GDR Vision 2021 – Lille

Conference program – abstracts book

Thursday 21/10
Imaginarium, Plaine Images, Tourcoing

12h30	**Welcome**
13h	**Sabrina Hansmann-Roth -** *On the real bandwidth of perceptual experience: Detailed internal representations of visual ensembles*
14h	Kim Beneyton - *Evidence for feedback pattern motion signals in early visual areas*
14h15	Anna Montagnini - *Expectations about motion direction affect perception and anticipatory smooth pursuit differently*
14h30	Gaelle Nicolas - *Neural Correlates of Intra-saccadic Motion Perception*
14h45	Thérèse Collins - *Serial dependence tracks objects and scenes in parallel and independently*
15h	CAFE
15h30	Jade Guénot - *Optic flow processing in macular degeneration patients*
15h45	Sara Monteiro - *Development of a large-scale screening tool for functional vision impairments in early childhood*
16h	Hanane Ramzaoui - *Instrumental activities of daily living and visual search: Analysis of eye movements in Alzheimer's disease*
16h15	Aurélie Calabrèse - *Can individuals with central field loss perform head pointing tasks in a virtual reality environment?*
16h30	Léa Entzmann - *EyeProxy_DB : une base de donnees ouverte sur le systeme visuel de jeunes volontaires sains (signaux oculometriques, EEG et IRM)*
16h45	Eric Castet - *From translational research on low vision to the use of virtual reality for rehabilitation, visual aids and ... visual neuroscience*

From 6pm : Social - Bistrot St-So (beers / drinks / finger food)

Friday 22/10

Amphi B7, Lille University, Campus Pont de Bois, Villeneuve d'Ascq

9h	**Jean Lorenceau -** *La pupille voit double : Dr Jekill et Mister Hyde dans l'œil du cyclope*
10h	Jonathan Vacher - *Unifying Different Psychometric Methods : Theory and Experiment*
10h15	Miao Li - *Feature migration in redundancy masking*
10h30	Dandan Yu - *Foveal input can be ignored in ensemble emotion perception*
10h45	CAFE + **Posters**
11h45	Pascal Mamassian - *A generative model for visual confidence judgments*
11h45	Adrien Paire - *Quest+ : Reliability of PSE estimation, but sensitivity overestimation*
12h15	Laurie Gallas - *Spatial dynamics of perceptual rhythms*
12h30	Anne-Laure Vittek - *Single-units and local field potentials in the medial pulvinar show multisensory integration*
12h45	LUNCH + **Posters**
13h45	**Claudia Lunghi -** *Reactivating Visual Plasticity in Adult Humans*
14h45	Rasa Gulbinaite - *Spatial dimension of resonance phenomena in mouse primary visual cortex*
15h	Camille Fakche - *Phase-amplitude tradeoffs of spontaneous alpha oscillations predict cortical excitability and visual perception*
15h15	CAFE + **Posters**
15h45	Marie-Alphée Laurent - *Towards an optimal comparison of cortical (face) networks in macaques and humans with fMRI frequency-tagging*
16h	Hugo Ladret - *Modulation of orientation selectivity by orientation precision in V1*
16h15	Manuel Vidal - *Reef fishes in a video game: Assessing their visual abilities to recognize conspecifics and predators*
16h30	Business

The 2021 GDR Vision forum received support from SCALab (UMR 9193 – U. Lille & CNRS) & the Federation de Recherche Sciences et Cultures du Visuel (FR 2052)

Invited Keynotes

Thursday 21 – 1pm

On the real bandwidth of perceptual experience: Detailed internal representations of visual ensembles

Sabrina Hansmann-Roth
SCALab - CNRS, Universite de Lille

All natural scenes contain elements, for example the leaves on a tree, that share visual features such as shape, texture, and colour. How are these ensembles represented in the visual system? During the last decade, studies have suggested that the visual system encodes summary statistics (e.g., mean and variance) of ensembles to save resources and bypass the bottlenecks of attention and working memory. Claims have even been made that representing visual information as summary statistics is what determines the richness and limitations of our conscious experience. In a set of behavioural experiments, I will show that such explicit reports severely underestimate the richness of visual representations.
Our observers searched for an odd-one-out target among heterogeneous distractors and their memory of distractor characteristics was tested using explicit or implicit measures. Observers could explicitly distinguish distractor sets with different mean and variance, but not differently shaped probability distributions. In contrast, our implicit assessment revealed the encoding of mean, variance, and even distribution shape. Furthermore, explicit measures had common noise sources that distinguished them from implicit measures.
This shows that the visual system does not reduce information about visual features to summary statistics, but instead that explicit decisions about summary statistics are limited, as if they were based on small samples from an otherwise fully encoded probabilistic representation of visual features. This discovery has implications for the understanding of how information is stored in the visual system and how it is accessed for decision making, suggesting that perception for action can be less limited than visual awareness.

Friday 22 – 9am

La pupille voit double : Dr Jekill et Mister Hyde dans l'œil du cyclope

Jean Lorenceau
Integrative Neuroscience and Cognition Center - CNRS, Universite de Paris

Friday 22 – 1:45pm

Reactivating Visual Plasticity in Adult Humans

Claudia Lunghi
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Neuroplasticity is a fundamental property of the nervous system that is maximal early in life, within a specific temporal window called *critical period*. However, it is still unclear to which extent the plastic potential of the visual cortex is retained in adulthood. We have surprisingly revealed residual ocular dominance plasticity in adult humans by showing that short-term monocular deprivation unexpectedly boosts the deprived eye (both at the perceptual and at the neural level), reflecting homeostatic plasticity. This effect is accompanied by a decrease of GABAergic inhibition in the primary visual cortex and can be modulated by non-visual factors (physical exercise, motor plasticity and energy metabolism). Finally, we have found that combining short-term reverse occlusion with physical exercise promotes the long-term improvement in visual acuity and stereopsis in adult amblyopic patients. Taken together, these results challenge the classical view of a hard-wired adult visual cortex, indicating that homeostatic plasticity can be reactivated in adult humans.

GDR Vision 2021 – Lille

Talks

Evidence for feedback pattern motion signals in early visual areas.

Kim Beneyton*[1], Micha Heilbron[2], Henry Kennedy[1], Kenneth Knoblauch[1], and Floris De Lange[2]

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Résumé

Numerous studies have demonstrated cortical hierarchy in terms of the anatomy of ascending (feedforward, FF) and descending (feedback, FB) interareal pathways. The function of FF connections has been well studied and characterized in the hierarchical construction of classical receptive field (RF) properties (Felleman and Van Essen, 1991). FB connections are more numerous and have a greater hierarchical reach than do FF connections (Markov JCN 2014). Despite the prominence of FB and in contrast to FF, little is known about their functional role in perception. Movement perception is thought to involve the dorsal pathway in which area MT is located. Because RFs are very small in area V1, a hierarchical model of motion perception proposes that complex pattern motion is analyzed in area MT where RFs are considerably larger than area V1. Here, we investigated the nature of the FB signal examining the well-documented strong and direct FB pathway between MT and early visual areas V1 and V2, using bistable moving plaid stimuli and functional imaging. We used a bistable perception paradigm where the same stimulus is presented continuously, so that visual input remains constant, but for which spontaneous switches in perception occur between two different stable interpretations. We showed 34 participants a plaid composed of a superimposed pair of moving square-wave gratings that was alternatively perceived as pattern or superimposed component motions. Using both decoding analyses and pattern correlation, we found that perceptual state was reliably decoded from areas V1, V2 and hMT+. The fact that perceptual state varies for a constant visual input suggest that the perceptual information is provided by higher level areas projecting back to V1 and V2. Future research will aim to unravel the role of a FB pattern signal in area V1, by determining whether perceptual modulations in V1-V2 originate from hMT+, and what are the laminar activity profiles of the top-down pattern motion signals. These investigations will inform on the possible role of FB pathways in hierarchical processing. This work is supported by grants from the European Research Council (CONTEXTVISION) and from the French National Research Agency (LabEx_Cortex and Dual_Streams).

Mots-Clés: neuroimaging, cortical hierarchy, feedback function, motion integration

*Intervenant

Expectations about motion direction affect perception and anticipatory smooth pursuit differently

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Résumé

Smooth pursuit eye movements and visual motion perception rely on the integration of current sensory signals with past experience. Experience shapes our expectation of current visual events and can drive eye movement responses made in anticipation of a target, such as anticipatory pursuit. Previous research revealed consistent effects of expectation on anticipatory pursuit-eye movements follow the expected target direction or speed-and contrasting effects on motion perception, but most studies considered either eye movement or perceptual responses. The current study directly compared effects of direction expectation on perception and anticipatory pursuit within the same direction discrimination task to investigate whether both types of responses are affected similarly or differently. Observers ($n = 10$) viewed high-coherence random-dot kinematograms (RDKs) moving rightward and leftward with a probability of 50, 70, or 90% in a given block of trials to build up an expectation of motion direction. They were asked to judge motion direction of interleaved low-coherence RDKs (0-15%). Perceptual judgements were compared to changes in anticipatory pursuit eye movements as a function of probability. Results show that anticipatory pursuit velocity scaled with probability and followed direction expectation (attraction bias), whereas perceptual judgments were biased opposite to direction expectation (repulsion bias). Control experiments suggest that the repulsion bias in perception was not caused by retinal slip induced by anticipatory pursuit, or by motion adaptation. We conclude that direction expectation can be processed differently for perception and anticipatory pursuit.

Mots-Clés: Motion expectation, Eye movements, Visual perception, Prior, Probabilistic encoding

*Intervenant

Neural Correlates of Intra-saccadic Motion Perception

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Résumé

Castet and Masson (2000) demonstrated that motion perception was not inhibited during saccades. Intra-saccadic motion was perceived when a moving stimulus, optimized to preferentially activate the magnocellular pathway, was observed. Indeed, motion perception was mediated by retinal temporal frequency induced at the time of the saccadic peak velocity. We adapted this protocol to electroencephalography recordings by adding a *control* condition for which intra-saccadic motion perception was not possible to compare with the *stimulus* condition for which it was possible. A significant difference between these two conditions would clearly demonstrate the cortical involvement of the magnocellular pathway, particularly the primary visual areas (V1-V2) and the motion area (MT-V5) during intra-saccadic motion perception.

We used joint electroencephalography (EEG) and eye-tracking (ET) recordings. The task of the participant was to perform horizontal saccadic movements towards a target and then indicated the strength of stimulus motion perception between two possible choices, *strong* or *weak/null*. Two conditions were implemented (*stimulus* and *control*) and two visual categories were considered: the perception was possible (*stimulus-strong*) or not (*control)*. The main saccade in each trial was selected based on ET recordings. We introduced two thresholds (2 Hz, 40 Hz), to ensure that the retinal temporal frequency induced by the peak velocity

*Intervenant

was inside the bandwidth of the magnocellular pathway. In addition, because our focus was on *stimulus-strong* category, we selected trials for the EEG analysis with low retinal temporal frequency ($<$ 20.4 Hz) or equivalently, with high peak velocity ($>$ 240 $\circ$/s). This allowed us to have the largest possible threshold on the retinal frequency with similar distributions of the saccade features (size, duration and velocity) between the two categories. Then the only characteristic that differed was intra-saccadic motion perception.
Our results demonstrated the effective involvement during saccades of the areas V1-V2 and MT-V5. Differences were observed on the evoked potential at the saccade onset between the two categories, with a larger and a higher positive component in the *stimulus-strong* category compared to *control*, regardless the area considered. We confirm the behavioural results of Castet and Masson (2000) by recording neural correlates of intra-saccadic motion perception in human.

Mots-Clés: Saccade, Intrasaccadic motion perception, Evoked potentials

Serial dependence tracks objects and scenes in parallel and independently

Thérèse Collins*[1]

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Résumé

The visual world is made up of objects and scenes. Object perception requires both discriminating an individual object from others and binding together different perceptual samples of that object across time. Such binding manifests by serial dependence, the attraction of the current perception of a visual attribute towards values of that attribute seen in the recent past. Scene perception is subserved by global mechanisms like ensemble perception, the rapid extraction of the average feature value of a group of objects. The current study examined to what extent the perception of single objects in multi-object scenes depended on previous feature values of that object, or on the average previous attribute of all objects in the scene. Results show that serial dependence occurs independently on two simultaneously present objects, that ensemble perception depends only on previous ensembles, and that serial dependence of an individual object occurs only on the features of that particular object. These results suggest that the temporal integration of successive perceptual samples operates simultaneously at independent levels of visual processing.

Mots-Clés: serial dependence, history effect, ensemble perception

*Intervenant

Optic flow processing in macular degeneration patients

Jade Guénot*[2,1], Yves Trotter[1,2], Paul Fricker[2,1], Marta Cherubini[1,2], Vincent Soler[1,3], and Benoit Cottereau[1,2]

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Résumé

Macular degeneration (MD) is the leading cause of blindness in countries with ageing populations. It involves a gradual decrease of central vision through degenerative lesions – leading to a progressive scotoma and steady loss of visual acuity with severe consequences on the patient's quality of life. If it is established that MD patients have important deficits for reading and visual categorization tasks, much less is known about their ability to process dynamic scenes. Here, we characterized their perception of optic flow, the pattern of motion that falls on the retinas during locomotion. We performed psychophysical experiments in 7 MD patients (4 patients with Stargardt disease, 3 AMD, mean age: 56.71 ± 13.91, range: 27-86) with dense binocular scotomas of less than 10∘. Stimuli consisted of random-dot kinematograms (RDKs) projected on a large screen (56 x 40∘). Patients fixated the center of this screen monocularly with their best eye. For each of the three components of optic flow (translational, radial and rotational), they were involved in a 2-alternative forced choice task (2-AFC) and had to report their perceived motion direction (leftward versus rightward for translational, inward versus outward for radial and clockwise versus anti-clockwise for rotational patterns). We manipulated motion coherency (i.e. the percentage of dots moving in the same direction) and estimated the thresholds corresponding to 80% of correct detection. Thresholds were very low for radial and rotational patterns (14.13 ± 4.29% and 22.28 ± 6.6% on average) and comparable to those measured in a population of younger controls (mean age: 33.33 ± 12.99) without visual deficits (10.91 ± 2.2% and 27.65 ± 5.54% on average for the radial and rotational patterns). In contrast, thresholds for translational patterns were more variable and higher on average (59.6 ± 37.41%) than those observed in the control group (16.67 ± 3.59%). Altogether, our results suggest that selectivity to radial and rotational optic flow patterns is preserved in MD patients, in line with previous findings on self-induced motion perception (Tarita-Nistor et al., 2008).

Mots-Clés: optic flow, macular degeneration, AMD, Stargardt disease

*Intervenant

Development of a large-scale screening tool for functional vision impairments in early childhood

Sara Monteiro*[1], Pascale Esch , Géraldine Hipp , and Sonja Ugen

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Résumé

Cerebral Visual Impairment (CVI) is a term used to designate a neurological disorder of the visual pathways impacting visual processes at any given level (Lueck et al., 2019). Due to the advances in perinatal and medicinal care, CVI's occurrence has increased significantly over the last years (Chokron & Dutton, 2016). The condition almost always entails aggregated functional vision impairments, i.e., limitations on the use of binocular vision during everyday tasks (Dutton, 2015). CVI can have effects on school achievements if undetected. Early detection is thus key to offer appropriate aids to avoid a negative impact on learning processes.
The aim of this project is to develop a large-scale screener at the beginning of formal schooling, to identify functional vision impairments early on. For this reason, a set of items assessing different visual functions will be incorporated into the Luxembourgish school monitoring program. Based on a theoretical model of visual perceptual processing (Humphreys and Riddoch, 1987), we developed timed and non-timed items that can be administered in a large-scale classroom setting which target different stages of visual perceptual processing. Furthermore, we included visual functions connected with both dorsal and ventral streams, visual spatial processing, visual exploration and visual memory.
We will present the design of the large-scale screener in relation to the theoretical model, as well as the rationale used to include or exclude various perceptual visual functions in the final test. Furthermore, we will explain the planned data collection and tool validation processes.

Mots-Clés: Large Scale Screener, Visual Perceptual Processing, Grade 1, Functional Vision Impairment

*Intervenant

Instrumental activities of daily living and visual search: Analysis of eye movements in Alzheimer's disease

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Résumé

The progression of Alzheimer's disease (AD) leads to difficulties in carrying out instrumental activities of daily living (IADL, e.g., cooking, managing finances or medications). Although one of the criteria for the diagnosis of AD is a significant loss of autonomy, there is no 'gold standard' method to evaluate everyday functioning when investigating dementia. Efficient information gathering via eye movements and object search in complex environments are indispensable to successfully perform IADL. For example, more fixations are made on task-relevant than task-irrelevant objects. This study aimed to investigate how top-down factors modulate eye-movement behaviour during visual search and IADL performance in patients with mild-to-moderate AD compared to age-matched healthy controls. We examined the influence of (1) the target-cue type (picture cue vs. word cue) on search guidance, and of (2) the functional and semantic relationship of objects with IADL (functional object, necessary for the IADL vs. semantically consistent distractor, but not necessary for the IADL vs. inconsistent distractor). We also examined the effect of IADL type (making tea, making a toast, and preparing a postcard for mailing). The results showed that search was slower in patients than in controls, but this gap was removed with a picture cue, suggesting a greater use of guidance provided by prior information about the target's physical appearance in AD. Thus, this indicates that pictorial cues can act as a source of environmental support to improve search in AD. IADL accuracy, in terms of the number of errors, was comparable in AD patients and controls. However, patients fixated more distractor objects than controls in the non-domestic IADL (preparing a postcard for mailing), suggesting a reduced use of guidance provided by task goals in AD in that IADL. This finding indicates that the use of eye tracking in analysing fine-grained behaviour during IADL is promising for the detection of functional decline in mild-to-moderate AD.

Mots-Clés: Alzheimer's disease, instrumental activities of daily living, visual search, eye movements, real environment

*Intervenant

Can individuals with central field loss perform head pointing tasks in a virtual reality environment?

Aurélie Calabrèse*[1], Séverine Dours[1], Ambre Denis-Noel[1], Marco Benzi Tobar[2], Hui-Yin Wu[3], Frédéric Matonti[4], Pierre Kornprobst[3], and Eric Castet[1]

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Résumé

Purpose: Virtual Reality (VR) headsets are raising more and more interest in low-vision research since they offer a promising framework for vision aids and rehabilitation protocols. Head pointing (a common way to interact with the world in VR) may represent a promising option for patients with Central Field Loss (CFL), who lose the ability to direct their gaze efficiently towards a target. The purpose of this study is to evaluate whether CFL patients are able to perform precise head-pointing tasks in VR.
Methods: 38 controls (age 8-67; mean = 35±15) and 53 individuals with binocular CFL (age 11-97; mean = 77±13), were tested with a VR headset in a plain VR environment (grey background). At the beginning of each block, a head-contingent reticle was displayed, either in the center of the visual field or in one of 8 fixed positions at 10∘ eccentricity. At each trial, a target appeared in the visual field and subjects were instructed to move their head to position the reticle precisely onto the target. Targets were black circles (2∘ diameter) randomly presented in 8 fixed locations (top, top-right, right, bottom-right, bottom, bottom-left, left, top-left) 12∘ away from the center of the reticle. Both accuracy and reaction time (RT) were measured.

Results: For control subjects, performance was high (accuracy = 100%; mean RT = 3.46±2.01 sec) and stable for all positions of the reticle. An age effect was observed: RT decreased with age before 20 and increased after 20. The visually impaired subjects succeeded in performing the task (min success rate 94.5%) with a mean RT of 5.58±5.71 seconds, showing significantly lower performance than controls. More importantly, an effect of the reticle position was found for these CFL subjects.
Conclusions: For individuals with CFL, performance of a head-pointing task in VR varies according to the position of the reticle, likely reflecting the position and shape of the binocular scotoma. The effect of age found in control subjects must be taken into account when developing optimised rehabilitation tools using VR for the low-vision population.

Mots-Clés: low vision, central field loss, virtual reality, head pointing task, age

*Intervenant

EyeProxy_DB : une base de données ouverte sur le système visuel de jeunes volontaires sains (signaux oculométriques, EEG et IRM)

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Résumé

Objectif : Les signaux oculométriques (mouvements oculaires et diamètre pupillaire) constituent une signature non invasive du fonctionnement cognitif et de l'état physiologique du sujet. Ainsi, des signaux oculométriques anormaux peuvent caractérisés certaines pathologies. **Eye-Proxy** propose une plateforme d'acquisition et d'analyse des signaux oculométriques conjointement à la neuroimagerie (IRM, EEG), dans des contextes expérimentaux et avec des stimuli visuels variés. Les données recueillies constitueront une base de données ouverte. *Méthode* : Les protocoles de stimulation visuelle utilisés permettent d'explorer le contrôle des mouvements oculaires dans 3 tâches : (i) reconnaissance d'objets et de visages (neutres ou émotionnels), (ii) poursuite d'objets en mouvement et (iii) choix saccadique. Ils sont optimisés pour limiter la durée d'acquisition (35 min) tout en maximisant la détection d'activation corticale différentielle entre conditions. Ces protocoles sont utilisés en IRM puis en EEG, sur la plateforme IRMaGE avec un enregistrement des signaux oculométriques conjointement aux signaux IRM et EEG. Les chaines de traitement sont développées avec des briques logicielles génériques (BrainStorm, SPM) et internes.

Résultats : Les tâches utilisées impliquent les premières aires visuelles (V1-V2), la Face Fusiforme Area (perception des visages), le Lateral Occipital Cortex (reconnaissance d'objets), MT/V5 (perception du mouvement), le Frontal Eye Field et deux structures sous-corticales (LGN, Colliculus Supérieur) pour le contrôle des saccades. **EyeProxy_DB**, est une base de données de référence unique qui regroupe les données acquises chez 40 sujets ($<$ 40 ans) d'oculométrie et d'imagerie, anonymisées brutes et traitées. Elle est en cours de finalisation de dépôt sur la plateforme Shanoir (shanoir.org).

*Intervenant

Conclusion : **Eye-Proxy**, repose sur les compétences de chercheur.e.s de 3 laboratoires grenoblois (GIN, GIPSA-lab et LPNC). Les protocoles développés permettront un screening des étages de traitement de l'information visuelle chez des sujets adressés à la plateforme IRMaGE. Cela devrait contribuer à une meilleure connaissance de l'impact de certaines altérations cérébrales sur les mouvements oculaires et pourrait permettre d'affiner la nosologie des pathologies neurodégénératives, psychiatriques et lésionnelles. La mise à disposition des données à la communauté contribuera à la démarche " Science ouverte " et permettra d'inférer les tailles d'effet pour calibrer les effectifs dans de nouvelles études.

Mots-Clés: Mouvements oculométriques, EEG, IRM, database, open source

From translational research on low vision to the use of virtual reality for rehabilitation, visual aids and ... visual neuroscience.

éric Castet*[1], Pierre Kornprobst[2], and Aurélie Calabrèse[3,4,5]

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Résumé

Research on low vision in the last decades has produced a vast amount of data and many theoretical approaches and controversies. Behavioural and psychophysical studies have characterized some basic visual, attentional and oculo-motor factors limiting the visual perception of visually-impaired persons in general and of age-related macular degeneration (AMD) patients in particular. It seems timely to use this immense knowledge to develop innovative rehabilitation protocols and visual aids.

I will describe how recent results on text reading performance, as well as oculo-motor behaviour, measured in patients with AMD has encouraged us to develop systems that leverage the benefits of Virtual Reality for low vision persons. The numerous assets and potential applications of Virtual Reality as we envisage them will be exposed in details.

Developing these VR systems has also been an incentive for us to start in parallel a project whose goal is to provide an open-source and collaborative software ("PTVR" for "Perception Toolbox for Virtual Reality") allowing our community to easily build Virtual Reality experiments. This software should allow vision scientists to perform controlled and replicable VR experiments leading to efficient multi-centric tests of novel rehabilitation techniques or visual aids based on Virtual Reality.

Mots-Clés: virtual reality, low vision

*Intervenant

Unifying Different Psychometric Methods : Theory and Experiment

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Résumé

The two-alternative forced choice (2AFC) paradigm is one of the main methods used to measure perceptual thresholds and biases. Measurements from a 2AFC experiment can be modelled using signal detection theory (SDT) from which the psychometric function can be derived theoretically. Recent efforts to combine SDT with Bayesian probabilities has linked thresholds and biases to hypothesized prior knowledge and optimal encoding/decoding [1]. From another perspective, the maximum likelihood difference scaling (MLDS) paradigm is a more recent method that allows the experimenter to estimate a perceptual scale that links a physical property to a psychological dimension [2]. Such a perceptual scale is obtained from the comparison of relative differences between pairs of stimuli. Here again, the underlying model can be understood in terms of SDT and Bayesian probabilities. However, no comparison between MLDS and 2AFC measurements has been performed yet. Here, we introduce the theory that unifies those measurements and we present some preliminary experimental results. The output of this work is crucial for future developments in psychophysics both theoretically and experimentally.

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Mots-Clés: 2AFC, MLDS, bayesian probabilities, information theory

*Intervenant

Feature migration in redundancy masking

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Résumé

In redundancy masking (RM), the number of perceived items in repeating patterns is lower than the number of presented items. For example, when presented with a line triplet in the periphery, most observers report a line pair instead of 3 lines. Here, we investigated RM by exploring whether a unique feature of one of several otherwise identical objects is lost, migrates to other objects or protects against RM. Participants viewed 3-6 concentric circles surrounding fixation. One of the circles had a gap (ranging from 0.02∘ to 0.14∘) in one of the four cardinal directions (left, right, up, or down). Participants were required to indicate (1) the number of circles, (2) on which circle the gap was perceived (1st, 2nd,..., nth circle, or no-gap), and (3) the direction of the gap. Overall, we found strong RM: the reported number of circles was lower than the actual number (RM-trials), even when gap direction discrimination was at ceiling performance, and there were almost exclusively RM-trials around gap direction discrimination thresholds (with the smallest gap sizes). In non-RM trials where the number of circles was correctly reported, the gaps predominantly migrated towards more peripheral circles. In the key condition, where 3 circles were presented but 2 were reported (RM trials), the gap on the central circle was most often reported on the 2nd (i.e., outer) circle. Taken together, these results show that salient features did not prevent or against RM. Large gaps either migrated or caused RM of typically weakly masked positions (in particular, outer positions when three circles were presented). We suggest that feature migration in RM shows the perception of features of unseen objects.

Mots-Clés: peripheral vision, crowding, redundancy masking

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Foveal input can be ignored in ensemble emotion perception

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Résumé

Individuals can extract the summary emotional information from groups of multiple faces, an ability called ensemble emotion perception. However, not every member in the crowd is weighted equally. For example, it was shown that members presented around fixation weighed more in ensemble emotion perception, revealing a 'foveal input bias'. To test directly whether the foveal input bias is ubiquitous, we measured participants' capacity to perceive the average emotion of a group while asked to voluntarily ignore the fixated face (foveal input). In two experiments, participants either judged the average emotion of a face set (Experiment 1) or were asked to ignore the foveal input and judge the average emotion of only the surrounding faces ('flankers', Experiment 2). The stimulus consisted of nine faces - a central face at fixation surrounded by 8 flankers. Presentation time was 100ms. The emotion of the central face was either varied (happy and angry randomly interleaved) or kept constant (a single emotion: happy, angry, neutral, scrambled, or absent) throughout a block of trials. In separate blocks, the emotion of the flankers was either identical in a given trial (eg, all flankers 20% happy) or mixed (a mix of happy, neutral, and / or angry). We found a strong foveal input bias with varied but not with constant foveal faces. When the flankers were mixed, the foveal input bias in the varied condition was strongly reduced. Furthermore, there was a more substantial foveal input bias with angry than happy faces. In Experiment 2, performance was similar in all conditions and there was no foveal input bias, showing that participants could ignore the foveal face. Our results demonstrate that observers can ignore the foveal input, suggesting that foveal input bias is not ubiquitous but can be overcome by voluntary control.

Mots-Clés: ensemble emotion perception, foveal input bias, voluntary control

*Intervenant

A generative model for visual confidence judgments

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Résumé

Visual confidence is an evaluation of the validity of our visual decisions. We present here a complete generative model that describes how confidence judgments result from some confidence evidence. The model that generates confidence evidence has two main parameters that affect the sensitivity of confidence, namely confidence noise and confidence boost, in addition to parameters that capture metacognitive biases. Confidence noise reduces the sensitivity to the confidence evidence, and confidence boost accounts for information used for confidence judgment which was not used for the perceptual decision. The opposite effect of these two parameters creates a problem of confidence parameters indeterminacy, where the confidence in a perceptual decision is the same in spite of differences in confidence noise and confidence boost. We discuss experimental conditions that let us estimate both of these parameters, thus giving us the opportunity to decide whether confidence is generated using the same primary information that was used for the perceptual decision or some secondary information. We also describe a novel measure of confidence efficiency relative to the ideal confidence observer, as well as the estimate of one type of confidence bias. Finally, we apply the model to the confidence forced-choice paradigm and the more classical confidence rating paradigm.

Mots-Clés: visual confidence, metaperception, modelling, uncertainty

*Intervenant

Quest+ : Reliability of PSE estimation, but sensitivity overestimation

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Résumé

One of the most precise - and time-consuming - methods to establish psychometric functions and estimate threshold and slope parameters is the constant stimuli procedure. Adaptive procedures (e.g., non parametric staircases, Bayesian procedures...) enable reliable threshold estimation while reducing the number of trials. One recent substantial improvement of Bayesian procedures is to also estimate the slope (related to discrimination sensitiviy). The Bayesian QUEST+ procedure (Watson, 2017), a generalization and extension of Watson and Pelli's (1983) QUEST procedure, includes this refinement. Our goal was to assess the efficacy of this procedure empirically, in four yes-no designs evaluating size (Expt. 1A and 1B), orientation (Expt. 2), or time perception (Expt. 3). We compared points of subjective equivalence (PSEs) and discrimination sensitivity obtained in 91 adult participants in total with the Quest+, constant stimuli and simple up-down staircase procedures. While PSEs did not differ between procedures, sensitivity estimates obtained with the QUEST+ procedure were overestimated (i.e., just noticeable differences were underestimated). Thus, this study empirically confirmed that the QUEST+ procedure can be considered as a method of choice to accelerate PSE estimation, while keeping in mind that sensitivity estimation should be handled with caution.

Mots-Clés: psychophysics, quest+, size perception, time perception, orientation perception, PSE, JND

*Intervenant

Spatial dynamics of perceptual rhythms

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Résumé

Although visual perception appears stable, our ability to detect stimuli rises and falls rhythmically over time. Studies have shown that performance is modulated periodically by the phase of low-frequency brain oscillations (theta: 4-7 Hz, alpha: 8-12 Hz), with optimal phases leading to increased performance, while opposite, non-optimal phases lead to decreased performance. However, less than 20% of the trial-by-trial variability in behavioral performance is accounted for by phase angle differences. We propose that not only the temporal but also the spatial dimension of brain oscillations can explain behavioral variability. Specifically, using psychophysics (Sokoliuk and VanRullen, 2016; Fakche and Dugué, in prep) we tested whether brain oscillations travel across the retinotopic space to modulate perceptual performance periodically. Participants were asked to detect near-threshold targets (black dots; contrast titration to reach 50% detection) while a checkerboard annulus was presented around central fixation. Every 100 ms, the checkerboard's pattern reversed from black to white (or white to black) to tag brain activity at 10 Hz. EEG recordings showed successful tagging of brain activity at 10 Hz (and power analyses showed a 20 Hz harmonic). Targets were presented at random delays and at three different eccentricities between central fixation and the annulus (2.16∘, 2.45∘, 2.81∘ from fixation; dot's sizes and positions adjusted to cortical magnification). Performance was calculated separately for each target eccentricity and binned as a function of the delay at which the target appeared relative to the 10Hz-flicker. A one-cycle sine wave at 10 Hz or 20 Hz, or a complex sine wave, was then fitted to the behavioral data. Preliminary results show that performance was modulated periodically at each target position at the first harmonic (20 Hz). Additionally, the optimal phase, i.e., the phase leading to the highest detection performance, of the 20Hz-behavioral pattern (and not the 10Hz-pattern) shifted as a function of the distance from the annulus (toward the center) suggesting a potential functional dissociation between the induced frequency and its first harmonic. Together, our results suggest that brain oscillations can travel across the retinotopic space to modulate performance periodically.

Mots-Clés: Oscillatory Traveling Waves, alpha oscillations, perception, behavioral rhythms, psychophysics, EEG

*Intervenant

Single-units and local field potentials in the medial pulvinar show multisensory integration

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Résumé

The pulvinar is the largest thalamic nucleus in primate. It is anatomically and functionally heterogeneous and can be subdivided in multiple subdivisions, one of which is the medial pulvinar. The medial pulvinar is densely connected with the cortex, specifically with the primary visual, auditory and somatosensory cortices, as well as with the multisensory parietal, temporal and prefrontal associative cortices and the premotor cortex. Based on its anatomical connectivity, the medial pulvinar is proposed to play an important role in the integration of information from multiple sensory modalities. However, evidences in this respect are sparse. In the present work, two macaque monkeys were trained to perform a fixation task while single-units and local field potentials were recorded in the medial pulvinar. Monkeys had to maintain fixation on a central point during the presentation of a visual stimulus, an auditory stimulus or both together. Single-units (n = 213) revealed the presence of visual, auditory and audiovisual neurons. Audiovisual neurons accounted for almost half of the neurons. Multisensory integration was mainly sub-additive and suppressive. Local field potentials (n = 163) were analyzed in the time domain and in four functional frequency bands. In the time domain, we obtained evoked potentials for every stimulus conditions. This was true at the population level and for 96% of the sessions. The frequency analysis showed a distinction between low and high frequencies. The two low frequency bands (4.5-8.5 Hz and 8.5-20 Hz) were strongly multisensory (respectively 90% and 96% of the sessions) and very similar (67% of sessions classified identically). On the contrary, high frequencies, divided into 35-60 Hz and 60-120 Hz, were distributed between unisensory and multisensory responses. In conclusion, our study shows that the medial pulvinar is indeed a multisensory hub, multiplexing visual, auditory, and audiovisual information, which are characterized by different frequency rhythms.

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Mots-Clés: medial pulvinar, single, units, local field potentials, multisensory, audiovisual

SPATIAL DIMENSION OF RESONANCE PHENOMENA IN MOUSE PRIMARY VISUAL CORTEX

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Résumé

Sensory cortices stimulated by rhythmic sounds, lights, or touch will respond in a rhythmic
manner with frequencies identical or harmonically related to the stimulus. Although such responses are preserved across species, reported temporal frequency tuning curves in human and mouse primary visual cortex (V1) do differ. In human EEG recordings (macroscale), V1 shows temporal frequency tuning with characteristic resonance peaks at _˜10, _˜20, and _˜40 Hz, whereas only a single peak below 8 Hz is present in temporal tuning curves derived from multiunit and spiking activity (microscale) in mouse V1. By imaging transgenic
animals expressing high temporal resolution glutamate fluorescent reporter iGluSnFR, we sought to characterize temporal frequency tuning in mouse V1 and its spatial distribution at a mesoscale neuronal activity. For this, we used a wide range of sine-wave modulated temporal frequencies (2-72 Hz). We found that mouse V1 responded to flickering light as high
as 52 Hz – a limit dictated by the kinetics of iGluSnFR fluorescent reporter. Most importantly,
temporal tuning curves showed resonance peaks at 8 Hz, 15 Hz, and 33 Hz, indicating that resonance phenomena in mouse V1 highly resemble that of humans. We also observed a variation in temporal frequency preference across V1: (1) lower flicker frequencies activated larger portions of V1 as compared to higher flicker frequencies; (2) all temporal frequencies elicited response at stimulus corresponding retinotopic location of V1, with additional spatial peaks present at certain temporal frequencies. The latter finding suggests, contrary to previous reports, the existence of at least some clustering by temporal frequency preference in mouse V1. In conclusion, temporal frequency tuning with prominent resonance peaks in humans and in mice exhibit a high degree of similarity.

Mots-Clés: Oscillations, Steady state visual evoked potentials, Mouse, widefield imaging

*Intervenant

Phase-amplitude tradeoffs of spontaneous alpha oscillations predict cortical excitability and visual perception

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Résumé

Numerous studies provide evidence in favor of a role of spontaneous alpha oscillations (_˜10 Hz) in visual perception. Both alpha phase and amplitude (studied independently) modulate cortical excitability and subsequent visual performance. The interaction between alpha phase and amplitude remains, however, ill-defined. We investigated the causal role of phase-amplitude tradeoffs of spontaneous alpha oscillations on cortical excitability and visual perception. We tested specific predictions of the Pulsed Inhibition theory, which states that alpha oscillations are associated with periodic functional inhibition (Klimesch et al., 2007; Jensen & Mazaheri, 2010). Specifically, this theory predicts that high alpha amplitude induces an alternation between states of cortical inhibition, at non-optimal phases, and states of cortical excitation, at opposite, optimal phases, leading to periodic visual performance. Inversely, low alpha amplitude is less susceptible to this phasic effect leading to overall high performance. To evaluate these predictions in humans, single pulses of transcranial magnetic stimulation (TMS) were applied over the visual cortex (V1/V2) at perceptual threshold (50% detection) to elicit phosphene (illusory flash) perception, with simultaneous electroencephalography recordings (reanalysis of data from Dugué et al., 2011). We showed that the phase of spontaneous alpha oscillations predicts phosphene perception, with a non-optimal phase between -π/2 and -π/4. Critically, this phase effect is larger when the amplitude of spontaneous alpha oscillations is high (simulations and Event-Related Potential, ERP, analyses confirm that the results are not a mere analysis confound in which the quality of the phase estimation covaries with the amplitude). In addition, when the phosphene was perceived at the non-optimal phase, we observed an increase in post-pulse ERP. Our study is in line with the Pulsed Inhibition theory, which predicts that the interaction between alpha phase and amplitude plays a functional role on visual performance. Spontaneous alpha oscillations induce periodic states of cortical inhibition, leading to periodic visual performance, specifically when the amplitude of alpha is high.

*Intervenant

Mots-Clés: Alpha oscillations, TMS, EEG, phase, amplitude, phosphene perception, cortical excitability

Towards an optimal comparison of cortical (face) networks in macaques and humans with fMRI frequency-tagging

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Résumé

Nonhuman primate (NHP) neuroimaging can provide essential insights into the neural basis of human cognitive functions. While functional fMRI localizers can play an essential role in reaching this objective (Russ et al., 2021), they often differ substantially across species in terms of paradigms, measured signals and data analysis, making the comparison challenging. Here we introduce a functional frequency-tagging face localizer for NHP imaging, successfully developed in humans and outperforming standard "face localizers" in terms of validity, sensitivity, objectivity and reliability (Gao et al., 2018). Recordings were performed at 3T in two awake macaques with a dedicated 8-channel coil positioned above the animal's head. Within a rapid 6 Hz stream of natural images of non-face objects, 7 variable face stimuli were presented in bursts, alternating with nonface objects, every 9s during a 243s run. Either human or monkey faces were presented in different runs. We also included control conditions with phase-scrambled versions of all images. Only runs with fixation maintained above 85% of the time were considered for analysis. As in humans, runs were analyzed in the frequency domain where face selective responses were objectively identified and quantified, without hemodynamic response modeling, at the peak of the 0.111 Hz (1/9s) face-stimulation frequency. In the two monkeys, focal activations with high signal-to-noise ratio were found in regions previously described as face-selective, mainly in the STS ("Posterior Lateral" (PL), "Middle Lateral" (ML), "Middle Fundus" (MF) clusters; also "Anterior Lateral" (AL), "Anterior Fundus" (AF) clusters). These face-selective regions were observed using both human and monkey faces. Robust activations were also found in the prefrontal cortex of one monkey with a very high signal-to-noise ratio in the "Prefrontal Ventro-Lateral" (PVL) and "Prefrontal Orbital" (PO) clusters. Face selective responses were highly reliable and our analyses of the phase-scrambled control conditions demonstrated that they excluded all contributions from low-level visual cues contained in the amplitude spectrum of the images. Our results suggest that fMRI frequency-tagging provides a valid approach to directly compare human and monkey neural face recognition systems with the same experiments in both species.

Mots-Clés: fMRI, face localizer, frequency tagging, nonhuman primate imaging

*Intervenant

Modulation of orientation selectivity by orientation precision in V1

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Résumé

In our everyday visual environnement, oriented contours are grouped into distributions of orientations which are processed by our brain. Depending on the bandwidth of these orientation distributions, the visual cortex has access to a more or less precise orientation information to build the neural representations of our visual world. Despite this fundamental principle of vision, most of our understanding of orientation processing still comes from studies using single-orientation stimuli, i.e. with the highest possible precision, which creates a major gap in our understanding of the visual cortex's behaviour in its natural environnement. Here, we have sought to understand whether a neural correlate of orientation precision existed in the primary visual cortex (V1). Using naturalistic stimuli and machine learning decoding, we found that the population code of V1 was highly robust to decode a wide range of orientation distributions. This decoder further demonstrated that V1 co-encodes orientation and its precision, which enhances population decoding performances compared to sole orientation decoding. Temporally distinct dynamics mediated this process, supporting a description of precision-weighted message passing in the visual cortex, in line with predictive processing theories.

Mots-Clés: V1, orientation, selectivity, precision, decoding

*Intervenant

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Posters

Serial Dependence Compared on Responses Given With and Without Visual Feedback

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Résumé

Despite the highly variable input that the human visual system receives from the external world, perception is stable and smooth. The continuity field may be one of the psychological mechanisms behind this perceptual stability by integrating the sensory evidence spatiotemporally. The continuity field can be quantified by serial dependence (SD), an attractive effect of recent stimulus history on current perceptual responses. SD is often measured by having participants match a visual response cue to a visual attribute such as orientation. The current study sought to determine the role of the response cue in the strength of the SD effect. We compared SD when responses in an orientation matching task were given in the presence and absence of visual feedback. In the visual feedback condition, responses were given manually by a lever whose orientation was mirrored via visual feedback on the screen. In the no-visual feedback condition, responses were also given by adjusting the lever, but there was no visual feedback on the screen. Results show that the strength of serial dependence is significantly smaller when the responses were given without visual feedback compared to the visual feedback condition. This suggests that the response cue acts as a recent stimulus and may contribute to reported SD effects.

Mots-Clés: continuity field, visual perception, serial dependence, visual feedback

*Intervenant

Appearance at threshold: How Snellen symbols look like

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Résumé

Visual acuity (VA) is commonly evaluated by identification of letter optotypes. While such tasks can reveal the limits of the visual system, particularly useful to assess visual health, information about the stimulus' appearance, i.e. details of what the observer sees, is lost. Indeed, identification tasks usually constrain the observer to categorical responses, allowing them to report the item closest in appearance to an available category while leaving unclear what exactly was perceived. Appearance could however carry useful information about how the visual system constructs the percept, and what fails in case of visual dysfunction. In this study, ten of the classical Snellen's symbols, a set of high contrast symbols comprised of regular elements where each stroke width is a fifth of the optotype's full height, were used. All observers had normal or corrected-to-normal VA. After VA assessment using the Freiburg visual acuity test, Snellen symbols were presented in the fovea for unlimited viewing time. Symbol size was set to the participant's VA threshold as well as below and above threshold (1.0, 0.5 and 1.5 threshold size, respectively). The participants' task was to replicate the appearance of the target on a 5x5 square pixel-grid interface where each square could be turned on or off by mouse clicks. Preliminary results showed that at threshold size, the target's outer features were mainly preserved. However, internal features (e.g. an inside bar) were commonly absent or deformed. Location deviations, i.e. the placement of each feature, as well as fusion of the targets' elements (e.g., the connection of three bars in a target) were observed for both threshold and above threshold sizes. Below threshold, the target's entire structure was lost: participants mainly responded with a single square of the grid. In summary, results showed details of how Snellen symbols below, at, or above VA threshold appeared, revealing how visual perception operating at its limits is more intricate than is captured in common identification tasks. Thus, capturing appearance might offer a more detailed view into the building blocks of visual perception, and their relationship to the cellular components giving rise to vision.

Mots-Clés: optotypes, visual acuity, appearance, pixel, grid

*Intervenant

Ultra-fast categorization of image containing animals in vivo and in computo

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Résumé

Animals are able to categorize images from broad categories in a very efficient and rapid fashion. Humans, for instance, can detect the presence of an animal in an image in as little as 120 ms. In the last decade, the field of artificial intelligence has experienced one remarkable breakthrough. In a relatively short period of time, neuroscientifically-inspired deep-learning algorithms designed to perform a visual recognition task literally bloomed. Artificial networks now achieve human-like performance levels, but are usually trained on less ecological tasks, for instance the 1000 categories of the ImageNet challenge. Here, we retrained the VGG Convolutional Neural Network adapted to ImageNet on two ecological tasks : detecting animals or artefacts in the image. We show that retraining the network achieves human-like performance level and we could also reproduce the accuracy of the detection on an image-by-image basis. This showed in particular that these two tasks perform better if combined as animals (e.g. lions) tend to be less present in photographs containing artefacts (e.g. buildings). Then, we reproduce some behavioural observations from humans such as the robustness to rotations (e.g. upside-down image). Finally, we could test the number of layers of the CNN which are necessary to reach such a performance, showing that a good accuracy for ultra-fast categorization could be reached with a few layers. We expect to apply this network to perform model-based experiments in humans.

Mots-Clés: deep learning, computational neurosciences, behavior, animals categorization

*Intervenant

Repeated psychophysics measurements in laboratory and online studies

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Résumé

Computer-generated images (CGI) are widely used in everyday life and it is useful to compare online thresholds measurement to thresholds measured in the laboratory. The algorithms of photorealistic images induce some visual noise, which varies inversely with the number of iterations. A major issue is to detect the threshold at which a quality improvement is not detectable by a human observer. For CGI perception, online experiments have higher ecological validity than laboratory studies. The objective of this study was to define a pattern of thresholds and generalize the findings of a previous study across different scenes with various features.

Observers participated in an experiment separated in 5 sessions with 5 indoor and outdoor scenes. We measured perceptual thresholds of the perceived quality of CGI in an online experiment (N=49), and in a laboratory-controlled study (N=11).

For the online condition, the Kruskal-Wallis test showed significantly different thresholds between the five scenes (p=3.49e-07). The same significant difference was observed in the laboratory condition (p=5.42e-05). For the laboratory data, we also recorded the eye movements and constructed fixation maps to quantify the visual exploration of the scenes. The individual fixation pattern is similar to the averaged fixation map. The most often fixated areas were the areas with bright colors and without texture. Our results may contribute to improve the rendering methods of CGI.

Mots-Clés: Online behavioral studies, QUEST+, repeated measurements, computer, generated images

*Intervenant

Etude de la déficience du contrôle synergique comportemental entre les mouvement posturaux, visuel et la charge mentale subjective pour une population parkinsonienne.

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Résumé

La maladie de Parkinson (MP) est une maladie neurodégénérative qui entraîne des déficiences posturales, visuelles et mentales. Nous avons étudié ces déficiences liées à la MP dans le contrôle synergique comportementale entre les mouvements oculaires, les mouvements posturaux et la charge mentale subjective. Dix-neuf patients atteints de la MP et 20 témoins ont exploré de grandes scènes de maison en réalité virtuelle. Ils ont effectué, debout, une tâche de recherche visuelle (détection d'objets cibles) et une tâche d'observation libre avec cinq essais par tâche. Les mouvements du corps étaient enregistrés avec trois capteurs Pohlemus (bas du dos, haut du dos et tête) et les mouvements des yeux avec un eye-tracker SMI. Entre chaque tâche les participants complétaient un questionnaire d'évaluation de la charge mentale ressentie (NASA-TLX). L'analyse des résultats entre tâche de recherche vs exploration a montré une moindre réduction de l'amplitude et une moindre augmentation de la vélocité des mouvements oculaires et posturaux chez les patients atteints de la MP que chez les témoins. De plus, le score global NASA-TLX était un covariateur significatif dans les deux analyses et était significativement plus élevée chez les patients atteints de la MP que chez les témoins. Les patients atteints de la maladie de Parkinson étaient moins capables que les témoins d'ajuster leur contrôle postural pour effectuer la tâche de recherche, ce qui indique clairement une altération du contrôle synergique comportemental. Dans l'ensemble, notre étude a montré la présence de déficience synergique chez les MP au niveau de l'intégration vision-posture, associée à une charge mentale subjective plus élevée. Cette conjecture pourrait expliquer une performance moindre dans la tâche de recherche des MP vs témoins.

Mots-Clés: Maladie de Parkinson, tâches visuo, posturales, charge mentale subjective, déficience synergique comportementale

*Intervenant

A reverse hierarchy of visual metacognition

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Résumé

Reverse hierarchy theory proposes that explicit vision proceeds in a reverse hierarchy, where high-level representations are more quickly and easily accessible than low-level representations. Visual metacognition, our ability to feel more or less confident that we have made a correct perceptual decision, requires explicit scrutiny of our perceptual representations. We tested whether visual metacognition also follows a reverse hierarchy, where low-level perceptual decisions should be less efficiently scrutinised by metacognitive processes than high-level perceptual decisions.

In separate blocks, participants made either high- or low-level perceptual decisions about the same stimuli. In the high-level task, participants judged the direction of gaze of an avatar face (with gaze directed to the left or right of them). In the low-level task, participants discriminated the relative contrast of the two irises (with either the left or right iris presented with higher contrast from the sclera). Confidence was measured with a forced-choice procedure where participants discriminate which of two consecutive perceptual decisions was more likely to be correct. Participants' perceptual sensitivity was equal across the high- and low-level tasks, but even so, we found that participants were indeed better at discriminating their correct from incorrect high-level decisions compared to low-level decisions. However, in an effort to replicate this first experiment with a larger sample of participants, we ran a second experiment online and found the reverse effect on metacognitive efficiency (though perceptual sensitivity did not substantially differ).

We examined what caused this difference in a third experiment. We found the difference in the duration from stimulus offset to perceptual response cue (a difference of 700 ms from Experiment 1 to Experiment 2) was sufficient to explain the changes in metacognitive efficiency across experiments. The metacognitive evaluation of the high-level representation of gaze direction benefited from additional time, but for the low-level representation of relative contrast, metacognitive efficiency suffered. This highlights the role of post-stimulus and post-decisional processing for metacognitive evaluation, and suggests an important difference in our ability to maintain perceptual representations for evaluating decision confidence across the visual hierarchy.

Mots-Clés: Visual Metacognition, Confidence, Reverse hierarchy

*Intervenant

Investigating the time-course of visuo-motor and linguistic processes during reading: A combined eye-tracking and EEG study.

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Résumé

Eye movements during reading have been studied for over a century. Although many models have been proposed, the great majority relies on the assumption that readers' saccades are controlled in a top-down manner by the needs of ongoing word-identification processes. However, both the similarity in readers' eye-movement behavior in the presence and absence of linguistic content and the recent finding that reading-like behavior can be generated simply using illiterate visuo-motor principles in the superior colliculus argue against this assumption. These findings also suggest that eye fixations during reading (on average 225 ms) may not be long enough to enable predominant top-down control. Here we tested this assumption by looking into readers' brain to determine the respective time course of visuo-motor and linguistic processes. The co-registration of eye movements and cerebral activity using electroencephalography (EEG) has developed in recent years, allowing to highlight relationships between brain activity and eye-movement control. We used this approach to assess the time course of brain activity after the onset of eye fixations (Fixation-Related Potentials or FRPs) in reading and pseudo-reading tasks. Twenty university students, all French-native speakers, read 316 sentences from the French Sentence Corpus, as well as 316 pseudo-sentences (the same sentences but with all letters replaced by the letter "z"), while their eye movements and EEG activity were recorded. FRPs were analyzed using Unfold, a recently developed toolbox for regression-based EEG analyses. Our preliminary results replicated previous findings, showing EEG potentials typical of FRPs, notably the posterior P1, N1, P2 and N400 potentials. Here, we will present how FRPs were affected by readers' oculomotor behavior and the linguistic content of the material being read, as well as the visual and linguistic properties of the encountered words.

Mots-Clés: Eye, movement, EEG, Reading, Fixation, Related Potentials

*Intervenant

Learning effects in peripheral vision

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Résumé

While there is a large body of evidence for perceptual learning in central vision, the possibility of perceptual learning in the discrimination of basic features in peripheral vision appears more equivocal. We conducted three experiments evaluating perception of the size (Expt. 1), feature orientation (Expt. 2) and temporality (Expt. 3) of simple stimuli visually presented in the periphery. After a familiarization session, points of subjective equivalence (PSEs) or simultaneity (PSSs) as well as discrimination sensitivity (JNDs) were assessed in three successive blocks of trials. Learning effects were visible in each experiment, in that JNDs decreased over the blocks i.e., sensitivity increased (and PSEs remained stable). In Experiment 3, because the bias in temporal order judgements disappeared (PSS_˜0), and because other studies failed to show any learning effect, we rather attribute the performance improvement to non-perceptual processes (e.g., familiarity with the procedure or stimuli). We are nevertheless confident that a true perceptual learning occurred in the experiments on object size and feature orientation (Expts. 1 and 2). Our findings add further evidence that such learning in peripheral vision can occur on a short time scale.

Mots-Clés: psychophysics, size perception, temporality perception, orientation perception, learning effect, peripheral vision

*Intervenant

From event-based computations to a bio-plausible Spiking Neural Network for digit recognition

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Résumé

We propose a neuromimetic online classifier for always-on, event-driven digit recognition. To achieve this, we extend an existing event-based algorithm (Lagorce et al. 2017) which introduced novel spatio-temporal features: time surfaces. Built from asynchronous events acquired by a neuromorphic camera, these time surfaces allow to code the local dynamics of a visual scene and to create an efficient hierarchical event-based pattern recognition architecture.

Its formalism was previously adapted in the computational neuroscience domain by showing it may be implemented using a Spiking Neural Network (SNN) of leaky integrate-and-fire models and Hebbian learning (Grimaldi et al. 2021).

Here, we add an online classification layer using a multinomial logistic regression which is compatible with a neural implementation (Berens et al. 2012). A decision can be taken for each event as input of the classification layer by taking the argmax of the probability values associated to each class. We extend the parallel with computational neuroscience by demonstrating that it is also equivalent to a layer of spiking neurons with a Hebbian-like learning mechanism. Our method obtains state-of-the-art performances on the N-MNIST dataset (Orchard et al. 2015) and we show that it is robust to both spatial and temporal jitter.

As a summary, we were able to develop a neuromimetic SNN model for online digit classification. We aim at pursuing the study of this architecture for natural scenes and hope to offer insights on the efficiency of neural computations, and in particular how mechanisms of decision-making may be formed.

Mots-Clés: pattern recognition, event, based computations, spiking neural networks, computational neuroscience, online classification

*Intervenant

Adaptation of internally-guided saccades in young children

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Résumé

Saccadic adaptation is fundamental to maintain accurate saccadic eye movements for optimal perception and interaction with the environment throughout life. We previously showed that adaptation mechanisms for reactive (externally-triggered) saccades (RS) are in place early during development despite saccade hypometria that characterizes young children (Lemoine-Lardennois *et al.*, 2016). Here we asked whether these adaptation mechanisms are also in place for voluntary (internally-guided) saccades (VS). Indeed, adaptation mechanisms are partially separate for RS and VS in adults (Pélisson *et al.*, 2010), and brain regions involved in VS adaptation also show late maturation (e.g., Lenroot & Gieed, 2006). We thus hypothesized that adaptation mechanisms for VS mature later than those for RS.
We modified our previous protocol to elicit VS, without verbal instruction, in toddlers (age $<$ 4 years) and adults (18-30 years), using an overlap procedure. To prompt a decision, two identical peripheral stimuli appeared simultaneously at 10∘ eccentricity from the starting point (the distance between targets varied between 45∘ and 180∘ over the 140 trials). During the saccade toward the selected target, it systematically stepped in the direction opposite to the saccade to induce an adaptive decrease in saccade amplitude.

First results showed that toddlers (n=39; age: 20-39 months) were able to select and direct their gaze toward one target without any explicit task instruction. Analysis of baseline performance revealed longer saccade latency (M = 381ms, SD = 87ms) and lower accuracy (M = 9.2∘, SD = 0.6∘) in toddlers compared to adults (n=37; M = 221ms, SD = 36ms; M = 9.5∘, SD = 0.6∘). Crucially, both adult and toddler groups exhibited an adaptive decrease in saccade amplitude, with similar amount of adaptation.
Overall, our results suggest that, similar to RS, the neural mechanisms underlying VS adaptation are in place early during development.

Mots-Clés: eye movements, sensori, motor adaptation, child development, saccade control, visual exploration

*Intervenant

Characterisation of anticipatory smooth eye movements in complex environments

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Résumé

Saccades and smooth pursuit eye movements are essential to visual perception and to guide many of our actions. The predictability of the environment allows not only to promptly respond to visual stimuli but also to drive anticipatory eye-movements towards the expected target location or motion direction. In two-directions motion tasks where the uncertainty about target motion direction was experimentally manipulated, several previous studies have documented anticipatory smooth eye movements (ASEM), starting ahead of target motion onset and directed in the most likely direction. Under these conditions, we previously showed that mean anticipatory eye-velocity is a linear function of direction probability. However, it is still an open question how generalizable such tuning of anticipatory eye movements is with regard to more complex probabilistic manipulations of the environment and to different motion properties. To address this question, we recorded (Eyelink1000) pursuit eye movements in healthy human volunteers while performing two novel motion tracking experiments. First, we show that ASEM can still be evoked in more complex environments, such as when the target can move in four different directions, with different probabilities for each direction. Our results indicate that anticipatory eye velocity towards the most probable direction increases linearly with its actual probability, similarly to the two-directions condition. In a second experiment, we manipulated the velocity of the target, including accelerating and decelerating conditions, while keeping the direction fixed. Results demonstrate that ASEM scales with target velocity and it is modulated by target acceleration. However, the integration of target acceleration to adjust ASEM seems to be suboptimal: the results indicate that the amount of anticipation depends on the initial velocity of the target rather than on its detailed dynamics. Overall, our results extend the previous results about anticipatory eye movements to more complex environmental contingencies.

Mots-Clés: ASEM, smooth pursuit, acceleration, probability

*Intervenant

Action-outcome consistency modulates causality judgments but not temporal judgments

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Résumé

Causal perception depends partly on the perceived temporal order of events: causes must *precede* their effects. However, humans do not have a sense dedicated to time. What information does the brain use to estimate the timing of actions and sensations and thus to determine causality? A recent study suggests that the perceived temporal order of action and sensations is modulated by *which* sensory outcome an individual is expecting to generate with his/her action expected outcomes presented *before* actions were more often erroneously reported to have occurred after action execution compared to unexpected outcomes. However, it remains unclear what process underlying perceptual judgments is modulated by outcome expectations. Outcome expectation may directly influence the perceived temporal order of action and outcome, leading to an *illusory* reversal of the temporal order, or it might induce a "*causal bias*", participants might be more inclined to report a temporal order that matches their causal assumptions.
The present study aimed at tackling this issue. We designed a task that allowed us to investigate whether outcome expectation induces a change in temporal perception or temporal decision, and to explore the common mechanisms between temporal and causal judgments, in an active and passive – tactile – condition. In a nutshell, we observed that outcome expectation influenced causal but not time perception. These results are of importance since they contribute to the understanding of the relation between time perception and causal inference and shed further lights on the mechanisms underlying these two processes.

Mots-Clés: Sense of agency, causal judgments, simultaneity perception, action, outcome consistency

*Intervenant

Investigating the role of motor preparation in perceptual confidence

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Résumé

Established theoretical models of metacognition argue that perceptual confidence mainly results from the strength or quality of sensory evidence that also leads to a perceptual decision. However, alternative views and empirical dissociations between perceptual decisions and confidence judgments suggest that perceptual confidence is modulated by the entire perception-action cycle. In particular, it has been suggested that the motor system may contribute to the underlying computations of perceptual confidence. In two experiments, we investigated the influence of motor preparation on confidence judgments. Participants were asked to report, by executing a left or a right action, the orientation of a Gabor patch presented at discrimination threshold. A motor cue presented before the onset of the Gabor induced the participants to prepare the same or opposite-side action that they subsequently used to report the orientation of the Gabor. For instance, in ipsilateral (contralateral) trials the motor cue induced the participants to prepare a left action and they subsequently used a left (right) action to report the orientation of the target stimulus. Interestingly, we observed that perceptual confidence, but not accuracy, was higher when participants prepared the contralateral action (e.g., left action) compared to when they prepared and executed the ipsilateral action. These findings suggest that action preparatory processes impact perceptual confidence over and above performance. This observation is consistent with second-order models of metacognition that argue that perceptual confidence emerges from the integration of distinct sources of information including motor and sensory inputs.

Mots-Clés: perception, confidence, motor processes, performance monitoring, open data

*Intervenant

Did it move? EEG evidence of post-saccadic prediction error

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Résumé

The benefits of eye movements for vision are undeniable; however, they also pose significant problems like the phenomenon of saccadic suppression of displacement (Bridgeman, Hendry & Stark, 1975; Deubel, Schneider & Bridgeman, 1996). Participants systematically fail to report stimulus motion that occurs during (or shortly after) a saccade. Consequently, after a saccade, there can be a post-saccadic error between the predicted and actual retinal position of the target object. Although target displacement often goes unnoticed by the observer, it is registered by the oculomotor system since post-saccadic errors lead to saccadic adaptation (McLaughlin, 1967; Collins & Wallman, 2012). The goal of the present study was to find a brain signature of the post-saccadic targeting error in the absence of conscious perception of target displacement. We recorded the brain activity of nineteen volunteers using an Electroencephalogram (EEG). Participants were asked to report whether a visual target moved or not while they were executing a saccade towards it. Using multivariate pattern analysis, we investigated whether we could dissociate from EEG activity the trials in which the target moved and the trials where the target did not move. This classification analysis was performed separately for "yes, the target moved" and "no, it did not move" responses. Interestingly, we decoded above chance brain activity associated with target displacement and no displacement trials for both types of responses. Decoding accuracy was significant as early as 50 ms after the displacement (cluster-based permutation tests for "no" responses $p < 0.001$; cluster-based permutation tests for "yes" responses $p = 0.05$). The most critical electrodes to displacement classification were occipital and parieto-occipital electrodes (Permutation tests for "no" responses: $p< 0.05$; 65-85 ms = [O1, Oz, O2, PO7]; Permutation tests for "yes" responses: $p< 0.05$; 65-85 ms = [Oz, O2, PO3, POz]). This suggests that post-saccadic prediction error is represented in cortical visual areas during early image processing stages.

Mots-Clés: eye movements, saccadic suppression, EEG, multivariate pattern analysis

*Intervenant

Associations entre croyances inflexibles et stabilité perceptive : Intérêt du modèle de l'Inférence Circulaire

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Résumé

Introduction

Selon la théorie Bayésienne de la perception, nos représentations mentales (désignées ici par le terme " croyances "), seraient issues d'un système d'inférence probabiliste. Ainsi, une des hypothèses du modèle de l'Inférence Circulaire (IC), stipule que des perceptions et des croyances aberrantes pourraient émerger d'une redondance de l'information traitée le long de la hiérarchie corticale (Jardri & Denève, 2013). Des travaux récents ont par ailleurs montré qu'une légère circularité dans la propagation des informations descendantes était nécessaire à la mise en place d'un système perceptif stable (Leptourgos et al., 2017). Sur la base de ces résultats, nous pensons que la réverbération neuronale d'information pourrait être présente à des degrés divers en population générale, le long d'un continuum allant du normal au pathologique. Ces réverbérations seraient à l'origine de prédictions inexactes et potentiellement de fausses croyances et/ou de fausses perceptions.

Méthode & Résultats attendus

En s'appuyant sur une tâche de perception probabiliste, nous avons tenté de capturer des variations de la stabilité perceptive individuelle lors de la présentation d'un stimulus bistable (i.e. le Cube de Necker) en population non-clinique. Nous formulons les hypothèses suivantes :

(1) de telles variations seraient associées à la force de l'adhésion à certaines croyances rigides

*Intervenant

(notamment les croyances complotistes, particulièrement ravivées dans le contexte récent de la pandémie de COVID-19) et la prédisposition aux expériences perceptuelles anormales (susceptibilité aux hallucinations) mesurées à l'aide d'échelles auto-rapportées.

(2) ces associations seraient modulées par le niveau de stress des participants. Nous nous intéressons en particulier au stress engendré par les évènements socio-politiques majeurs actuels tels que le contexte pandémique mondial, les élections présidentielles aux États-Unis ou la mise en place du Brexit au Royaume-Uni.

Ces populations ont été ciblées via une procédure implémentée en ligne.

Conclusion
Cette étude devrait conforter l'apport du modèle computationnel de l'IC dans la compréhension des systèmes inférentiels à l'origine de la génération et du maintien des croyances rigides et expériences perceptives aberrantes en population générale.

Mots-Clés: perception, bistabilité, inférence, croyances

Neural bases of peer presence effect on pro- and anti-saccades

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Résumé

"Social facilitation or impairment" (SFI) refers to the enhancement or impairment of performance engendered by the mere presence of others. It has been shown for a diversity of behaviors. In a recent study (Tricoche et al. 2020), we showed that SFI also affects eye movements. Here, we conducted an fMRI study to unveil the neural bases of this social influence. Adult volunteers (19-27 years, n=29, 20 females) performed pro- and anti-saccades, either alone or in a presence of a familiar peer. Pro- and anti-saccades were presented either successively, in separate blocks (easy blocks), or pseudorandomly mixed within the same block (difficult blocks). Each participant performed two sessions, about a month apart. For one session, a familiar peer was present (Observation condition), and observed the participant performing the task via the live video streams of three cameras placed inside the scanner. For the other session, no peer was present (Alone condition) and the participant performed the task unobserved. The order of the two sessions was counterbalanced across subjects. We measured reaction times and percent errors to assess the behavioral effect of peer observation. We are currently using whole-brain and ROI analyses to assess accompanying neural changes in both brain areas known as major nodes of the oculomotor brain, such as the frontal eye field, and brain areas know as major nodes of the social brain, such as the medial prefrontal cortex. The results could help determine whether others 'presence exerts its action by modifying neural activity within the specific neural substrates of a given task, via a task-independent, domain-general neural system dedicated to social information, or a combination of both.

Mots-Clés: Peer Presence, Saccades, fMRI

*Intervenant

Fast discrimination of fragmentary images: role of optimal local features

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Résumé

The ability to process quickly and reliably visual information is fundamental for survival. It is widely recognized that the visual system must operate a drastic reduction of information at an early stage, to efficiently process relevant visual information within limited available resources. In past work, we utilized the principle of constrained maximum-entropy to define a small number of specific local features that are optimal carriers of information. Experimentally, we found that images where only these features are kept (sketches), are still as recognizable in fast vision conditions as the original images.
Here we explore whether these specific local features still play an important role in a more natural setting, where all existing features are kept, but the overall available information is drastically reduced by showing only a fraction of the image. An alternative possibility is that of global information becoming more important in these different conditions.
We measure natural image discrimination (2IFC) based on brief presentation (25 ms) of a limited number of small patches, randomly extracted from the image, as a function of their number and size.
Results show that a very small fraction of the area of an image (0.5-2%) is sufficient to discriminate it from others. We also find that the probability of correct discrimination directly correlates with the number of optimal features contained in the visible patches.
This indicates that these special local features keep an important role in image discrimination even in such limiting conditions.

Mots-Clés: Fast vision, information maximization, psychophysics

*Intervenant

Information-optimal local features attract attention and gaze orientation

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Résumé

Visual analysis is optimized through the selective sampling of the most salient regions in the scene. Several factors may contribute to the definition of local salience. Here we used specific local features, predicted by a constrained maximum-entropy model to be optimal information-carriers, as candidate "salient features". Previous studies in fast vision showed that subjects choose optimal features as "more salient" if explicitly asked. Here, we investigate the *implicit* saliency effect of optimal features through subjects' performance in two attentional tasks.
In the covert-attention task, contrast threshold for orientation discrimination of a peripheral gabor was measured; in the overt-attention task, saccades towards a peripheral placeholder were analyzed. In both tasks, the target was preceded by two brief peripheral cues, one more salient than the other according to the model. In valid trials, the target was presented on the same side of the optimal cue. Independently on cue validity (50% or 80%), results showed lower contrast thresholds, saccadic latencies, and proportion of direction errors in valid trials, and the opposite in invalid trials, compared to baseline values obtained with equally-salient cues. Also, optimal features triggered more anticipatory saccades. Similar effects were found with high-luminance control cues.
Our results demonstrate that, in fast vision, covert and overt attention are automatically attracted by the saliency of the optimally informative features predicted by the reference model. These findings suggest that the maximization of visual information, coupled with biologically plausible computational constraints, contributes to determine what features are considered to be salient by our system.

Mots-Clés: Fast vision, Visual saliency, Saccadic orientation, Covert attention.

*Intervenant

Saccadic "Adaptation" at Late Target Reappearance

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Résumé

According to literature, saccadic adaptation in humans is disrupted when the presentation of the post-saccadic target is delayed, and disappears at delays around 600ms. This generally accepted result is however based on two small research samples (6 subjects in total). In this study, to establish the exact time window of saccadic adaptation, we examined the effect of various temporal delays of target displacements on the amount of adaptation. Because an increased delay leads to the perception of displacements, adaptation should differ in nature. Recent works suggest that distinct learning processes can contribute to the modification of saccadic amplitude: an implicit learning (automatic and slow) and an explicit learning (voluntary and fast). In this study we evaluated both components by measuring reaction times, saccades' variability and stabilization, learning and retention rates for each tested delay. Preliminary results show that saccades' amplitude is modified up to a 1200ms delay, and still visible in large proportion up to 600ms. Our visual system continues to "adapt" eye movements even when target displacements can be attributed to a change in the environment and not to saccadic errors anymore. Our results, however, do not allow us to differentiate the exact nature of the mechanisms involved yet.

Mots-Clés: Saccadic Adaptation, Target delay, Strategy/Motor learning

*Intervenant

Visual and motor plasticity interact in adult humans

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Résumé

Neural plasticity is maximal during development, allowing the fine-tuning of our sensory systems as well as learning and memory. In adulthood, the plastic potential of the sensory brain decreases, while it remains stable for brain areas mediating motor and cognitive functions. Recent evidence has shown that motor and sensory plasticity might rely on similar neural mechanisms (GABAergic inhibition), however, the relationship between these two forms of plasticity remains still unknown. Here we tackle this issue by investigating the interaction between visual and motor plasticity in adult humans. We quantified visual and motor plasticity in a group (N = 28) of adult volunteers using two established behavioral paradigms: short-term monocular deprivation and motor sequence learning. On separate days, each participant performed either the visual or the motor task alone (simple tasks) or a combined task in which motor sequence learning occurred during the monocular deprivation period. We found that eliciting visual and motor plasticity at the same time impairs visual plasticity while sparing motor plasticity: when motor learning occurred during monocular deprivation, the effect of deprivation (shift in ocular dominance measured by binocular rivalry) was significantly reduced ($F(1,27) = 14.4$, $p = 0.001$), while motor plasticity (reduction in reaction times observed after learning) did not change compared to the simple motor task ($F(1,27) = 0.18$, $p = 0.67$). These results show for the first time a functional interaction between visual and motor plasticity, indicating that different forms of plasticity might share common neural resources. The interaction between these two types of plasticity lays the groundwork for further studies aiming at rehabilitative interventions in fields such as neurology, aging, and learning.

Mots-Clés: visual plasticity, ocular dominance plasticity, motor plasticity, monocular deprivation, motor learning, neuroplasticity, binocular rivalry

*Intervenant

Brain substrates of reactive saccades adaptation and error processing.

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Résumé

Previous behavioral, clinical and neuroimaging studies suggest that beyond the critical role of the cerebellum, the neural substrates of adaptation of saccadic eye movements involve several still undetermined cortical areas. Furthermore, no study has explored the neural underpinnings of the behavioral differences between "forward" and "backward" saccadic adaptation. Finally, only one neuroimaging study has attempted to differentiate error processing mechanisms from the resulting plastic oculomotor changes. The present fMRI study was designed to compare forward (FW) and backward (BW) saccadic adaptation (using systematic intra-saccadic target jumps) to each other as well as to non-adapted saccades performed with an error signal (random intra-saccadic target jumps) and to saccades without error signal (no target jump). BOLD signal (3-T Siemens scanner) and oculomotor responses (EyeLink eye-tracking) were continuously recorded in 24 healthy volunteers while they performed 5 'Experimental runs' each implementing the 4 saccade conditions defined above and 2 independent 'Saccade Localizers runs'. Data from Experimental runs were analysed both through a GLM approach applied at the whole-brain level and a Multi-Variate Pattern Analysis (MVPA) applied to the 34 regions of interest (ROIs) identified with the Saccade Localizer data. Behavioral results indicate that adaptation of reactive saccades was reliably elicited whenever subjects were exposed to systematic double-step targets (BW and FW blocks), despite a low block duration (31.2 sec) and number of trials (16). The MVPA-identified areas specifically related to adaptation were found in the right Occipital cortex, right and left MT/V5, left Inferior-Temporal cortex (also disclosed by GLM), right FEF and right Pallidum. The MVPA-identified areas specifically related to error signal processing were found in the left Occipital cortex, left parietal areas BA7 and PEF (also disclosed by GLM), left PreCuneus, Cingulate cortex, left inferior and superior Cerebellum. Finally, MVPA revealed direction-specific areas for the forward (left Occipital cortex and MT/V5, right Pallidum) and backward conditions (right Occipital cortex and MT/V5). In this presentation we will detail these results and discuss a new saccadic adaptation architecture.

Mots-Clés: Saccade, fMRI, MVPA, double, step target, sensorimotor plasticity, post, saccadic error.

*Intervenant

Use of EEG localizers for EEG sources localization informed by fMRI at high spatio-temporal resolution (S4 method).

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Résumé

Sources localization in electroencephalography (EEG) is an ill-posed inverse problem. There is no unique solution because an infinite number of different source's configurations can generate exactly the same pattern of EEG activity. To solve this problem, different constraints on the source's distribution had to be added. These constraints can be on a statistical nature via the covariance matrix of the sources (MNE, Hämäläinen & Ilmoniemi, 1994). Moreover, spatial constraints can be added in the source covariance matrix by insertion of information about the localization of the functional brain areas involved in the task. This information can be provided by fMRI experiments or by atlases (MSP, Friston et al., 2008; FACE, Cottereau et al., 2012). The S4 method (*Spatial Sparsity in the Source Space*) (Samadi et al., 2016) allows source localization in EEG with high spatio-temporal

*Intervenant

resolution through the joint use of EEG and fMRI data from the same task. This allows to have the same temporal markers in EEG and fMRI in order to form the same contrasts of interest and to search for spatial distributions of cortical sources in EEG that are the most correlated with the corresponding BOLD signal. This method hypothesized that brain activity is sparsely distributed, meaning that only few cortical sources are active at any given time. The inverse problem is solved in a new low dimensional sparse space formed by the temporal sources that are the most correlated with the contrasts of interest. In our case, we used localizer experiments done sequentially in fMRI and then in EEG. The spatio-temporal fusion of spatial (fMRI) and temporal (EEG) information allows to obtain for each localizer (V1, V2, MT-V5 and FEF) a fine description of the active sources, both in space and in time by spatial filtering of the EEG signals. These spatial filters will then be used to process the EEG data of a main experiment to finely explore the involvement of the cortical network formed by V1, V2, MT-V5 and FEF brain regions. Two main experiments will be concerned (i) an intra-saccadic motion perception experiment and (ii) a saccadic choice experiment.

Mots-Clés: Source localization, EEG, visual areas, fMRI

Cerebellum drives motor adjustments and visual perceptual changes during size adaptation of reactive saccades

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Résumé

Saccadic adaptation (*SA*) is a cerebellar-dependent learning of motor commands (*MC*) which aims at preserving saccade accuracy. Since *SA* alters visual localization during fixation and even more so across saccades, it could also involve changes of target and/or saccade visuospatial representations, the latter (*CDv*) resulting from a motor-to-visual transformation (forward internal model) of the corollary discharge of the *MC*. In the present study, we investigated if, in addition to its established role in adaptive adjustment of *MC*, the cerebellum could contribute to the adaptation-associated perceptual changes. Transfer of backward and forward adaptation to spatial perceptual performance (during ocular fixation and trans-saccadically) was assessed in eight cerebellar patients and eight healthy volunteers. In healthy participants, both types of *SA* altered *MC* as well as internal representations of the saccade target and of the saccadic eye displacement. In patients, adaptation-related adjustments of *MC* and adaptation transfer to localization were strongly reduced relative to healthy participants, unraveling abnormal adaptation-related changes of target and *CDv*. Importantly, the estimated changes of *CDv* were totally abolished following forward session but mainly preserved in backward session, suggesting that an internal model ensuring trans-saccadic localization could be located in the adaptation-related cerebellar networks or in downstream networks, respectively.

Mots-Clés: Cerebellum, saccadic adaptation, corollary discharge, transsaccadic perception, visuospatial representations

*Intervenant

Stakes of foveation on event cameras

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Résumé

Foveation is the organic action of directing the gaze towards a visual region of interest, to selectively acquire relevant information. In the recent advent of event cameras, we believe that developing such a mechanism would greatly improve the efficiency of event-data processing. Indeed, applying foveation to event-based data would allow to comprehend the visual scene while significantly reducing the amount of raw data to handle. We study the evolution of the accuracy of segmentation with respect to the amount of event data used, to demonstrate the stakes of foveation.

Mots-Clés: foveation, event camera, segmentation, saliency

*Intervenant

Computational modeling of MEG-EEG Oscillatory Traveling Waves in human

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Résumé

Temporal properties of brain oscillations and their potential role in various cognitive functions including visual perception, are extensively studied. However, less is known about their spatial organization. Recent studies suggest that brain oscillations can travel across the cortex. Mesoscopic waves specifically, traveling within cortical areas, are mainly observed with invasive measurements (e.g., electrocorticography), which limits their investigation. Measuring traveling waves in human non-invasively, such as with magneto- and electroencephalography (MEG, EEG), is particularly challenging due to technical and biophysical constrains (e.g., source summation, volume conduction). To address these issues, we developed a two-stage computational model combined with simultaneous MEG-EEG recordings. (1) The putative neural sources of a propagating 5 Hz-oscillation are modeled within the early visual region (V1) using individual retinotopic mapping from functional MRI recordings (encoding model); and (2) the modeled sources are projected onto the MEG-EEG sensor space to predict the resulting MEG-EEG signal (biophysical forward head model). We tested our model by fitting its predictions against the MEG-EEG signal obtained when participants viewed a visual stimulus consisting in a black-and-white sinusoidal wave oscillating at 5 Hz and propagating from the center to the periphery of the screen. This "traveling" stimulus was used to elicit a 5Hz-neural oscillation traveling across the retinotopic space. A "standing" stimulus, oscillating at the same frequency with the same phase across the visual field, was used as control. Preliminary data show that the model was able to distinguish MEG-EEG recordings while participants viewed a traveling stimulus compared to a standing stimulus. Our model aims at bridging the gap between mesoscopic (neuronal populations) and macroscopic (full brain recordings) scales, to facilitate a better understanding of the functional role of brain oscillations for cognition.

Mots-Clés: Oscillatory Traveling Waves, computational modeling, MEG, EEG, brain oscillations

*Intervenant

Toward the characterization of a visual form of dyslexia: reduced visuo attentional field for symbols visual search

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Résumé

Several studies have shown that some dyslexics cannot process multiple letters simultaneously. Tenants of the phonological theory of developmental dyslexia argued that this reduced visuo-attentional (V-A) span measured with letters can be a consequence of a poor reading experience in dyslexics. In this study, we moved away from the reading context and used visual search tasks. A study has shown that poor readers are slow in visual searches involving multifeatured shapes, i.e. when target and distracters are made of a combination of multiples lines (symbols) and not when they are made of a unique line or of filled objects. Dyslexic children and healthy children made visual search task with symbols or filled objects. We observed that some dyslexic children were slower for visual search involving symbols than full objects. In this study we showed that this slowness was due to a reduced V-A field in the symbol condition. They could not process simultaneously as many elements as in filled objects condition. The demonstration that some dyslexics exhibit a reduced V-A field out of a reading context is an argument for an independent V-A deficit that can lead to dyslexia. It also opens the way to early detection and remediation because visual search can be tested and trained before reading acquisition.

Mots-Clés: Dyslexia, Visuo Attentional, Visual search

*Intervenant

Blending into the Crowd: Electrophysiological Evidence of Gestalt Perception of a Human Dyad

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Résumé

Human faces and bodies are environmental stimuli of special importance that the brain processes with selective attention and a highly specialized visual system. It has been shown recently that the brain also has dedicated networks for the perception of *pluralities* of human bodies in synchronous motion or in face-to-face interaction. Here we show that a plurality of human bodies that are merely in close spatial proximity are automatically integrated into a coherent perceptual unit. We used an EEG frequency tagging technique allowing the dissociation of the brain activity related to the component parts of an image from the activity related to the global image configuration. We presented to participants images of two silhouettes flickering at different frequencies (5.88 vs. 7.14 Hz). Clear responses at these stimulation frequencies reflected responses to each part of the dyad. An emerging intermodulation component (7.14 + 5.88 = 13.02 Hz), a nonlinear response regarded as an objective signature of holistic representation, was significantly enhanced in the (typical) upright configuration relative to an (altered) inverted position, demonstrating that neural integration of the parts of the dyad occurs only for the regular dyad configuration. Moreover, the inversion effect was significant for the intermodulation component but not for the stimulation frequencies, suggesting the existence of a trade-off between the processing of the global dyad configuration and that of the structural properties of the dyad elements. Our results suggest that when presented with two humans merely in close proximity, the perceptual visual system will bind them. Hence the perception of the human form might be of a fundamentally different nature when it is part of a plurality.

Mots-Clés: Social Group Perception / EEG, Frequency Tagging / Gestalt

*Intervenant

Investigating the Role of Auditory Cues that Create Expectation Effect for Visual Targets

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Abstract

In the literature, it has been shown that visual cues can create visual expectation, and also it is known that people perform worse in object location detection tasks when the expectation is unmet (Urgen & Boyaci, 2021). However, in the literature, the effect of expectation on the sensory processes is mostly studied within one particular modality. Therefore, for vision studies expectation is mostly provided by visual cues. The goal of to current study is to investigate the role of expectation across modalities. For this purpose, we compared conditions with and without auditory cues in the 2-AFC visual target location detection task. Results showed that an auditory cue can create a visual expectation and so cause participants to decrease their perception duration threshold. For inspecting this prior effect in detail, mixed trial phases which include both congruent (expectation met) and incongruent (expectation unmet) trial phases in two different coherence levels (%50 validity, %75 validity) were also added. Linear mixed model results showed that even the accuracy of participants significantly differed between validity conditions, there is no significant difference in thresholds between the two validity conditions. These results suggest that although the performance in a visual task is regulated by non-visual cues, this effect of auditory cues doesn't depend on the coherence level of trials.

Keywords: cross, modal, audio, visual, expectation, prior

*Speaker

GDR Vision 2021 – Lille

Venues

Thursday 21st : The forum will take place at l'Imaginarium where the equipex Irdive is hosted, located at the Plaine Images, in Tourcoing. See the map below. The address is 99a Boulevard Descat 59200 Tourcoing. It takes 30 minutes from the Gare Lille Flandres / Gare Lille Europe to get to the building. Métro line 2 Arrêt Alsace

Friday 22nd : The forum will take place at the Amphi B7, Lille University, Campus Pont de Bois, in Villeneuve d'Ascq. It takes 20 minutes from the Gare Lille Flandres to get to the building. Métro line 1 Arrêt Pont de Bois

Thursday 21st : Social event : We will gather at the Bistrot de St So, for drinks and finger food. From Tourcoing it takes about 35 minutes to get there. Métro line 2 Arrêt Mairie de Lille. It's a nice 15 minutes walk from the city center.