es.
[1] *Faculty of Psychology, University Complutense of Madrid.*
[2] *Institute of Neuroscience, Newcastle University, Newcastle upon Tyne, United Kingdom*

The stereoscopic anisotropy is one of the most intriguing phenomena of stereoscopic vision. It shows that the sensitivity to detect 3D sinusoidal horizontal corrugations is much greater than for vertical corrugations for spatial frequencies lower than 1c/deg. A recent study has shown that the anisotropy increases during childhood and that visual experience probably plays an important role in its development. Here we want to determine the impact that the visual experience has throughout life in the stereoscopic anisotropy. We performed two experiments testing two age-groups of 35 participants each. The young group aged 18 to 45 years and the elderly group aged 62 to 90 years. In the first experiment, we measure the stereoscopic visual acuity, and in the second experiment we measured disparity thresholds for 3D sinusoidal corrugations of 0.1c/deg, with vertical and horizontal orientation. For each participant we computed the anisotropy index by subtracting the thresholds in logarithmic units of the vertical minus the horizontal corrugation. The analyses show that young participants have lower stereoscopic thresholds than elderly participants (mean=80.28arcsec, SD=31.38). Stereo thresholds for vertical corrugations are similar for both groups, however, for horizontal corrugations the thresholds are much higher for the elderly group. Therefore, the anisotropy was much stronger in the young group (mean=0.667, SD=0.461) than for the elderly group (mean=0.247, SD=0.296). Pearson correlation between the anisotropy index and age shows a negative and significant correlation (r =-0.49, p=1.65x10-5), this is, as age increases, the anisotropy decreases. Thus, the visual experience and the environment play an important role in the development of stereo vision. In aging, although there is a loss of sensitivity for horizontal corrugations, which is consistent with the reduction of stereoscopic acuity, surprisingly, the recorded sensitivity for vertical corrugations remains stable and does not change. Therefore, the stereoscopic anisotropy decreases with aging.

P1.07 **Time-frequency filtering with zeros of the psychophysical wavelet transform magnitude.**

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Real-world stimuli for the human senses are noisy multicomponent non-stationary signals so the separation of their different components and their segregation from noise (denoising) are classic problems not only in the field of signal processing but also in sensory neurobiology and psychophysics. A time-frequency (TF) filtering method proposed by Flandrin (IEEE Signal Process. Lett., 22 (11), pp. 2137-2141, Nov. 2015) for signal disentangling and denoising, based on spectrogram zeros, could be carried out, in principle, by mechanisms of some human senses. To show that, a similar procedure is proposed here that uses, instead of spectrogram zeros, the zeros of the psychophysical wavelet transform (PWT) (a kind of TF representation based on visual neurobiology and human sensory psychophysics). As synthetic test signals we use a cubic phase chirp and a two-component signal, both embedded in additive white Gaussian noise. Following the Flandrin´s procedure, after computing the zeros of the PWT magnitude and Delaunay triangulation, significant regions of the TF domain were selected by designing disjoint masks in the TF upper half-plane where the length of the edges of the triangles met the appropriate criterion. For each test signal, the numerical reconstruction of each component as a linear combination of the locally matched cosine Gabor wavelets, whose frequencies, amplitudes, and phases were obtained from filtering with the corresponding mask, is almost accurate for specific SNR values. We tentatively conclude that, at least numerically, the zeros or "silent points" of some psychophysical TF representations may contain sufficient information for disentangling, denoising, and retrieving sensory stimuli.

20th June

P1.08 **Visual Awareness at stimulus energy and feature levels.**

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The fundamental nature of visual awareness continues to be a controversial subject of debate within consciousness research. While some studies suggest that visual awareness emerges in an all-or-none manner, others propose that it develops gradually through different states of subjective awareness. The level of processing tries to reconcile these two perspectives by proposing that low-level stimulus perception (i.e. stimulus energy and features) is graded whereas high-level (i.e. letters, words, meaning) stimulus perception is all-or-none. In the present study, we set up a masked design in order to examine the nature of visual awareness at stimulus energy (i.e. detection task) and feature levels (identification task) at specific target durations (i.e. 13, 27, 40, 53 and 80 ms). Different visibility conditions were produced at each stimulus presentation by manipulating the strength of the masking. Participants' subjective experiences where gathered using a 4-point awareness scale, whereas objective (accuracy levels) awareness performances were also analysed. Results showed that intermediate ratings (i.e. ratings 2 and 3, which index graded awareness experiences) were used in more than 50% of the trials for target presentations of 27, 40, 53 and 80 ms. In addition, target presentations of 27 and 80ms produced linearly increasing detection and identification accuracies across the awareness scale categories, respectively. Overall, our results suggest that visual awareness at energy and feature levels of stimulus perception may be graded. Furthermore, a divergence in detection and identification performance results was found, which emphasizes the need of an adequate election of target durations when studying different perceptual processes such as detection vs. more complex stimulus identification processes. Finally, "clarity" should be exhaustively defined depending of the level of processing of the stimulus, as participants may recalibrate the meaning of the different awareness categories depending on task demands when using the perceptual awareness scale.

P1.09 **Metacognition of the strength of a belief: patriotism.**

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This study tries to clarify the complex relationships between cognition and emotion in a type of belief: patriotism. How does the emotional reaction to some icons affect performance in a task that requires attention? How does the physiological response to these types of symbols (flags) relate to the degree of adherence or conformity to patriotic belief? And to what extent do the two measures converge? This study aims to cover two objectives. On the one hand, we intend to measure the strength of patriotism through the effect of Emotional Attentional Blinking (EAB). On the other hand, to examine the degree of relationship that exists between the attentional measure and the physiological response. Subjects were given two tests. One test measured the effect of EAB through a rapid serial visual presentation (RSVP) paradigm, using an image with emotional content (flag) as "prime". In the other test, subjects were asked to make congruence judgments between two types of paired images susceptible of causing different degree of emotional reactivity: the picture of a politician (a total of 6: 3 of an ideological signs and 3 opposite) and the image of a flag (2 nationalist-pro secessionists, 2 nationalist-pro unionists, 2 neutral). In the EAB test, a behavioural measure (% of hits) was analysed; while in the congruence test (politicians-flag), two physiological measures were recorded: heart rate and galvanic skin response. Finally, subjects responded to a brief questionnaire where age, gender, nationality and affinity to the flags were recorded. Results show, first, the impact that emotional reactivity has on cognition (EAB effect). Second, the relationship between subjective assessment and objective (electrophysiological) measurement. Implications of patriotism metacognition on behaviour of subjects are discussed, ranging from unconsciousness to full consciousness.

P1.10 **The influence of Parvocellular and Magnocellular streams on fine stereopsis.**

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Recent results in Schizophrenia have linked an impairment in fine stereopsis with deficits in the magnocellular (M) stream (Schechter et al. 2006). However, previous results from Kontsevich & Tyler (2000) suggest that stereopsis in humans is mediated strongly by the parvocellular (P) stream. Here, in order to test the link between M and P pathways with fine stereopsis, 41 subjects performed 6 experiments. In 2 experiments we measured contrast detection thresholds using vertical Gabor patches of 0.5 c/deg drifting at 10 Hz (M condition), and 10 c/deg drifting at 2 Hz (P condition). In the other 4 experiments we measured the stereoacuity of the participants using two tasks (2AFC vs. 4AFC) with static or dynamic random dots stereograms. Results show that M and P contrast thresholds were uncorrelated, and M thresholds did not correlate with any of the stereoacuity measurements. However, the stereoacuity obtained in all four tasks significantly correlate with P thresholds. These results suggest that fine stereopsis is mainly mediated by the parvocellular stream.

P1.11 **Determining the underlying mechanisms for detecting the orientation of stereo corrugations by measuring individual differences.**

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Disparity thresholds for sinusoidal corrugations shows a well-known orientation anisotropy: the sensitivity for sinusoidal corrugations of low spatial frequencies is much higher for horizontal than for vertical orientations. In a recent study with sinusoidal corrugations, Peterzell et al, (2017) using factor analytic techniques, have shown the existence of at least two underlying mechanisms for spatial frequency and probably one for the stereo anisotropy (only orientations of 0 and 90 deg were tested) assuming a single mechanism for detecting the orientation of stereo corrugations. Here, we wanted to extend that study for 7 different orientations (from 0 to 90 in steps of 15 deg) and two spatial frequencies (0.1 and 0.4 c/deg) with the objective of uncovering the number and nature of the orientation mechanisms underlying stereovision by measuring individual differences. Using Bayesian staircases, we measured the stereo thresholds of 76 subjects, 38 for spatial frequency 0.1 c/deg and 38 for 0.4 c/deg. Stereo thresholds show a strong anisotropy for 0.1 c/deg, with thresholds increasing in a sigmoid fashion as the corrugations change from 90 (horizontal) to 0 (vertical) degrees. Correlation and factor analyses for stereo thresholds for each spatial frequency revealed two factors highly intercorrelated, one for orientations in the range 0 to 30 deg and the second factor in the range 45 to 90 deg. In summary, although the stereo thresholds for vertical (0 deg) and horizontal (90 deg) corrugations are highly correlated for both spatial frequencies (i.e. 0.1 c/deg: $r=0.61$, $p<0.001$ and 0.4 c/deg: $r=0.45$, $p=0.004$), our results suggest two separate neuronal mechanisms underlying the processing of the orientation of stereo corrugations.

20th June

12:00-13:30 Symposium: Computational Perception

S1.01 **Visual stress and efficient encoding of natural scenes.**

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Our visual system is constantly bombarded with a torrent of sensory information, the processing of which is routine. Some visual scenes, however, cause visual discomfort, can induce headaches in patients with migraine, or even cause seizures in patients with photosensitive epilepsy, and that independently of what they represent. These phenomena, gathered under the term visual stress, are rare in the natural environment but frequent in the man-made environment, in particular, in the presence of stripy patterns, which are prevalent in modern, modular architectural design. We will explore possible low-level mechanisms underlying visual stress. Using an excitatory-inhibitory neurodynamic model of the early visual cortex that includes machinery for an efficient encoding of natural scenes and contour grouping, as well as contextual modulations through lateral interactions, we will see that images judged as uncomfortable to look at are represented using a code that is less sparse than the code associated with images judged comfortable. This result is consistent with the hyperBOLD activity found in response to uncomfortable images. Moreover, the modelling suggests that differences in cortical excitation/inhibition balance may also explain disparities in susceptibility to visual discomfort between individuals. All in all, the model suggests that visual stress may arise as the consequence of a mismatch between specific visual features and the typical statistics of natural scenes. The visual system may fail to encode with limited metabolism visual features that deviate excessively from those it adapted to during evolution and development.

S1.02 **Computational modeling of visual attention: What do we know from physiology and psychophysics?**

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Latest computer vision architectures use a chain of feedforward computations, mainly optimizing artificial neural networks for very specific tasks. Although their impressive performance (i.e. in saliency) using real image datasets, these models do not follow several biological principles of the human visual system (e.g. feedback and horizontal connections in cortex) and are unable to predict several visual tasks simultaneously. In this study we present biologically plausible computations from the early stages of the human visual system (i.e. retina and lateral geniculate nucleus) and lateral connections in V1. Despite the simplicity of these processes and without any type of training or optimization, simulations of firing-rate dynamics of V1 are able to predict bottom-up visual attention at distinct contexts (shown previously as well to predict visual discomfort, brightness and chromatic induction). We also show functional top-down selection mechanisms as feedback inhibition projections (i.e. prefrontal cortex for search/task-based attention and parietal area for inhibition of return). Distinct saliency model predictions are tested with eye tracking datasets in free-viewing and visual search tasks, using real images and synthetically-generated patterns. Results on predicting saliency and scanpaths show that artificial models do not outperform biologically-inspired ones (specifically for datasets that lack of common endogenous biases found in eye tracking experimentation), as well as, do not correctly predict contrast sensitivities in pop-out stimulus patterns. This work remarks the importance of considering biological principles of the visual system for building models that reproduce this (and any other) visual effects.

S1.03 **Paradox in Deep Neural Networks: Similar yet Different while Different yet Similar.**

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Justus-Liebig-Universitat-Giessen

Deep neuronal networks (DNN) have reached human performance in many tasks related to visual information processing. This opens new opportunities to compare their underlying mechanism to how human visual perception solves a similar problem. In this work, we analysed multiple architectures trained to classify objects in static images of real-world scenes (i.e. ImageNet data sets, which is large visual object recognition consisting of more than 1000 categories). We evaluated the performance of the networks under various distortions and transformation (e.g. reducing image contrast, eliminating chromatical information, or adding noise). Next, we computed the intrinsic similarity of their constituent kernels. While we expected a close correspondence between these two measures, we observed a puzzling phenomenon. Pairs of networks whose kernels' weights are over 99.9% correlated can exhibit significantly different performances, yet other pairs with no correlation can reach quite compatible levels of performance. Analysing their activation maps shows each network might pay more attention to some part of an image and visual features. Recently, it has been demonstrated that there are individual differences in visual saliency along semantic dimensions (de Haas et al. 2018). This is a line of investigation that we are currently pursuing, whether the individual differences among networks coincide with those of human subjects.

S1.04 **A Neurodynamical Approach to Brightness Perception: From Aftereffects to the Symmetry Perception.**

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Many computational models of brightness perception usually take a two-dimensional luminance image as input and transform it into an output image. The output image is supposed to be a prediction of perceived luminance (=brightness), or sometimes even perceived reflectance (=lightness). Typically, the input images for such models do not change with time. Here I present a computational approach to the dynamics of brightness perception, based on filling-in. The model is based on well-known neuronal principles for information processing in early vision, such as spatiotemporal contrast computation in ON- and OFF channels, and active reset mechanisms. Specifically, I propose that the representation of the retinal image in the primary visual cortex (=brightness representation) is selectively updated where changes in the retinal image are detected (= reset-at-change or RAC), rather than being generated from the scratch each time. The advantage of RAC is an improved speed-memory trade-off. My model can explain experimental results about the temporal limits of brightness perception (temporal modulation of the intensity of the Craik-O'Brien-Cornsweet illusion), aftereffects, and how the RAC mechanism may contribute to the perception of a symmetry axis in simple figures (i.e., a neural implementation of the medial axis transformation).

20th June

15:00-16:00 Talks: Audition & aesthetics

T1.01 **Effects of the Contralateral Medial Olivocochlear Reflex on High-Frequency Psychoacoustical Tuning Curves.**

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A primary function of the peripheral auditory system is to separate out the multiple frequency components of incoming sounds, a property referred to as frequency selectivity. The limited frequency selectivity of human listeners has been studied by means of Psychoacoustical Tuning Curves. A PTC is a plot of the threshold masker level required to just mask a pure-tone signal as a function of masker frequency and can be thought of as a psychoacoustical correlate of a cochlear tuning curve. Just as cochlear tuning curves can change with activation of the medial olivocochlear efferent reflex (MOCR), PTCs can also change with activation of the MOCR. In this study, PTCs for a 4-kHz pure tone probe were measured in forward masking in the presence and in the absence of contralateral acoustic stimulation – CAS – (60 dB SPL white noise). Masker frequencies ranged from 0.5 to 1.2 times the probe frequency. It was assumed that maskers were sufficiently short (40 ms) not to activate the ipsilateral MOCR and that only the contralateral MOCR was active in the presence of CAS. Five listeners with normal hearing participated in the experiments. Masker levels at threshold were measured using a two-interval, two alternative forced-choice adaptive procedure. The results indicate that frequency selectivity worsens (PTC broaden) when the contralateral MOCR is active. It is reasoned that these results might be due to the MOCR reducing basal cochlear gain. [Work supported by MINECO (BFU2015-65376-P) to EALP.]

T1.02 **Musical–visual Aesthetic Sensitivity.**

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University of the Balearic Islands.

We conceive aesthetic sensitivity as the extent to which a given feature affects someone's liking or preference and measure it as the individual slope in linear mixed effects models. Forty-eight non-musicians nor visual artists rated their liking for visual patterns and musical motifs varying in balance, contour, symmetry, or complexity. We examined musical and visual aesthetic sensitivities to each attribute and their constituent structural properties across domains. The results suggest a binary pattern related to information density underlying liking for both images and music. Art experience, openness to experience, need for cognitive closure, and desire for aesthetics predicted aesthetic sensitivity to some of the studied features. Our notion of aesthetic sensitivity has proven useful in investigating aesthetic valuations and is thus of application in research on musical and visual aesthetics, psychology, or therapy. Our study sheds light on the domain specificity and generality of aesthetic judgments. Furthermore, it contributes to understanding valuation processes in general and their underlying factors, which makes it of interest to multiple psychological fields.

T1.03 **Mindset affects differently preference for symmetry and preference for curvature.**

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University of the Balearic Islands.

People use different mental states to complete a task. They are referred as mindsets and affects preference. We activated a mindset on symmetry or contour by making participants focus on one of these features with the objective to measure implicitly preference for symmetry and preference for curvature by using a revised Stimulus-Response Compatibility task. The stimuli were meaningless shapes that combined symmetry and contour features: symmetrical/curvy, non-symmetrical/curvy, symmetrical/sharp, and non-symmetrical/sharp. The response cues were schematic faces –that represented happiness and sadness– with positive and negative affective valence. Participants had to match as fast as they could a stimulus with a schematic facial expression. Two blocks were presented, one in which contour dimension had to be evaluated and one in which symmetry dimension had to be evaluated. In each block participants had two types of trials: incongruent and congruent. Congruence was when target features –curvature and symmetry– had to be matched with the "happy" face, whereas incongruence was when target features had to be matched with the "sad" face. The aim of the task was to assess the facilitation of the congruency of the stimuli. The four types of stimuli got faster responses in congruent condition than incongruent condition. The effect size was higher in the symmetry dimension than in the contour dimension regardless of the mindset. The effect size in the symmetry dimension was similar in both mindsets. However, the effect size in the contour dimension (preference for curvature) was higher in the symmetry mindset than in the contour mindset. We conclude that mindset does not affect preference for symmetry, but it affects preference for curvature. When participants do not focus on contour, preference for curvature is higher.

T1.04 **What does viewing behaviour can tell us about preference for curvature?**

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Empirical aesthetics shows that we prefer visual curvature and symmetry compared to angularity and asymmetry. In this study, we aimed to test preference for curvature and symmetry related to viewing behaviour by focusing on contour basic property. We used four types of meaningless patterns: symmetrical-curved, symmetrical-sharp, asymmetrical-curved, and asymmetrical-sharp. In the first experiment, we tested preference for symmetry and curvature using these stimuli in a liking task. It consisted of a seven-point likert scale. Participants' ratings showed a preference for symmetrical-curved stimuli, consistent with literature in empirical aesthetics. Comparing symmetry and curvature, ratings on symmetrical stimuli were significantly higher than ratings for curved stimuli. The second experiment was based on a free-viewing paradigm in which we presented two stimuli that only differed in contour: curved or sharp-angled. We registered ocular movements for 2 seconds while the patterns were on the screen. We analysed the first fixation, the time to first fixation, and the total time of fixations about every pair of stimuli. First fixation and time to first fixation did not differ significantly between curved and sharp-angled versions. However, participants spent more time looking at curved stimulus. Specifically, on asymmetrical pairs, we found a higher proportion of first fixations and total time of fixations to curved stimuli, but not on symmetrical ones. We conclude that our participants preferred curved and symmetrical stimuli and, regarding viewing behaviour, we discuss the influence of symmetry on preference for curvature.

20th June

16:30-18:00 Symposium: Eye Movements, Perception & Action

S1.05 **Saccadic gain controlled by a visual discrimination task.**

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Saccadic adaptation reflects the ability of the oculomotor system to quickly adapt to changes in sensorimotor contingencies. Although it is usually thought that the post-saccadic error is the driving signal for adaptation, we have previously shown that an arbitrary reinforcer, such as an auditory tone or viewing the target on the fovea, can also control changes in saccade gains. That reinforcement learning can induce saccade adaptation in the absence of a visual position error suggests that this adaptation might rely on general learning mechanisms rather than on dedicated motor calibration mechanisms. The present study asks whether adaptation-like modulations in saccade amplitude may be induced by the ability to perform a visual discrimination task in the absence of a post-saccadic position error using a new gaze-contingent paradigm. A four-alternative forced-choice task was designed in which subjects were instructed to report which symbol was briefly (60ms) displayed across the whole screen immediately after a saccade. The possibility to perform the discriminative task was contingent on meeting a specific saccade amplitude criterion based on the median horizontal gain of the previous 50 trials. When saccades did not meet the criterion, one of four irrelevant symbols was displayed such that the participant could not perform the discriminative task. Five participants performed at least 16.600-trial learning sessions. The criterion first encouraged an increase and then a decrease in horizontal gain. The saccade gain significantly changed according to the reinforcement contingencies in force. We conclude that saccades may be reinforced by the ability to perform visual discrimination tasks. These results extend the functional significance of saccadic adaptation well beyond motor calibration.

S1.06 **Perception and eye and arm movements are closely linked.**

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We often study perception, eye and arm movements as separate processes. However, there is sufficient evidence establishing close links between the three. We normally direct our gaze at targets we want to interact with, and this behaviour has been proved important for both accurate perception and successful arm movements directed to such targets. Previous studies have shown that our eye movements have a clear influence on how we perceive targets to move. For example, it has been shown that corrective saccades in the same or the opposite direction than that of the target affect the perceived speed of the target. At the same time, it is known that how one perceives a target to be moving influences the way one is going to interact with that target and determines errors in trying to manually intercept it. I will discuss these results and show new data that directly addresses the influence that eye movements have on the errors that we make in trying to manually intercept moving targets.

S1.07 **Continuous control of human movements.**

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I will present various lines of evidence that interceptive arm movements are continuously controlled on the basis of the latest sensory information. Although it is possible to catch a ball without constantly looking at it, or even without seeing it at all during part of its flight, people normally try to obtain as much information about a target that they want to intercept as possible. They avoid blinking during the interceptive movement and pursue the target with their eyes and head. They use the obtained information to continuously update their movements in order to achieve the highest possible accuracy. I will explain why we believe that constantly updating one's predictions about the ongoing movement is useful, and present evidence that the updating is really continuous and takes task requirements into consideration. Finally, I will discuss some limitations and their consequences.

S1.08 **What eye movements tell us about visual search strategies.**

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Search is one of the central functions of vision. It has often been studied through cover attention paradigms that require participants to fixate a central location while performing a visual search task in the periphery. However, in natural situations visual search almost always involves eye movements. Analysing gaze strategies in visual search help us understand how vision is used actively to gather the relevant visual information. In this talk we will present and compare the results of some sets of experiments that employed different search paradigms while recording eye movements: repeated, comparative and dual-target visual searches. For repeated search we presented a search display made of 72 colored letters (12 letters x 6 colors), which was the same for all searches. Participants searched for different combinations of letters and colors. Depending on the experiment, targets were completely different in each trial, or a subset of letters was searched for repeatedly. In the comparative search experiment the screen was divided in two halves and an identical random configuration of eight elements (red and green squares and circles) was presented in each. Both halves differed either on one element's colour or shape. In each trial, participants had to find the element that was different and indicate the differential feature. In the dual-target task two target letters were presented on the left side of the screen and a set of 6 colored letters was presented on the right side. In each trial, participants had to decide whether any of the target letters was present in the set. The analysis of the eye movements in these three tasks showed that visual information was acquired and used differently in each situation to guide search. There were also differences in how and to what degree task performance was optimized in each case.

21st of June 2019

9:00-10:00 Talks: Vision

T2.01 **Humans trust central vision more than peripheral vision in the light and the dark.**

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Human vision is supported across a wide range of lighting conditions by two types of photoreceptors: rods, active under dim illumination at night and absent from the fovea; and cones, active under bright daylight illumination (photopic viewing) and highly concentrated in the fovea. These inhomogeneities allow high-acuity vision at the fovea in daylight, but also lead to a functional foveal scotoma in night vision. Since rod- and cone-signals converge on the same pathways and their cortical processing is similar except for the foveal scotoma, it is unclear if the scotopic foveal scotoma is filled-in and if humans can take into account the differences between scotopic and photopic viewing when making perceptual decisions. Here, two main experiments were performed in both scotopic and photopic viewing, using stimuli with a striped center and surround that either had the same (continuous) or the orthogonal (discontinuous) orientation. Each trial consisted of a pair of stimuli presented sequentially. In Experiment 1, observers reported discontinuous and continuous stimuli in the scotopic foveal scotoma as continuous more often than continuous stimuli in the periphery. In Experiment 2, observers had to select first which of the two stimuli they want to judge and then indicate if this selected stimulus appeared continuous or discontinuous. In the first task, observers selected any foveal stimulus more often than continuous stimuli in the periphery. In the second task, observers consistently reported discontinuous stimuli in the scotopic foveal scotoma as continuous. The results of both experiments show that the scotopic foveal scotoma was filled-in with information from the immediate surround and that humans trusted this inferred information more than veridical information from the periphery. A similar preference was observed under daylight illumination, indicating a default preference for foveal information even if this information is not veridical, like in night vision.

T2.02 **Accuracy and precision of time-to-contact estimates based knowing size and gravity**

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Catching a flying ball is a demanding task which requires a high spatio-temporal accuracy. However, how we deal with visuomotor delays at key moments of a parabolic motion is still controversial. Gómez and López-Moliner showed that a predictive model based on prior knowledge of the physical size and gravity (GS model) is able to calibrate the optical space providing grounds for an internal model to accurately estimate the time-to-contact (TTC) under certain circumstances (e.g. ending point at the observer's position). However, the TTC estimates would be overestimated for balls falling behind the observer and underestimated for balls falling in front of the observer. Likewise, precision of the estimates will also be directly related to the ending point. The model's predictions then allow us to test whether observers estimate TTC using this model for balls falling at different ending points relative to the observer. To do this, we presented a soccer ball describing a parabolic movement. We obtained the estimated time to contact for a fixed set of ending points around the participant in an augmented reality environment. Total flying time was 1 s., ball was occluded at 40% of the trajectory, air drag was neglected. The participants used a joystick to produce their answers. Our results support our main hypothesis about accuracy and precision in accordance with the GS model predictions of the remaining flying time. However, our experimental data shows that the lateral distance of the ending point elicits larger time to contact estimates. We consider our study to be the starting point to provide further empirical evidence for a general predictive mechanism, rather than a heuristic, to initiate and guide interceptive behaviour.

T2.03 **Vision Models Fine-Tuned by Cinema Professionals for High Dynamic Range Imaging in Movies.**

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Many challenges that deal with processing of high dynamic range material remain very much open for the film industry, whose extremely demanding quality standards are not met by existing automatic methods. Therefore, when dealing with HDR content, substantial work by very skilled technicians has to be carried out at every step of the movie production chain. Based on models from vision science, we present in this talk effective tone mapping and inverse tone mapping algorithms for production, post-production and exhibition. These methods are automatic and real-time, and they have been both fine-tuned and validated by cinema professionals, with psychophysical tests demonstrating that the proposed algorithms outperform both the academic and industrial state-of-the-art. We believe these methods bring the field closer to having fully automated solutions for important challenges for the cinema industry that are currently solved manually or sub-optimally.

21st June

T2.04 **The Reverse Pulfrich Effect: Misperception of Motion in Depth.**

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The Pulfrich effect is a well-known stereoscopic illusion, caused by interocular differences in luminance. The neural processing time of the image with lower retinal illuminance suffers a delay, producing an effective disparity which explains the illusion. But the impact of interocular blur differences, present in monovision corrections for presbyopia, has not been reported. The impact of differential blur on motion-in-depth perception was studied in three observers, in a haploscope rig at one-meter distance. Different interocular blur differences were induced with trial lenses: from 0 to +1.5D in one eye, then in the other eye. Onscreen spatial disparities between the LE and the RE images of the moving stimulus were used to induce interocular temporal shifts. Without illusion, a stimulus with zero interocular temporal shift would seem to move in the fronto-parallel plane of the screen. However, with non-zero interocular temporal shifts (in the stimulus or induced by the illusion), the stimulus follows a near-elliptical trajectory of motion in depth. We used a constant stimuli method changing the onscreen disparity/delay to measure the effect, in a 2AFC procedure. The task was to determine whether a bar was moving to the right or to the left when it appears closer. As opposed to the classic Pulfrich effect, where the manipulated eye with reduced signal suffers a delay, we found that the image in the blurrier eye is processed faster: 1.4-3.7ms across subjects. These processing time differences can lead to dramatic misperceptions. For a target at 5m moving at 25 km/h and with 1.5D of differential blur, the perceived distance will be overestimated by 3m. We report a new version of a 100-year-old illusion, producing motion-in-depth misperceptions in presence of interocular blur differences, as in monovision, that could potentially cause public safety issues.

10:00-11:30 Symposium: Colour Perception

S2.01 **Robust colour constancy in red-green dichromacy.**

Leticia Álvaro[1] lalvaro@ucm.es, Julio Lillo[1], Humberto Moreira[1], João M.M. Linhares[2], & Sérgio M.C. Nascimento[2].
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Red-green (R-G) dichromats have a reduced colour discrimination but the impact on their colour constancy remains unclear. Current research estimates illuminant discrimination thresholds for four normal observers and seven R-G dichromats. Spectral reflectance data from two natural scenes of rural and two of urban environments was obtained from an existing database (Foster et al., 2006, J. Opt. Soc. Am. A, 23, 2359). The scenes were presented under simulated daylight illuminants on a calibrated CRT display controlled by a ViSaGe MKII (Cambridge Research Systems). First experiment used two conditions. In the pure correlated colour temperature (CCT) change condition, illuminants varied on their CCT in the range 4012-40231K (steps of 23.3 MK-1) along the daylight locus but their average luminance was constant at 10 cd/m2. In the pure luminance change condition, illuminants varied on their average luminance in the range 6-15 cd/m2 (steps of 1 cd/m2). Thresholds for detecting an illuminant change were estimated with a 2AFC: observers viewed a reference scene illuminated by daylight with a CCT of 6700K and an average luminance of 10 cd/m2; observers then viewed sequentially two versions of the same scene (comparison scenes), one illuminated by either a higher or lower CCT (pure CCT condition) or luminance (pure luminance condition). The observers had simply to identify the comparison scene that looked different from the reference scene. It was found that thresholds estimated for R-G dichromats were marginally higher than for normal trichromats regarding CCT. Second experiment presented a reference scene and a comparison scene with a CCT or average luminance supra-threshold change tailored for each observer. Observers were asked whether or not the change was an intensity change. Normal observers and R-G dichromats did not differ significantly on their accuracy. These data suggest robust colour constancy mechanisms along daylight locus in R-G dichromats.

21st June

S2.02 **Developing a test for measuring red-green residual activity based on confusion lines.**

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Previous research has shown that about seventy-five percent of people diagnosed as red-green dichromats (protanopes and deuteranopes) by standard tests behave as anomalous red-green trichromats (protanomalous and deuteranomalous) in tasks that require responding to relatively big stimuli (over 3º). This phenomenon is known as large-field trichromacy. The aim of the work reported here is to adapt the UCDT (Universal Colour Discrimination Test) to diagnose red-green colour vision deficiencies based on the use of stimuli (1) of different sizes (2) presented on a computer screen. The main features of the test adaptation are as follow. Target stimuli size will be 1.5º or 4º (in order to avoid or to allow residual red-green discrimination, respectively). Background will consist of random luminance disks with a dominant wavelength of 575 nm. Target stimuli will consist of random luminance disks whose chromaticity will fall along the protanope or deuteranope confusion line of the background chromaticity, towards reddish or greenish direction. Mean luminance of background and target stimuli will be equated for each participant using heterochromatic flicker fluctuation (in order to avoid residual luminance cues). The aim of this adaptation is to extend the standard colour vision deficiency diagnosis to check the presence and quantify the magnitude of residual red-green discrimination in people diagnosed as red-green dichromats. Our hypothesis is that the increment of the size of the target stimuli will reduce the CIE distance needed to discriminate target from background. In order to test this hypothesis, pseudoisochromatic plates (Ishihara and HRR) and Rayleigh matches in a Nagel anomaloscope are being used to assign a total of 12 participants into groups: 6 normal trichromats will form the control group, and 6 participants diagnosed as red-green dichromats (3 protanopes and 3 deuteranopes) will form the experimental group.

S2.03 **The colours of paintings from pre-primary children**

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Children's drawings and paintings can be easily identified as done by children but are they that different from adults' colour compositions? The goal of this study was to analyse the colours of paintings of pre-primary school children and to compare their chromatic structure with traditional paintings made by adult artists. 104 paintings from 9 children in the age range 3 to 5 years old were digitalized with hyperspectral imaging. The spectral reflectance for each pixel of the paintings were estimated from spectral imaging data and used to render each painting under the standard illuminant D65. Data were then converted into CIELAB colour space. The colours of each painting were characterized by the properties of an ellipse fitted to the CIELAB data based on a least squares criterion. The distributions of the ellipses parameters across paintings were then compared with those obtained from spectral imaging data for 44 paintings rendered in the same way and done by different artists from different époques (Montagner et al, J. Opt. Soc. of Am. A, 2016). It was found that the chromatic structure of the paintings done by children is very similar to that of the paintings done by artists. The distributions of the parameters of the ellipses for children's and artists' paintings were remarkably similar. In particular, the ellipses show the same tendency to have axis ratios close to 0.6, i.e., the same degree of elongation of the colour gamut in CIELAB. They also show similar tendency to be oriented along an axis close to the blue-yellow axis. These results suggest that aesthetic preferences for colour compositions of very young children are similar to those of adults.

S2.04 **Evaluation of colour difference formulas for gonioapparent materials**

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Color & Vision Group, University of Alicante, Carretera de San Vicente del Raspeig s/n 03690, Alicante, Spain

Special-effect pigments provide a change in colour with viewing and illumination direction and a complex texture (goniochromatism). However, the measuring of colour differences involves a new challenge, but the quality control departments need standardized formulas for colour differences measurements. Nowadays, the last colour difference formula proposed by CIE is the CIEDE2000 colour difference formula, but this formula was designed for solid panels. For this reason, recently, two formulas have been proposed for goniochromatic colors: AUDI2000 and dDNA. Thus, the main objective of this work is to evaluate the correlation between both colour difference formulas in order to evaluate if both methodologies are equivalents. A total number of one hundred samples were evaluated divided into ten groups regarding the colour center. For each dataset, a master panel was defined in order to compute colour differences respect to that reference. The samples were measured by the BYK-mac i multi-angle spectrophotometer. After that, dDNA and AUDI2000 colour difference was calculated to compare both algorithms by considering the criterion of pass/fail. On the other hand, a visual experiment was designed. The visual experiment was carried out by direct comparison of colour pairs in a Byko lighting cabinet for the six measurement geometries. 30 colour pairs were selected among the data for the visual experiment. The observer's task was to estimate the colour difference in a colour pair by giving values from 1 to 3. Each observer performs three repetitions in sessions of 20 minutes. Finally, STRESS parameter was used to evaluate the performance of both methodologies. It was proven that AUDI2000 was significantly better than dDNA. Furthermore, observers did not pass any evaluated colour pair while dDNA and AUDI2000 accepted 50% and 13% of the colour pairs respectively. Therefore, from this work it can be said that AUDI2000 works better than dDNA colour difference.

21st June

14:30-15:30 Talks: Face perception & word recognition

T2.06 **Situated faces: processing of facial expressions of emotion is modulated by situational context.**

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Universidad Complutense de Madrid

Facial expressions of emotion are a basic component of communication in human social interactions. Much is known about the perceptual, cognitive and neural mechanisms involved in the decoding of FEE when presented in isolation. However, in daily life FEE are perceived in specific situational contexts as a part of specific social and emotional encounters. Much less is known about the way in which FEE and their context are integrated and on the way that context influences decoding of their meaning. We here report selected results of a series of studies in which facial expressions of different emotions were presented on the background of specific situational contexts (short sentences describing events related to different basic emotions). Using behavioral and electrophysiological measures (ERP, or event-related potentials) our studies show that 1) evaluation of the meaning of facial expressions is influenced by their congruency with the context in which they are perceived; 2) congruency between situational context and target facial expressions can modulate neural activity indicative of face processing at perceptual (N170, a face-sensitive ERP component) and post-perceptual/evaluative stages (LPP, an affect-sensitive ERP component); 3) contextual modulation of face processing interacts with task demands; and 4) congruency influences in a different way processing of faces expressing positive or negative emotions. These results have implications for general issues such as the relationship between affect and perception, the computation of affective congruency and the different structure of positive and negative emotions.

T2.07 **The role of perceptual history and its interaction with stimulus valence on face emotion recognition.**

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The recognition of facial expressions in real-time contexts is inherently dynamic. Due to its non-linear nature, the perception of emotions might lead to different perceptual interpretations of the same facial expression depending on the previous experience. We hypothesize that this time-based dependence of the emotion recognition system results from perceptual hysteresis. This theoretical account might provide an estimation of the contribution of memory mechanisms to the current percept at different time-scales. Here, we aimed to explore temporal context-related mechanisms underlying perceptual hysteresis on the recognition of dynamic emotional facial expressions. We used realistic expression transitions from a source to a target emotion with different valences, always passing through a neutral expression. Three pairs of emotions were used to design the dynamic transitions: anger-happiness, sadness-anger, and sadness-happiness. Psychophysical data were acquired from 20 participants, who were asked to identify the onset and offset of what they perceived as a neutral expression interval. Our results revealed the existence of temporal context effects on the recognition of dynamic emotions, thus revealing perceptual hysteresis. Importantly, we also found a relation between stimulus emotional content and perceptual history effects: negative valence stimulus content appeared to overrule recent perceptual experience effects, stored in short-term memory. As such, we suggest that recent perceptual experience affects the recognition of facial expressions by modulating short-term visual memory contributions to perceptual interpretation of emotional stimuli.

T2.08 **The role of perceptual salience of suffixes in visual word recognition.**

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This study is focused on the role of derivational suffixes in visual word recognition of complex stimuli by tracking the eye movements of 31 participants in a sentence-reading task in Spanish. Perceptual salience of suffixes was operationalized as the proportion of letters represented by the suffixes with respect to the full words, that is, we relate the number of letters comprising the suffixes to the number of letters in the words in which they appear. This approach to perceptual salience of suffixes is novel as perceptual salience has been operativized through different ways, including letter length, but not in the way we explore the notion of salience of suffixes. The results reveal a significant role in first fixation duration of both word frequency and perceptual salience. Moreover, in gaze duration, our results show a main effect of word length and significant interactions between word frequency and perceptual salience of suffixes on the one hand and between word frequency and word length on the other hand. These results support our operativization of perceptual salience of suffixes. Overall results are discussed in the light of the dual route models by which full-form and morphological processing interactively cooperate in visual word recognition.

16:00 – 17:30 Symposium: Motion perception

S2.05 **An individual differences approach yields three motion sensing mechanisms spatially tuned to fine-, middle-, and coarse scales**

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Due to an interaction between motion sensors tuned to low and high spatial frequencies, impairments in motion discrimination arise when coarse and fine-scale patterns are combined (e.g. a static coarse scale and a moving fine scale and also when both scales move coherently). Therefore, separate clusters of motion sensors, at least coarsely and finely spatial-frequency tuned, should be able to be identified through an individual differences approach. To that end, motion-direction discrimination was tested for Gabor patches of 0.25, 0.5, 0.75, 1, 1.5, 2, 3 and 6c/deg spatial frequency in two experiments. In Experiment.1 (N=26), these drifted with a speed of 2deg/sec and had contrasts of 0.1 or 0.9. In Experiment.2, contrast was 0.9 and drifting temporal frequency was 2Hz (N=27) or 8Hz (n=30). Duration thresholds were measured. Results from both experiments show a tendency in which duration thresholds either stabilize for frequencies lower than 1-1.5c/deg and then decrease (Exp.1), or increase up to 1-1.5 c/deg and then stabilize (Exp.2), which suggests two spatial-frequency mechanisms. Moreover, performance for 2Hz is parallel to 8Hz, although with larger duration thresholds, suggesting two temporal mechanisms; one slow and one fast, in agreement with previous literature. Conversely, a factor analysis separates the data into spatial frequency clusters, but not into temporal frequency ones. Particularly, it extracts 3 factors: one for spatial frequencies lower than 0.5c/deg, another for intermediate ones up to 1-1.5c/deg and another for larger frequencies. For the first time under an individual differences approach, we provide evidence pointing to the existence of three underlying motion sensing mechanisms tuned to different spatial scales. However, no such evidence is found for temporal frequency channels, although they do exist. This could be due to the motion sensing architecture, which performs spatial filtering after the temporal one, thus making temporal channels unidentifiable through a factor analysis.

21st June

S2.06 **Motion surround suppression is stronger for binocular than for monocular perception**

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Counterintuitively, our ability to discriminate motion direction of a Gabor patch diminishes with increasing size and contrast, indicating surround suppression. To date, the research about motion surround suppression has been focused on binocular vision, however, there are no studies about measuring surround suppression under monocular conditions. Accordingly, we performed two experiments in order to compare motion surround suppression under binocular and monocular viewing. Forty volunteers took part in the experiments: 8 in the first experiment and 32 in the second experiment. In both experiments, we measured duration thresholds for small (1 deg) and large (7 deg) drifting gratings of 1 cpd with 85% contrast and using a 2D Butterworth spatial window. The difference between both experiments was the technique used to occlude one eye. In the first experiment a mirror stereoscope was used and in the second experiment and eyepatch was used. For each subject a Suppression Index was calculated by subtracting the duration thresholds in logarithmic units of the large minus the small stimulus. The results did not depend on the occlusion technique and were similar between eyes. Interestingly, motion discrimination was faster for monocular viewing for large stimuli and slower for small stimuli than for binocular viewing. Taking in account both experiments, the average of monocular suppression index was 0.138 (SD=0.136) and the binocular suppression index was 0.246 (SD=0.125). Thus, surround suppression was almost double for binocular viewing. Our results are consistent with a reduction in perceived contrast for the monocular condition; however, contrast-matching studies show that binocular and monocular perceived contrast is the same for contrasts above 10-20%. On the other hand, our results may suggest that surround suppression is increased by binocular summation, however, to confirm this hypothesis more data testing different sizes and contrasts will be needed.

S2.07 **Are there sex differences in visual motion processing?**

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Recent results have shown that males have shorter motion discrimination thresholds than females (Murray et al., 2018, Current Biology). Likewise, a previous study had shown that males have a greater sensitivity for fine details and fast drifting stimuli than females (Abramov et al., 2012, Biology of Sex Differences). Here, we re-analyze the data of five different motion experiments to test those findings. Only the first experiment had the purpose of measuring sex differences in motion perception. In Experiment.1 (n=30, M=15,F=15), we measured the sensitivity (i.e. reciprocal of contrast threshold) for discriminating the motion of Gabor patches with low (0.6c/deg) or high (12c/deg) spatial frequencies drifting at 1Hz or 8Hz. In the second and third experiments, motion-direction discrimination was tested for Gabor patches of 0.25, 0.5, 0.75, 1, 1.5, 2, 3 and 6c/deg. In Experiment.2, these stimuli drifted with a speed of 2deg/sec and had contrasts of 0.1 or 0.9 (n=27, M=10,F=17). In Experiment.3, contrast was 0.9 and the drifting temporal frequency was 2Hz or 8Hz (n=30,M=13,F=17). In Experiment.4, we measured duration thresholds for small (0.7deg) and large (6deg) drifting Gabor patches of 1 c/deg with 92% contrast, at a speed of 2 deg/sec (n=47, M=16,F=31). Finally, in Experiment.5 (n=32,M=9,F=23), we measured duration thresholds for small (1deg) and large (7deg) drifting gratings of 1c/deg with 85% contrast, at a speed of 2deg/sec, using a 2D Butterworth spatial window under two viewing conditions: monocular and binocular. Results from all experiments show that, in general, the differences between males and females are not significant. However, results from experiments 2 to 5 show that in many conditions duration thresholds are higher for females than for males in agreement with previous findings. These larger duration thresholds for females are not restricted to a particular set of spatial frequencies, sizes or temporal frequencies.

S2.08 **A plausible model for perceived risk from visual motion**

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Visual motion can signal imminent changes in the environment whose uncertainty is increased by the variability of motion. Although perceived risk and uncertainty are related in many disciplines, it is unknown how visual motion uncertainty modulates the perceived risk. We evaluated risky decisions in a go/no-go task. Participants had to decide whether to make a square cross the screen in 300 ms without being hit by six moving targets (go) or not (no-go), by pressing one of two buttons. We manipulated the uncertainty level by having different speed variabilities (e.g. targets with identical, similar or very different speeds). Risk was defined by the mean time (0.6, 0.74, 0.9, 1.10, or 1.34 sec) that the targets (coming from the left and the right) would reach the path of the square in the middle of the screen (time-to-contact, TTC) and a cost function: successful and unsuccesful crossings were rewarded with +50 and -200 respectively. We fitted psychometric curves to participants' go responses against the TTC and the probability of go responses increased with targer TTCs as predicted by a cumulative Gaussian. Interestingly the amount of no-go responses (less risky responses) increased with larger speed variability shifting the mean of the psychometric curve to the right. To account for the whole pattern (i.e. rightward shifts of the curves due to speed variability), we fitted the go/no-go responses with a model including a normalization factor to transform speed variability into perceived risk. The input to the factor was the number of times (lambda) that targets overtook others while travelling in the same direction. A power function (single exponent of 3.9) on lambda accounted very well for the decision responses across all variability conditions. The model is neurophysiologically plausible and consistent with a modified Poisson process.

22nd of June 2019

9:00-10:00 Talks: Perceptual grouping & Haptics

T3.01 **Study on the dissociations between measures of perceptual grouping: An integrative approach.**

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The principles of perceptual organization describe the mechanisms that the visual system uses to extract the regularities of the environment in order to achieve a coherent representation of the world. From the pioneering proposal of Gestalt psychologists, most of the research has focused on the identification and description of these laws. However, the study of the relationships between these factors has been a relatively ignored issue, considering that the environments we perceive are complex, in which different perceptual cues interplay. We examined the interactions between common region and connectedness cues (Experiment 1) and the relationships between proximity and luminance similarity cues. For that, we used the repetition discrimination task (RDT) as a suitable indirect approach to study interactions between grouping cues. Furthermore, previous literature has reported dissociations between different measures of the strength of perceptual grouping cues. It has been suggested that a prior adjustment of the grouping strength of the cues based on phenomenological judgments does not ensure that the grouping cues are represented in an equivalent manner by the visuo-motor system. So that, we introduced a complementary objective equating phase to try to ensure the grouping strength mediated by both systems. Our results support the dominance of the principle of common region over the principle of connectedness. Similarly, we observed greater interference effects exerted by the principle of luminance similarity on proximity cues than vice versa. Our findings highlight the relevance of including complementary measures for the study of the interactions between principles of perceptual grouping. Finally, results from the present study suggest that individual differences should be carefully considered in future research on the principles of perceptual organization.

T3.02 **Neural responses underlying the interaction between competing perceptual states.**

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We visually experience the world as stable and mostly unambiguous. However, afferent sensory information is often ambiguous, requiring perceptual interpretation to disambiguate the visual cues and construct relatively stable percepts. A moving plaid is an example of such ambiguity: the perceptual system spontaneously alternates between two interpretations while the stimulus remains unchanged. Reciprocal inhibition among visual cortex neurons has been postulated as one of the mechanisms accounting for perceptual bistability. The dominance of one percept over the competing one derives from the activation of a subset of neurons encoding that perceptual interpretation and the simultaneous suppression of those related to the opposing representations. Here, we aimed to test how these mechanisms work over time and whether the brain responses to one percept vary depending on adaptation to the previous one. We hypothesize an interaction between the neural populations responding to opposing percepts. We acquired fMRI data from 20 participants. Initially, one of three moving plaid configurations was presented: constantly coherent or incoherent, leading to adaptation; and non-adapting. Then, either coherent or incoherent motion was shown. hMT+ responded differently for the three motion patterns. Initially, we observed the expected adaptation induced difference in activation amplitude. However, contrasting with the response to non-adapting motion, the response to adapting stimuli gradually increased over time, challenging the theoretical expected sustained decrease in activity due to adaptation. Continuous adaptation of the stimulated population and the consequent gradual disinhibition of the adjacent ones might explain this late surprising increase of net activity. hMT+ activity peaked after the transition to the opposing percept, further corroborating a disinhibition effect. Our study reveals a likely inhibition mechanism varying over time as a function of adaptation, which affects neighboring neural populations tuned to distinct global motion representations. It further demonstrates a neural correlate underlying the interaction between competing perceptual states.

22nd June

T3.03 **Determination of a haptic map of the torso and the back for improving immersion in virtual reality environments.**

Gonzalo García-Valle[1] gonzalo.gvalle@upm.es, Sandra Arranz-Paraíso[1,2], José Breñosa-Martínez[1], Ignacio Serrano-Pedraza[2,3] & Manuel Ferre-Pérez[1]
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The vibrotactile actuation is the main way to create haptic stimuli in virtual reality environments; hence the determination of vibrotactile perception all over the body is important to accurately configure haptic devices and create appropriate stimuli for improving immersion in virtual reality. Although prior studies are mainly focused on hands or arms, little is known about the haptic perception in the rest of the body. This study determines the absolute, and the upper and lower differential frequency thresholds of the torso and the back using vibration motors. We tested 16 areas to obtain the absolute thresholds and 8 areas for the differential thresholds. We measured both thresholds using Bayesian adaptative staircases with a two-interval forced choice (2iFC) task. The participants had to distinguish between a vibration and an empty stimulus to determine the absolute thresholds; whereas the differential thresholds were determined using a vibration matching task wherein the participants had to distinguish between a variable and a reference frequency (we used three reference frequencies). The absolute thresholds do not show significant differences between the 16 areas; thus, to produce haptic sensation, a single value above the average of all the absolute thresholds (69.107 Hz) must be selected for all areas. Moreover, although the differential thresholds showed some significant differences between certain areas when the reference frequency was 100 Hz, the results are similar between areas. Using these results, we obtained the Weber fraction to estimate the upper and lower differential thresholds for any reference frequency. Almost all areas have the same sensitivity (with the exception of the lower right back) and the K-values are similar (between 0.17 and 0.19). In summary, both thresholds are very similar among areas, which indicate that it is feasible to create vibrotactile haptic stimuli in a generalized manner for the torso and the back.

T3.04 **Wayfinding with a sensory substitution device.**

David Travieso García[1] david.travieso@uam.es, Lorena Lobo[2], Patric Nordbeck[3], Vicente Raja[3], Anthony Chemero[3], Michael A. Riley[3] & David M. Jacobs[1]
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The design of Sensory Substitution Devices often relies on the belief that the information supplied by the devices should allow the construction of spatial mental representations on the basis of which routes are planned. This study, in contrast, illustrates that navigation using an SSD can be conceived as an on-line, dynamic process, without the need for establishing a predefined plan or model of the task prior to its execution. We analysed route selection performed with a vibrotactile SSD that could detect environmental surfaces only within a short spatial range, limiting the availability of information about remote parts of the environment to be navigated. Sixty sighted participants performed a navigation task that involved the goal of reaching a target destination while avoiding five obstacles (placed in randomly predetermined configurations). Three groups of participants differed in the sensory modality used (restricted visual, acoustic+vibrotactile, and restricted visual+vibrotactile). While participants in the visual condition had fewer obstacle collisions and reached the target location sooner, the groups coincided to a large extent in terms of the routes that they followed. Furthermore, the routes selected by participants in all groups conformed well to routes predicted by a dynamic model of visually-guided locomotion (Fajen and Warren, 2003). These findings show that local, limited information about environmental layout can support route selection equivalent to that seen when information about the full environment layout is available.

10:00 – 11:30 Symposium: Optics & Perception

S3.01 **Optical and neural contributions to vision.**

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The optics of the eye degrades the quality of the images projected on the retina limiting the contrast and spatial resolution of the visual information available in further vision steps. Optical quality degradation arises from imperfections in the shape of the ocular elements, tilt, decentration, and interactions of the cornea and crystalline lens. Surgical and optical corrections modify the effective shape of the cornea, replace the crystalline lens by an intraocular lens, altering optical aberrations and likely visual perception. We used Optical Coherence Tomography to fully quantify the geometry of the eye's anterior segment in normal subjects and post-operatively and optically-corrected (i.e. contact lenses), allowing understanding links between ocular geometry and optical quality. We used aberrometers (Hartmann-Shack and LaserRayTracing) to characterize the optical aberrations of the normal and treated eye. Retinal image quality metrics obtained from the measured wave aberrations are compared to visual quality obtained from psychophysical measurements. Finally, adaptive optics (wavefront aberrometry+active elements) allow measuring and manipulating the ocular aberrations, allowing non-invasive assessment of the impact optical changes on vision. In particular, we studied the effect of correcting the eye's ocular aberrations, and of inducing high order aberration and phase patterns representing astigmatic or presbyopic corrections (i.e. contact lenses or intraocular lenses) on visual acuity, contrast sensitivity and perceived visual quality. We found that different corrections alter the eye's optical profile, and impact visual performance. For example, refractive surgery decreases the MTF and the CSF, and correcting optical aberrations increased decimal acuity, CSF, and improved performance of certain visual tasks (i.e. face recognition). However, the perceived best focus is altered by prior visual experience, indicating that the eye is adapted to its aberrations, and vision is not only limited by optical degradation but also by the calibration to its internal blur code.

22nd June

S3.02 **Adaptation to Retinal Blur.**

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The human visual system is continuously adjusting to changes in the environment and within the observer to maintain a constant visual perception. Adaptation processes recalibrate so that how the world looks depend on the recent and long-term visual experience, as every subject is chronically exposed to a different pattern of retinal blur. A series of psychophysical experiments were performed to investigate whether subjects are naturally adapted to their own level of retinal blur, (2) extract the orientation features of the internally coded blur and (3) test whether the internal code for blur is similar between eyes despite interocular differences. To guarantee that all subjects were exposed to a controlled retinal blur, computationally blurred images with known blur pattern were projected through a custom adaptive optics system and all the measurements were performed monocularly under full correction of subject's own retinal blur. Judgments of perceived blur were measured to determine the physical blur level that appeared best focused and oriented blur producing best perceived image quality were measured using a "Classification Image" inspired method. We found (1) a strong correlation between the blur of the best perceived image and the retinal blur produced by the subjects own ocular aberrations, (2) while there is some bias for in favour of individual blur orientation, subjects reveal relatively high tolerance to blur produced by different oriented blur and (3) the best perceived focus matched the retinal blur produced by the least aberrated eye. Adaptive Optics is an effective tool for testing visual perception under controlled retinal blur. The results strongly suggest that vision is adapted to the overall amount of retinal blur, calibration mechanisms for normalizing retinal blur operate to a lesser extent using orientation cues, and a cyclopean mechanism is used to compensate for interocular differences in retinal blur.

S3.03 **Visual Impact of the Chromatic aberrations of the eye.**

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The eye is an optical instrument that project scenes of the visual world onto the retina. However the human eye is far from being a perfect optical system, and, as a consequence, the images projected on the retina are blurred by ocular aberrations, as well as diffraction and scattering. In natural, polychromatic light, the retinal image is affected by interactions among longitudinal chromatic aberration , wave aberrations and transverse chromatic aberration (TCA). In addition optical and structural properties of the eye change with age and with certain ocular conditions and treatments, altering the natural aberrations, as well as the interactions between monochromatic and chromatic aberrations, and consequently the visual function. In the last years, multiple technologies, based on wavefront sensing and Adaptive Optics (AO), have been developed for the measurement and correction of ocular aberrations. Therefore, visual simulators based on AO, incorporating a psychophysical channel, are essential to understand the visual impact of the chromatic aberrations of the eye, the interactions of these aberrations and their effect upon. A series of experiments allowed us to measure in vivo for the first time (1) the longitudinal chromatic aberration (LCA) of the normal eye using objective and subjective techniques in the same subjects in a wide spectral range, with control of subjects' natural aberrations, (2) the in vivo LCA of pseudophakic subjects implanted with different designs and materials IOLs, and (3) the interactions between LCA and TCA of the human eye. Moreover AO has allowed us to study how the visual system is neurally adapted to the interactions between monochromatic and chromatic aberrations, and how vision is affected by them. In fact, imperfect optics may be the eye's protection against chromatic blur.

S3.04 **Visual simulators and programmable blur.**

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With presbyopia, the eye is no longer able to accommodate and loses the ability to focus at near objects. Ophthalmic corrections for presbyopia attempt to restore functional vision at all distances. Some presbyopic corrections implemented in the form of contact lenses and intraocular lenses provide the patients with new visual experiences in which sharpness has to coexist with blur. In monovision one eye is corrected for far and the other for near, producing an important interocular blur. In simultaneous vision, a multifocal image is created in the retina by combining sharp and blurred image components from different foci. It is not easy to predict the acceptance to these corrections in all cases. We have developed several programmable visual simulators based on optical manipulations to simulate the visual experience of presbyopic corrections. The visual simulators have been used in psychophysical experiments with observers and patients performing different visual tasks (through-focus visual acuity, image scoring, pairwise preferences between corrections, Multifocal Acceptance Score). The simulated multifocal lenses have been validated by direct comparison with real multifocal lenses projected onto the eye, fitted or surgically implanted. Subjects / patients are very consistent in their perceptual responses (STD in perceptual score less than 1 perceptual point in a 0-10 scale; preferences statistically significant across repetitions). This high intra-subject repeatability contrasts with significant inter-subject differences found in the perceptual responses to multifocallity. Visual simulators are a useful tool to include perceptual aspects in the design of presbyopic corrections and to help patients and practitioners choose the best correction according to the visual experience provided. The capability to generate programmable blur also make visual simulators suitable for fundamental research in blur perception.

22nd June

12:00 – 13:00 Talks: Colour perception & Attention

T3.05 **Chromatic Structure of Graffiti.**

Claudia Feitosa-Santana[1] claudia.feitosasantana@gmail.com, Carlo Gaddi[2] & Sérgio Nascimento[3]

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The colours of traditional paintings have a specific structure that in general mimics the chromatic structure of natural scenes . Urban artists make extensive use of colours, especially when expressing in graffiti. Their colours have not been quantitatively characterized and it is unknown whether they follow the same structure as more traditional paintings. The goal was to characterize the colours of graffiti and to compare to that of traditional paintings. Photos of 228 graffiti of the city of Sao Paulo, Brazil, were taken in five different zones of the city with a Nikon d7000DSLR camera with a CMOS sensor of 16MB resolution (3264×4928 pixels). A X-Rite Macbeth ColorChecker Classic was included in each photo for calibration. The illumination on the colour chart was measured immediately before the photo with a portable spectro-colorimeter Everfine SPIC-200. The spectral reflectance of each ColorChecker sample was measured with a Minolta CM2600d. These data were used to correct the sRGB data using the Moore-Penrose pseudo-inverse transformation. CIELAB for each pixel were computed from the corrected set of tristimulus values. The colours were characterized by the properties of an ellipse. The distributions of these parameters were then compared with those obtained from spectral imaging data from traditional paintings. It was found that graffiti have chromatic structures similar to those of traditional paintings. The distribution of orientations of the fitted ellipses for graffiti and paintings have maxima that are within 20 degrees of each other and their orientation is, on average, close to the yellow-blue axis. The distributions of the ellipses' axis ratios have maxima close to 0.6, the same degree of gamut stretching. The distributions for the graffiti are, however, broader than for more traditional paintings, suggesting more freedom in the use of colours and a wider range of aesthetic preferences.

T3.06 **No chromatic-chromatic interaction in colour assimilation.**

Xavier Otazu[1, 2] xotazu@cvc.uab.es & Xim Cerda-Company[1, 2].
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Colour induction is the influence of surrounding colours on the colour of the target region. When the target's colour shifts away from the one of the first inducer, colour contrast (CC) is occurring and when the target's colour shifts toward the one of the first inducer (opposite effect), colour assimilation (CA) occurs. In a previous study, we observed that CA depends on the luminance differences. Particularly, no CA and no CC are observed at equiluminance conditions, supporting the mutual-inhibition hypothesis (activated luminance neurons inhibit colour neurons and, thus, CA is stronger). In this work we study whether there is an interaction between konio- and parvo-cellular pathways, that is, to test whether this hypothesis is also valid for a chromatic-chromatic interaction instead of a chromatic-luminance one. We defined four chromatic conditions along the diagonals of MacLeod-Boynton colour space (activating both konio- and parvocellular pathways) and five luminance conditions (two darker and two brighter than the first inducer, plus equiluminant). Similar to the previous study, we observed that CA is stronger along the s axis. Moreover, we observed that CA only depends on the luminance contrast (i.e., we observe no CA at equiluminance). This, could suggest that mutual-inhibition hypothesis is only valid considering a luminance-chromatic interaction and that no mutual-inhibition exist between konio- and parvocellular pathways. Hence, CA only appears when a luminance difference is present in the visual stimulus, and chromatic differences per se cannot induce CA.

T3.07 **Measuring bottom-up visual attention in eye tracking experimentation with synthetic images.**

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In this study we present an extensive analysis of the main factors that contribute to bottom-up visual attention. Our objective is to analyze how eye movements are influenced by context, contrast, temporality, task and center bias. We have provided formulation of psychophysical patterns in a dataset of 230 images, corresponding to Corner Angle, Visual Segmentation, Contour Integration, Perceptual Grouping, Feature & Conjunctive Search, Search Asymmetries, Noise/Roughness, colour Contrast, Brightness Contrast, Size Contrast and Orientation Contrast in homogeneous/heterogeneous, linear/nonlinear and categorical search configurations. With all these 15 types of stimuli we have collected eye tracking data with 34 participants, measuring the Reaction Times and Saliency Index of finding the salient regions. First, we saw that differences on salient region localization exist upon varying feature type. Second, feature contrast is the main factor contributing to saliency. Third, first fixations are influenced more on saliency that late ones. Fourth, free-viewing tasks are more guided by endogenous attention than visual search. Fifth and last, the center bias increases upon viewing time. We also give the implementation to generate synthetic stimuli, also parametrizable for generating stimuli that could be used for any other type of experimentation.

22nd June

T3.08 **The effect of top-down attention in occluded object recognition.**

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Our experience about each object in the world occurs in conjunction with other objects that tend to be found in similar environments. It has been demonstrated that brain incorporates contextual information in order to detect objects in scene and recognition process can be influenced by top down information. In particular, the relevant contextual information can facilitate the perception procedure by providing informative cues about the items that share similar backgrounds. The focus of this study is on the advantage of consistency of top-down information in recognizing objects in difficult situations. This research is concerned with the effect of semantically consistent /inconsistent contextual priming in rapid occluded object recognition. To this end, a psychophysical experiment is conducted in which participants were asked to identify the category of partial objects that were presented on the screen. Before the presence of each object, participants briefly viewed a scene image that could be either consistent or inconsistent with the category of the following occluded objects. According to our hypothesis, the gist information of this image will direct attention to the common objects that tend to be found in similar environments. Hence, top-down attention signal modulates brain and rises a prediction coding about what might be seen next. The objects are chosen from two subcategories of vehicle/non-vehicle items. We measured hit rate, miss rate and the response time over the congruent and incongruent pairs of scene and object images in basic and superordinate modes. In basic mode, true recognition was considered based on correct category detection, while in the superordinate mode, the confusion between objects from similar superordinate categories of vehicle/non-vehicle was also considered as correct classification. Our results suggest that coupling occluded objects with consistent backgrounds leads to higher accuracy and lower time responses as opposed to inconsistent prior information in occluded object recognition task.

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Notes

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