- POSTER ABSTRACTS

#	TITLE	AUTHORS	LABOS	ABSTRACT
1	**A preliminary exploration of brain activations when trusting an autonomous system during a co-operative image recognition task**	Rogers daniel <rogda001@mymail.unisa.edu.au> (1), Bornkessel-Schlesewsky ina (1), Weuthen alexander (2), Schlesewsky matthias (1), Ullsperger markus (2)	1 - University of South Australia [Adelaide] (Australia), 2 - Otto-von-Guericke-Universität Magdeburg = Otto-von-Guericke University [Magdeburg] (Germany)	There is currently increased interest in identifying the neural correlates of trust in autonomous systems (AS) by applying knowledge of trust in humans to the study of trust in AS. Research on this topic to date using fMRI is currently limited however, and while one study has reported increased activation of the medial frontal cortex (MFC) when trusting humans as compared to trusting an AS, the brain areas and possible networks involved in trusting an AS remain unclear. In the current study, we aimed to further explore brain activations when trusting an AS by examining brain responses to participants' trust decisions in a co-operative image classification task. 44 participants (mean age 27 years; 14 female) were paired with either a virtual human or virtual AS partner and tasked with accurately discerning masked cat and dog images, following which their partner performed the same task. Each trial involved a decision to trust their partner's task performance based on the current task difficulty, with the goal being to make as many correct decisions as possible to obtain points and a monetary reward. Consistent with previous results, we found an increased response in the MFC, specifically in the dorsomedial prefrontal cortex, when deciding to trust a human as compared to an AS. Further analysis of trust decisions showed a possible involvement of the midcingulo-insular salience network, indicated by increased activations when trusting a human compared to an AS in the anterior insula and the anterior mid cingulate cortex. These results add to the limited fMRI findings related to trust in AS, suggesting that brain responses when trusting an AS differ to those found when trusting a human.
2	**A subthalamo-medio-prefrontal circuit for task switching demonstrated in human intracranial EEG**	Laquitaine maëva <maeva.laquitaine@wanadoo.fr> (1), Polosan mircea (2), Kahane philippe (2), Chabardes stephan (2), Yelnik jérôme (3), Fernandez-Vidal sara (3), Domenech philippe (3), Bastin julien (1)	1 - Grenoble Institut des Neurosciences (France), 2 - CHU Grenoble (France), 3 - Institut du Cerveau (France)	The ability to strategically switch between sets of rules in response to changes in the environment depends on the dorsomedial prefrontal cortex (dmPFC) and the basal ganglia. Yet, both the computational principles and the neural implementation of such higher-order cognitive control processes remain unclear. Here, we recorded local field potentials from two groups of rare neuropsychiatric patients performing a task-switching paradigm: (1) deep brain recordings of the subthalamic nucleus (STN) in patients with obsessive-compulsive disorder, and (2) stereo-electroencephalogram from dmPFC of drug-resistant epileptic patients. We fitted a drift-diffusion model to patients' choice behavior and found that task-switching was associated with a shift in the starting point of evidence accumulation (z), accounting for switch cost. At the neural level, we found that, during task switching, theta band (5-10 Hz) activity increased first in the dmPFC and then in the STN. dmPFC also encoded in anticipation the likelihood of switch in the beta band. Yet, a counter-intuitive finding was that excessive levels of theta activity led to premature responding and switching errors. Using a hierarchical neural drift diffusion model explained these seemingly paradoxical observations, as trial-by-trial fluctuations in theta power negatively correlated with the subjects' starting point parameter. Together, these findings suggest the existence of a versatile mechanism through which the dmPFC rapidly activates the STN, earlier in the decision process than previously thought, to overcome pre-established choices and allow time for flexible task-set reconfiguration.
3	**Adult age differences in the updating of state spaces**	Ruel alexa <alexa.ruel93@gmail.com> (1), Marx mirjam (2), Eppinger ben (3)	1 - Universität Hamburg (Germany), 2 - Freie Universität Berlin (Germany), 3 - Universität Greifswald (Germany)	An increasing number of empirical studies suggest that older adults experience difficulties engaging in goal-directed decision-making due to deficits in representing an abstract model of the task structure (i.e., state space) (see Eppinger et al., accepted). From a computational perspective, one possible explanation for older adults' deficits in representing state spaces is a reduced efficiency in the updating of transitions between task states. In the current study, we used a novel reversal learning paradigm in which younger and older adults experienced state prediction errors in two conditions: a reversal learning condition and an oddball condition. In both conditions, the perceptual input was identical, but differed with respect to the relationship between surprise and the need to update the internal representation of the task (see Fig 1). We examined if older adults differ from younger adults in their ability to discriminate between surprising outcomes that can be safely ignored (oddball trials), from those that dictate the need to update their internal model (reversal trials). Past work shows that the P3a and P3b components of the event-related potential (ERP) reflect distinct cognitive control processes. While the P3a has been shown to reflect surprise, the P3b seems to relate to the need to update the internal model of the task. Leveraging these findings, we examined the relationship between neural responses and consequential changes in behavior in the reversal learning condition. Our behavioral results reveal that older adults demonstrated greater stochastic responding in the reversal learning condition in comparison to the oddball condition. Our ERP analyses revealed that, in contrast to younger adults, older adults demonstrated reduced discrimination between surprising and unsurprising outcomes as reflected in the P3a component (see Fig 2). Further, preliminary correlation analyses demonstrated a positive relationship between the P3a and behavior in the reversal learning condition for younger, but not older adults (see Fig 3). Based on these results we suggest that adults' behavioral difficulties in reversal learning condition may arise from a deficit in discriminating between surprising and unsurprising outcomes in this condition. Future time frequency (wavelet) analyses will be run to further examine the potential representational deficits experienced by older adults.
4	**Age-dependent strategies in motivating effort towards deadlines from adolescence to adulthood**	Pfirrmann janine <j.pfirrmann@bham.ac.uk> (1), Vogel todd A. (1), Pisauro m. Andrea (1), Hogg tabitha (1), Gueguen margot (1), Apps matthew A. J. (1) (2), Lockwood patricia L. (1) (2)	1 - University of Birmingham [Birmingham] (United Kingdom), 2 - University of Oxford (United Kingdom)	From revising for examinations to completing coursework, the ability to work effectively under pressure before a deadline is a defining aspect of successful education in children and adolescents. The performance on such formal assessments has lifelong implications, predicting future earnings, mental well-being, and life satisfaction in adulthood. However, reaching deadlines requires effort, and typically people find effort aversive. Yet people also paradoxically put in great efforts in certain contexts for lower immediate reward, a puzzle known as the effort paradox. It could be that when there is a goal, effort changes from something aversive to something we seek to achieve our aims. We tested 39 adolescents (44% females, aged 12-17 years) and 65 adults (58% females, aged 18-35 years) on a task where they had to motivate physical effort to reach a deadline. Participants engaged in a scientific mission on the moon to collect alien space rocks as rewards, while also requiring effort to charge their spaceship's battery to a specific threshold. In this context, participants repeatedly chose between a higher-effort option, associated with greater battery charging but fewer space rocks (lower reward), and a lower-effort option associated with more space rocks (higher reward). Importantly, failure to reach the charging threshold resulted in an inability to return to Earth and the loss of all collected reward. Strikingly, across trials, adolescents were more likely to select higher effort in exchange for less space rocks to reach the spaceship's charging threshold compared to adults. Despite adolescents' seemingly higher motivation to invest effort, we found no group differences in the number of spaceships launched or the time required to charge the battery. This suggests that adolescents adopted a maladaptive strategy where they applied more effort than necessary to reach the goal, as they did not earn more total reward. Overall, these findings suggest that both adolescents and adults seek effortful options for lower rewards when there is a goal, consistent with the effort paradox. They also show that adolescents and adults vary in their strategies for motivating effort towards deadlines, with adolescents potentially invoking a less adaptive approach.

5	**Allocation of cognitive control through episodic retrieval of temporal context**	Wientjes sven <wientjes.s@gmail.com> (1), Holroyd clay (1)	1 - Department of Experimental Psychology, Ghent University (Belgium)	Humans can satisfy a large variety of abstract goals, such as driving to work or making a weekly grocery list. This requires us to maintain contextual information and guide neural information processing through top-down mechanisms (Miller & Cohen, 2001). The functions subserving this ability are collectively referred to as €œcognitive control€. Experimental investigation of cognitive control is often instantiated in €œdistractor-interference€ tasks, where a stimulus is presented that simultaneously contains information in favor of a correct decision, but potentially also in favor of an incorrect decision. Known examples are the Stroop task (MacLeod, 1991) and the flanker task (Eriksen & Eriksen, 1974). In these tasks, it is theorized an automatic process integrates information from an irrelevant dimension, such as word-reading in the Stroop task, while a controlled process integrates information from the relevant dimension (Cohen et al., 1990; Ulrich et al., 2015). Interestingly, various sources of information seem to determine the strength with which a participant can preferentially engage in controlled processing over automatic processing. For example, Gratton et al. (1992) found that participants are more efficient at processing an incongruent stimulus when the preceding stimulus had also been incongruent, compared to when the preceding stimulus had been congruent (the €œcongruency sequence effect€). Secondly, participants can engage in €œlist wide€ control allocation, maintaining a high level of controlled processing when most stimuli in a block are presented as incongruent (Bugg, 2014). Furthermore, participants can engage in €œitem specific€ control allocation, where a specific stimulus feature (e.g. the color €œblue€ in a Stroop task) can rapidly induce a within-trial preference for stronger controlled processing (Bugg et al., 2011). While some of these effects have been accounted for by reinforcement learning models of control allocation (Lieder et al., 2018; Verguts & Notebaert, 2008), Egner (2014) has provided an insightful explanation for a wide array of these effects in terms of €œepisode files€. This explanation assumes features of each trial, including the demand for controlled processing, are bound together and stored in episodic memory. When features of this trial repeat in a later trial, this memory can be partially retrieved, reinstantiating the previously associated demand for controlled processing. We formalize this theory in a computational model by including the demand for controlled processing as a stimulus dimension in the temporal context model, a formal model of human
6	**Antagonistic contribution of goal- and habit related brain systems at different stages of habit formation**	Wang xiaoyu <xiaoyu.wang3@tu-dresden.de> (1), Ruge hannes, Zwosta katharina, Korb franziska, Wolfensteller uta	1 - Technische Universität Dresden = Dresden University of Technology (Germany)	Introduction Previous studies have demonstrated that different neural systems of the human brain are differentially involved in habit formation. On the one hand, a behavioral measure of acquired habit strength was associated with decreasing engagement of a putative goal-directed brain system as learning progressed. On the other hand, habit strength could be predicted by learning-related connectivity changes of a putative habitual brain system. However, these conclusions are somewhat limited as inter-individual differences in habit strength were quantified rather indirectly by how strongly a learnt habitual response would interfere with task performance after response requirements had changed. The present study therefore aimed to probe more directly the antagonistic engagement of the two brain systems during stimulus-response learning. To this end, we varied within subjects the amount of training for different subsets of novel stimulus-response links. We expected an antagonist pattern of goal-related and habit-related brain systems in strongly and weakly trained S-R links. Methods The current dataset is part of a still ongoing TMS study which included two TMS-target region groups (premotor cortex or angular gyrus) and each group received both real and sham stimulation in two separate sessions. For the present analysis we pooled the sham sessions from both groups (49 subjects in total). The experimental paradigm was a modified version of a previous study design (Zwosta et al. 2018). Here, subjects were required to learn novel stimulus-response associations to gain monetary reward or to avoid monetary loss. The stimuli were appearing either 98 times (long training duration) or 8 times (short training duration) to investigate the difference between strong and weak habits. Error rates and response times were recorded to assess learning-related changes while neural processes were measured with fMRI. Statistical analyses were based on ANOVAs with learning stage (early vs. late) and training duration (long vs. short) as within-subjects factors. Results Behaviorally, we found decreasing reaction times and error rates across learning in both training durations. Reaction time and error rates in the short training duration was significantly higher than in the long training duration. Neural activation in the goal-directed brain system, comprising areas such as the inferior parietal lobe, were higher in the short training condition compared with the long training condition. In contrast, activation in the habitual system, comprising areas such as the premotor cortex and the putamen, were higher in the
7	**ANTERIOR INSULAR LESION DISRUPTS ADAPTATION TO NEGATIVE OUTCOMES**	Alexandre filipowicz (1) (2), Domenech philippe (3) (4), Verstraete charles <charles.verstraete@icm-institute.org> (4) (5), Beaumont sami (3), Koechlin etienne (6), Danckert james (2), Anderson britt (2) (7)	1 - Department of Neuroscience, University of Pennsylvania (United States), 2 - Department of Psychology, University of Waterloo (Canada), 3 - Centre Hospitalier Saint-Anne (France), 4 - Neurophysiologie des comportements rÃ©pÃ©titifs (France), 5 - Institut cellule souche et cerveau / Stem Cell and Brain Research Institute (France), 6 - Laboratoire des Neurosciences Cognitive (France), 7 - Centre for Theoretical Neuroscience (Canada)	The anterior insula (aINS) is commonly associated with error monitoring and behavioral adaptation. However, its precise neuro-computational function remains poorly characterized. Here, we assessed the ability of stroke patients with lateral prefrontal cortex (PFC) lesions to adapt their decision-making strategies against uncertain and volatile environments, which typically require to infer whether unexpected outcomes arise from noise or genuine rule changes. Approximately half of the patients performed at, or above, the level of healthy controls (Good Learners), while others performed substantially worse (Poor Learners). Consistent with our previous results, both controls and good Learners correctly traded off between using choice outcomes to gradually adjust their strategy or to trigger switches into active exploration. By contrast. Poor Learners behaved as if negative outcomes systematically, but incorrectly, "reset" their knowledge regarding which action to select in a given state. Voxel-based Lesion Symptom Mapping revealed that these differences between good and poor learners were due to lesions in the aINS. Further, computational modeling revealed that Poor learners correctly updated their decision-making strategy using only positive outcomes. Negatives outcomes associated to a given state trigger a default exploratory strategy whenever the same state was visited again, resulting in a seemingly random behavior right after negative feedbacks. Taken together, these elements give the insula a central role in the management feedback during decision-making process.
8	**Anticholinergic agent diminishes feedback learning**	Hils jonathan <hils@ovgu.de> (1), Weuthen alexander (1), Schulz steve (1), Ullsperger markus (1) (2)	1 - Otto-von-Guericke University Magdeburg, Institute of Psychology (Germany), 2 - Center for Behavioral Brain Sciences, Magdeburg (Germany)	Performance monitoring indicates the need for adjustment when actions fail to achieve a desired outcome. To enhance learning from errors, adjustment processes need to be initiated leading to adaptive attentional control and updating of memory contents. We hypothesize that these adjustment processes are mediated by cholinergic projections from the basal forebrain to sensory cortices and the medial temporal lobe. To investigate interactions between performance monitoring, adaptive attentional control and memory encoding we conducted a pharmacological EEG study using the muscarinic acetylcholine receptor antagonist biperiden. Administration of biperiden resulted in poorer memory performance. During the presentation of negative feedback, biperiden lead to a reduction of both feedback-related negativity (FRN) and midfrontal theta power. In addition, we found that biperiden decreases the modulation of occipital alpha oscillations following feedback and diminishes resting-state alpha reactivity between eyes opened and eyes closed. Current analyses aim to examine the representations of stimulus categories after feedback in perceptual regions. Reduced post-error decoding accuracy in the biperiden group could indicate reduced attentional allocation. In conclusion, muscarinic cholinergic blockade causes a deterioration in memory performance that is associated with changes in EEG correlates of performance monitoring and provides indications for reduced post-feedback adaptations.

9 Assessing goal-directed decision making in Parkinson's disease using dopamine, deep brain stimulation, and intracranial recordings from human fronto-basal ganglia circuits

Hoy colin <colin.hoy@ucsf.edu> (1), Kool wouter (2), Little simon (1)

1 - University of California [San Francisco] (United States), 2 - Washington University in St. Louis (United States)

Better understanding of human reward circuits is needed to treating disabling motivation deficits in neuropsychiatric disorders, including apathy and impulsivity in Parkinson's disease (PD). Recent work in computational psychiatry has linked severity of these symptoms to decreases in goal-directed decision making (Gillan et al., 2016, Patzelt et al., 2019), and dopaminergic medications have been found to boost goal-directed decision making in healthy controls and people with PD (Wunderlich et al., 2012; Sharp et al., 2016). Neuroimaging studies have identified frontal cortex and basal ganglia as key structures involved in controlling goal-directed decision making and reward learning (REFs), but the neural signals underlying goal-directed choices are poorly understood. Here, we use novel sensing-enabled deep brain stimulation (DBS) devices to record intracranial data from human frontal cortex and basal ganglia while people with Parkinson's disease perform a modified two-step reward learning paradigm that separates goal-directed and habitual decisions (Kool et al., 2016). Seven participants performed the task at home between 9 and 13 times (69 total sessions), both ON/OFF their dopaminergic medications and ON/OFF DBS. Choice data were modeled using a hybrid reinforcement learning (RL) algorithm that estimated the balance of habitual versus goal-directed decision making for each session. Neural preprocessing included filtering from 0.5-55 Hz, rejecting epochs with excessive noise, and removal of electrocardiogram artifacts. We then extracted time-frequency power from 3-30 Hz, which was normalized relative to a pre-stimulus baseline epoch and aligned to feedback. Linear mixed models (LMMs) were used to predict choices, reaction times (RTs), and single-trial neural power with fixed effects of task features, RL model parameters, and dopamine and DBS status and random intercepts by participant and by session-within-participant. Behavioral LMMs of choices to return to the same second state revealed both goal-directed (main effect of previous reward) and habitual (interaction of previous reward and change in starting state) influences on adaptive win-stay/lose-switch strategies. RTs were slower after changing starting states, after longer delays since visiting a given starting state (i.e., memory load), and when the overall average value of both starting state options was high, while RTs were faster for higher chosen values and when DBS was ON. We found individual differences in the effects of dopamine on goal-directed choice, with some participants increasing and

10 Behavioural determinants of neural network dynamics and strategy switching in monkey frontal cortex

Ungvarszki zsombor <ungvarszki.zsombor@gmail.com> (1), Goussi-Denjean clément (1), Orban gergo (2), Di Volo matteo (1), Procyk emmanuel (1)

1 - Institut cellule souche et cerveau / Stem Cell and Brain Research Institute (France), 2 - Computational Systems Neuroscience Lab, Wigner Research Centre for Physics, Budapest (Hungary)

Flexible decision making, where the optimal choice changes over time, involves performance monitoring and action selection. The lateral prefrontal cortex (LPFC) and the midcingulate cortex (MCC) were shown to play central roles in these processes. However, the neural mechanisms that guide action selection and switching between exploratory and exploitative strategies are not fully understood. In the current study, two macaque monkeys were performing a 3-armed bandit task in a non-stationary environment, while we simultaneously recorded single unit activities with linear probes from the MCC and the LPFC. We used a simple, model-free approach to describe the observed behaviour and to extract variables relevant for task execution. We found that during task execution the animals monitor their performance by computing a recency-weighted average of the previous outcomes, a quantity which we refer to as the action value. Our findings reveal that this action value, derived merely from the behaviour, could be decoded from the neural populations of both areas. Importantly, this value could be used to predict the behavioural strategies (explore vs exploit) chosen by the animals. PCA analysis revealed that different behavioural strategies have different underlying dynamics, and that this difference can be captured in a low-dimensional subspace. Our results indicate that MCC and LPFC represent critical factors necessary for the evaluation of alternative strategies: the action value being a good predictor of the changes between strategies.

11 Brain network dynamics and age-related differences in meta-memory judgements

Weuthen alexander <weuthen@ovgu.de> (1), Ullsperger markus (1) (2)

1 - Otto-von-Guericke-Universität Magdeburg (Germany), 2 - Center for Behavioral Brain Sciences, Magdeburg (Germany)

Memory performance declines with increased age. Subjective memory impairments can, however, predict later memory decline before being evident in objective memory tests. While awareness of memory deficits and unsuccessful learning is an important precondition for attempts to compensate, it is not well understood whether older adults show deficits in detecting memory demands or in following adaptation processes only. A cross-sectional functional magnetic resonance imaging (fMRI) study with 30 younger (18-35 years) and 25 older adults (50-80 years, no dementia) was conducted to investigate age differences in neurophysiological processes associated with the detection of memory errors, stimulus-related attention and memory formation. Older adults showed significantly worse memory performance than younger adults. While detection accuracy of memory errors was comparable between both age groups, older adults were less able to detect successful recall, and their recall certainty ratings were biased towards under-confidence. fMRI analyses showed age-related differences during encoding of subsequent correct compared to failed recall, with larger hemodynamic responses in medial frontoparietal default mode network regions for older adults. For older compared to younger adults, an increase in medial frontoparietal network and a decrease in midcingulo-insular salience network were, however, already evident when participants selected a low level of recall confidence. Although the results suggest that age-related memory impairments are not directly based on a deficient detection of memory errors, neurophysiological and behavioral results indicate an age-related impairment in specifying the confidence of memory representations.

12 Characterizing Human Habits in the Lab: A Comprehensive Experimental Investigation of Habitual Behavior

Nebe stephan <nebe.step@gmail.com> (1), Kretzschmar andré (2), Brandt maike C. (1), Tobler philippe N. (1)

1 - Zurich Center for Neuroeconomics, University of Zurich (Switzerland), 2 - Individual Differences and Assessment, University of Zurich (Switzerland)

Habitual behavior is characterized by responses elicited by stimuli without deliberation or reliance on the predicted value of the outcome. Thus, habits reduce cognitive load in everyday life, but they might also dominate behavior in psychopathologies like substance use or obsessive-compulsive disorders. Due to the ubiquity and clinical importance of habits, it is essential to study them in the lab. Yet, inducing and measuring habitual behavior in humans in the lab has proven difficult. In this Registered Report, we developed two novel behavioral tasks based on computational models, which suggest that habit strength should be proportional to the frequency of behavior and, in contrast to previous approaches, independent of outcome values. As the validity of our novel tasks but also of those tasks used in previous studies of human habits is still an open question, we added four previously used tasks and all three currently available self-report questionnaires of real-life habits to this study. Extended testing of 220 participants over five consecutive days in the lab and an additional online session created the most comprehensive dataset regarding habitual behavior to date. Linear mixed-effects models revealed that previous choice frequency significantly increased current choice frequency and decreased response times during a test session on the fifth day of assessment in line with our hypothesis. Computational modeling of participants' choice behavior corroborated the finding that previous choice frequency informs their behavior. Thus, previous choice frequency influenced current choices and response times, in addition to, and independent of, reinforcement. However, behavioral indices of choice frequency were not associated with measures of habits of the other four behavioral tasks. Moreover, those other tasks were not meaningfully associated with each other, and no behavioral task was associated with self-report measures of real-life habits. This important set of findings calls into question current approaches of inducing and measuring habitual behavior in the lab. Thus, a rigorous reassessment of our understanding and definition of human habitual behavior in the lab seems advisable. Future studies are needed to refine our theoretical understanding of habits, develop new behavioral tasks, and validate them against innovative measures of real-life habits beyond self-report, for example using ecological momentary assessment.

13	**Cognitive control is task specific: Further evidence against the idea of domain-general conflict adaptation**	Zhu daxun <daxun.zhu@ugent.be> (1), Wang xiangpeng (2), Zhao enwei (2), Nozari nazbanou (3), Notebaert wim (1), Braem senne (1)	1 - Ghent University (Belgium), 2 - Jiangsu Normal University (China), 3 - Indiana University (United States)	Adaptive control refers to flexible adjustments in control settings in response to conflicting situations, often measured using the congruency sequence effect (CSE), which is the observation that the congruency effect in conflict tasks decreases following incongruent compared to congruent trials. There has been a long-standing debate as to whether CSEs reflect a domain-general or domain-specific process €“ as often tested by studying CSEs across tasks. One model predicts a U-shaped relation where only highly similar or highly dissimilar tasks would show CSEs across tasks, because only those tasks can be represented or activated in parallel. While there has been an abundance of evidence for CSEs across highly similar tasks, only some recent studies seem to have reported CSEs across highly dissimilar tasks, with some failures to replicate. To this end, we interleaved two very different conflict tasks, a manual multi-source interference task and a vocal picture-word interference task. We ran this experiment in Dutch (Experiment 1, n=50) and in Chinese (Experiment 2, n=39). Across the two experiments, results show no cross-task CSE, but rather a reversed CSE when the previous trials are response-interference trials, which, if anything, is suggestive of very task-specific adaptive processes. These results do not fit with the U-shaped model, nor with the conclusion of other studies suggesting that there might be a domain-general mechanism behind CSEs. Instead, our results are most compatible with a very task-specific view on the mechanisms behind the congruency sequence effect. Keywords: cognitive control, conflict adaptation, congruency sequence effect, domain generality
14	**Combining surprise, value, and cognitive control in a computational model of dACC activity**	Vriens tim (1), Vassena eliana (2), Silvetti massimo (3)	1 - Computational and Translational Neuroscience Lab, Institute of Cognitive Sciences and Technologies, National Research Council (Italy), 2 - Donders Institute for Brain, Cognition, and Behaviour, Radboud University (Netherlands), 3 - Computational and Translational Neuroscience Lab, Institute of Cognitive Sciences and Technologies, National Research Council (Italy)	The role of the dorsal anterior cingulate cortex (dACC) during decision-making is a frequently studied yet highly debated topic. While most authors agree that the dACC is involved in decision-making, there is no consensus on what mechanisms drive this involvement. In a recent study, Vassena et al. compared several frameworks explaining the relation between dACC and decision-making in an attempt to settle this debate. They concluded that the predicted response-outcome (PRO) framework by Alexander & Brown was preferred over the expected value of control (EVC) framework by Shenhav et al., stating that the dACC tracks surprise, and not value or cognitive control. In this study, we expand on their research by including a new model, the reinforcement meta-learner (RML). The RML model hypothesizes that the dACC plays a role in surprise, value, and cognitive control. We used the RML to simulate behavior and dACC activity during the decision-making task under time pressure described by Vassena et al. We found that RML simulations reproduce the dACC activity pattern that is observed in human participants and predicted by the PRO model. This result provides evidence that the dACC could be involved in all three core mechanisms of surprise, value, and cognitive control under one unified framework, and confirms that the dACC could play a role in cognitive control after all. In sum, without increasing model complexity, the RML is able to explain dACC activity in decision-making under time pressure at least as well as the PRO. Although evidence suggests that the RML may account for a wider range of phenomena, additional research is necessary to dissociate whether dACC activity during decision-making is driven by surprise alone (as proposed by the PRO model), or whether it reflects surprise, value and cognitive control (as proposed by the RML model).
15	**Computational Mechanisms and distinct effect of apathy and anhedonia on Effort-Based Decision Making in adolescence with depression**	Zeng ningning <ningningzeng2020@outlook.com> (1), Zhou dongsheng (2), Zhou jiali (3), Su yaner (1), Deng guangzhi (4), Zhang junyi (3), Luo yuejia (4), Xu pengfei (4), Aleman andre (1)	1 - University of Medical Center of Groningen, University of Groningen (Netherlands), 2 - Kangning Hospital of Ningbo, China (China), 3 - Shenzhen University (China), 4 - Beijing Normal University (China)	Objective: Apathy is a syndrome of reduced motivation that commonly occurs in several neurological and psychiatric diseases, but the features and underlying mechanisms in depressive adolescence remain to be established. This study aimed to investigate the distinct effect of apathy and anhedonia in depressive adolescents. Methods: Thirty-nine adolescents with depression and fifty matched healthy controls participated a physical effort-based decision-making task. Participants were instructed to determine whether to exert different levels of physical effort (number of key-pressing) to obtain different magnitudes of rewards or avoid loss. Participants' choice and response time were integrated within a discounting model and a drift-diffusion model. Results: Firstly, higher apathy severity was associated with a reduced willingness, slower information accumulation, and a longer response time to exert effort to obtain rewards. Additionally, apathy and anticipatory anhedonia severity rather than consummatory anhedonia negatively predicted participant's acceptance. Apathy and consummatory anhedonia severity rather than anticipatory anhedonia negatively predicted the participant's information accumulation speed (drift rate). Conclusion: Our findings indicate a diminished sensitivity to rewards and a distinct effect between apathy and anhedonia on effort-based decision-making in adolescents, highlighting characteristics of motivational deficits as a potential early diagnostic marker for depression in adolescence. Furthermore, the use of computational modeling approaches sheds light on the hidden psychopathological processes, offering valuable insights for understanding and diagnosing psychiatric conditions in adolescence.
16	**Controllability estimation, reinforcement-learning and executive functions**	Ligneul romain <romain.ligneul@inserm.fr> (1)	1 - Centre de recherche en neurosciences de Lyon - Lyon Neuroscience Research Center (France)	Estimating controllability is key to alleviating credit assignment problems, predicting future events, and arbitrating between proactive and reactive behavioral strategies. However, very little is known about the computations underlying this ability, beyond the context of simple tasks such as the learned helplessness paradigm. Here, I will present data supporting the hypothesis that the human brain tracks controllability estimates by comparing two statistical models of the environment, in line with causal inference principles. I will further dig into the empirical relationship between this process and other cognitive functions such as reinforcement learning and working memory. Finally, I will show that controllability estimation models can be useful outside the context of tasks meant to evaluate them. Since controllability perception is altered in prevalent mental disorders such as depression, anxiety or obsessive-compulsive disorders, this line of work may provide new insights and predictive phenotyping tools for evidence-based approaches in neuropsychiatry.
17	**Cortical beta power reflects a neural implementation of decision boundary collapse in speeded decisions**	Kirschner hans <hans.kirschner@ovgu.de> (1), Fischer adrian G (2), Danielmeier claudia (3), Klein tilmann A (1), Markus ullsperger (1)	1 - Otto-von-Guericke-Universität Magdeburg = Otto-von-Guericke University [Magdeburg] (Germany), 2 - FU Berlin (Germany), 3 - University of Nottingham (United Kingdom)	A prominent account of decision-making assumes that information is accumulated until a fixed response threshold is crossed. However, many decisions require weighting of information appropriately against time. Collapsing response thresholds are a mathematically optimal solution to this decision problem. However, our understanding of the neurocomputational mechanisms that underly dynamic response thresholds remains very incomplete. To investigate this issue, we used a multistage drift diffusion model (DDM) and also analysed EEG beta power lateralization (BPL). The latter served as a neural proxy for decision signals. We analysed a large dataset (n=863) from a speeded flanker task and data from an independent confirmation sample (n=119). We show that a DDM with collapsing decision thresholds, a process where the decision boundary reduces over time, captured participants' time-dependent decision policy better than a model with fixed thresholds. Previous research suggests that BPL over motor cortices reflects features of a decision signal and that its peak may serve as a neural proxy for the decision threshold. Our findings offer compelling evidence for the existence of collapsing decision thresholds in decision-making processes.

18 Decoding errors and their potential implementation as error remedial augmenting BCI devices

Vilà Ballo adrià <adria.vila@udg.edu> (1), Cerda-Company xim, Cunillera toni, Rodriguez-Fornells antoni

1 - Department of Psychology University of Girona (Spain)

The ability to process errors and learn from them is fundamental to adapt behavior to environmental demands. Several processes occur from stimulus presentation to response execution. Besides visual processing, motor preparation, inhibition, error monitoring and correctness are crucial stages involved in fast reaction time paradigms. Some of these processes have been associated to specific sensory or response-evoked potentials such as the lateralized readiness potential (LRP) and the N2 family components (including the ERN). The latency and reliability of these components at single-trial level are relevant for developing brain computer interfaces (BCI) applications, which might allow communication through decoding brain activity and augment error monitoring preventing fast erroneous decisions. In the present study, we explored the use of a support vector machine classifier to separate correct and erroneous responses at the trial level during a flanker task, pre- and post-response analysis (N = 35 participants). The results showed the possibility of separating brain activity from correct and error responses, before and after the response. Discrimination was based on the latency and topography of the components. We studied pre-response activity (stimulus-locked), corresponding to correct/error LRP modulations and the N2, and response-locked activity based on ERN/Pe complex. These findings suggest potential implementation of error-remedial BCI algorithms that could artificially augment error-monitoring and correction in humans and prevent serious operation errors.

19 Decoding internal vs external errors using a single trial error-related brain potentials

Cerda-Company xim <ximcer@outlook.com> (1) (2) (3), Gomez-Andres alba (2) (3), Cucurell david (2) (3), Vilà -Ballo adrià (2) (3) (4), Cunillera toni (2), Rodriguez-Fornells antoni (2) (3) (5)

1 - Universitat AutÃ²noma de Barcelona (Spain), 2 - Department of Cognition, Development and Educational Psychology, Universitat de Barcelona (Spain), 3 - Cognition and Brain Plasticity Unit, Institut d'Investigacions BiomÃ¨diques de Bellvitge (IDIBELL) (Spain), 4 - Universitat de Girona (Spain), 5 - InstituciÃ³ Catalana de Recerca i Estudis AvanÃ§ats (Spain)

The ability to differentiate between actions originated from oneself and those generated externally plays a crucial role in learning and adaptive behavior. Existing research has highlighted that, when individuals make or perceive errors, specific brain signals known as error-related potentials (ErrPs) can be detected in electroencephalography (EEG), including the error-related negativity (ERN) component. These components have received significant interest for their potential use in brain-computer interfaces (BCI) applications, which enable users to communicate by decoding their brain activity.

In this study, we investigated the possibility of using a support vector machine classifier to accurately distinguish between self-agency errors and other-agency errors in the EEG signal at a single-trial level. The study involved 23 participants, and the results demonstrated the feasibility of correctly identifying self/internal versus other/external errors at different stages of brain processing. This discrimination was based on the timing (latency) and the spatial distribution (topographical distribution) of key ErrP features, namely the ERN and P600 components, respectively. These findings offer a fresh perspective on how to discern self-generated errors from externally generated errors, opening up new potential applications for BCI systems.

20 Distinct roles played by Dopamine and Serotonin systems in approach-avoidance behavior : a pharmacological study associated with PET imaging in non-human primate.

Gauthier lisa <lisa.gauthier@isc.cnrs.fr> (1) (2), Drui guillaume (2), Debatisse justine (2) (3), Saga yosuke (2), Millot mathilde (2), Martinez eva (2), Météreau elise (2) (4), Portier karine (1) (5), Tobler philip N (6), Tremblay léon (1) (2), Pasquereau benjamin (1) (2)

1 - UniversitÃ© Claude Bernard Lyon 1 (France), 2 - Institut des sciences cognitives Marc Jeannerod - Centre de neuroscience cognitive - UMR5229 (France), 3 - Centre de recherche en neurosciences de Lyon - Lyon Neuroscience Research Center (France), 4 - Hospices Civils de Lyon (France), 5 - VetAgro Sup - Institut national d'enseignement supÃ©rieur et de recherche en alimentation, santÃ© animale, sciences agronomiques et de l'environnement (France), 6 - Laboratory for Social and Neural Systems Research (Switzerland)

Approaching pleasant, positive stimuli and avoiding unpleasant, negative ones is a core element of adaptive behavior in response to important, emotionally valenced stimuli. Biased approach-avoidance behaviors are a hallmark of many psychiatric disorders such as depression, anxiety and substance use disorders. To regulate appetitive and aversive motivational states involved in these types of behaviors, the proper attribution of positive or negative valence is thought to be regulated by the dopamine (DA) and serotonin (5-HT) systems. However, the specific roles played by DA and 5-HT neurotransmissions in approach-avoidance tendencies remain unclear. Some studies suggest a distinct involvement of these two neurotransmitters in motivation to achieve rewards or to avoid negative events, while others describe a combined regulation of approach-avoidance behaviors by both DA and 5-HT systems. To address this issue, we compared the effects of DA or 5-HT manipulation in 4 macaque monkeys trained to perform an approach-avoidance task in which animals had to adapt their behavior depending on the valence of visual stimuli. Elevations in synaptic dopamine levels were induced via injections of methylphenidate (MPH) (0.1 mg/kg), while 5-HT levels were selectively boosted by some injections of fluoxetine (FLX) (4 mg/kg). In addition, we conducted PET scans with [11C]PE2I or [11C]DASB to identify where in the brain these two reuptake inhibitors acted primarily to modulate DA/5-HT systems and further affect monkeys' choice. Consistent with a selective role of DA in regulating approach responses, monkeys exposed to MPH showed an increase in the willingness to work to get rewards and no effects on aversive condition. Combined with imaging findings, these results suggest a specific role of DA in the processing of positive information within the anterior striatum. Monkeys exposed to FLX showed a better self-control and task engagement in aversive condition, when animals avoided anticipated air-puffs. These drug-induced effects indicate a strong involvement of 5-HT system in regulating the processing of negative information required to drive avoidance behavior. In PET results, the neural network supporting this negative valence system appears to be distributed between the limbic cortical regions and the anterior striatum. Hence, in addition to a key role in appetitive processing modulated by the DA system, our results shed light on the involvement of the anterior striatum in aversive processing modulated by the 5-HT system. Together, DA and 5-HT systems appear to play complementary roles in

21 Dopamine boosts prosocial motivation for effort in Parkinson's disease

Talbot jamie <jtalbot.esq@gmail.com> (1), Cutler jo (1), Tamm marin (2), Lockwood patricia (1) (2), Apps matthew A. J. (1) (2)

1 - University of Birmingham [Birmingham] (United Kingdom), 2 - University of Oxford (United Kingdom)

Dopamine is well known to play a crucial role in motivating people and animals to exert effort to obtain rewards for themselves. However, there is mixed evidence for the role dopamine plays in social decisions. Some evidence suggests it may increase selfish behaviours that benefit oneself at the expense of other people's outcomes, but other work shows increasing dopamine can increase people's willingness to benefit others. However, the paradigms have often conflated one's own rewards with other people's and have not measured people's sensitivity to the effort of the prosocial act. Here, we tested between two hypotheses: (i) that boosting dopamine might increase people's willingness to put in effort for ourselves relative to working for other people or (ii) that boosting dopamine will increase our willingness to be prosocial and put in effort for others. To test between these hypotheses we tested 37 patients with Parkinson's disease (PD) on and off their usual dopaminergic medication, and 42 healthy, age-matched controls, on a prosocial effort task where participants made decisions on separate trials about whether to exert effort to increase their own bonus payment or to increase the bonus of an anonymous others. In line with previous studies participants were overall prosocially apathetic - less willing to work and exert effort for reward when the recipient was another participant compared to themselves. However, on dopamine PD patients showed a reduction in this prosocial apathy, with an increased willingness to choose to exert effort for others. In addition on dopamine PD patients showed increased sensitivity to reward for both self and other, and showed increased vigor in their motor responses. These results support the notion that dopamine plays an important role in prosocial behaviour, increasing the willingness to exert effort for others and reducing selfish tendencies.

22 Dynamical effort allocation in an effort-cost decision-making task in schizophrenia

Blouzard elodie <elodie.blouzard@univ-grenoble-alpes.fr> (1), Bastin julien, Dondé clément

1 - Grenoble Institut des Neurosciences (France)

Negative symptoms (i.e.; amotivation, social withdrawal, alogia, and flat affect) are a part of the schizophrenia's syndrome and are responsible for a significant part of the functional impairment of patients. There exists no treatment to alleviate these symptoms partly because their cognitive mechanisms are not well understood. Effort-cost decision-making tasks have been developed in order to understand the mechanisms behind amotivation. We used such task to explore the mechanisms of amotivation through studying dynamical effort allocation. The goal was to study online adaptation to effort to understand the cognitive mechanisms behind effort initiation and re-initiation. The task consisted of 30s trials with varying levels of difficulty (3 levels) and incentive (3 levels). Trials were designed so that subjects could not maintain their effort for the whole duration. The goal was to generate effort reinitiations to study their computational determinants. Healthy controls (N = 27) had higher performance than people with schizophrenia (N = 28) ($F(1,55) = 10.6$, $P = 0.002$) and there were significant group by difficulty interaction ($F(2,2648) = 6.75$, $P = 0.001$) and group by incentive interaction ($F(2,2648) = 4.42$, $P = 0.01$) suggesting a faulty integration of effort parameters in decision-making. These results echo other effort-cost decision-making study in schizophrenia which did not consistently detect a group effect on performance but consistently found different patterns of adaptation to effort between patients with schizophrenia and healthy controls. This faulty valuation of effort could in part explain negative symptoms as motivated behaviour is defined as overcoming an effort to get a reward. This thus constitutes a promising finding to understand the mechanisms behind negative symptoms. Next, exploring the neuroanatomical underpinnings of dynamical effort allocation in schizophrenia could also further our understanding of the phenomenon and help us find new leads for the treatment of negative symptoms.

23 Dynamics of Decision-Making: Insights from Eye-Tracking in a Choice Task with Monkeys

Lespart arnaud <arnaud.lespart@icm-institute.org>, Bouret sébastien (1)

1 - Institut du cerveau (France)

Understanding the dynamic of decision making is crucial in studying its neurophysiological substrates. In the classical theorical framework, decision-making process spans from options representation to action realization, implying involvement of both sensorial and motor processes. In this study we propose to investigate the dynamic between these different processes using eye tracking as a continuous behavioral measure. In addition, we posit that choice dynamic may also be influenced by preparatory processes occurring even before the options are available in the environment. To address these questions, we analyzed the behavior of two monkeys in a choice task manipulating effort and reward, in which the animals exerted effort by pressing a grip to obtain the chosen reward. Moreover, at to start each trial, the animals were required to touch a lever, followed by a one-second period before visual cues appeared. To study choice dynamics, we studied the influencing factors of choices, exerted force and eye-tracking measures. The monkeys' choices were clearly influenced by both reward and effort levels in each trial, and the animals adapted the exerted force, showing appropriate option valuation and appropriate mobilization of resource for action. Furthermore, their reaction times to perform the action depended on the difference in value between the two options (choice difficulty). Eye-tracking data analysis revealed that the animals fixated on the visual cues of the chosen option before executing the action. Saccade analysis unveiled a dichotomy, with some trials exhibiting a single saccade towards the chosen option, while others, characterized by higher choice difficulty, involved multiple saccades towards both options. Overall, the reaction time for the final saccade towards the chosen option was dependent on choice difficulty, indicating a significant step in the decision-making process. In the period preceding cue onset, the animals exhibited a significant reduction in the number of saccades in the last 500ms, along with a closer average gaze position to the center of the screen. Interestingly, a decrease in gaze position distance from the center of the screen significantly reduced reaction time for choice-triggering saccades, suggesting a preparatory process for receiving sensory information. Furthermore, gaze position during this period weakly correlated with the side chosen by the animals, demonstrating an influence of this preparatory phenomenon on the weight assigned to each option. These results demonstrate that the decision-making process can be dynamically influenced by preparatory processes,

24 Electrocortical positive prediction error processing in threat avoidance versus monetary reward learning

Stolz christopher <christopher.stolz@ovgu.de> (1) (2) (3), Pickering alan D. (3), Mueller erik M. (2)

1 - Institute of Psychology, Otto-von-Guericke University Magdeburg (Germany), 2 - Department of Psychology, University of Marburg (Germany), 3 - Department of Psychology, Goldsmiths, University of London (United Kingdom)

Prediction error processing has been associated with electrocortical activity, including slow wave delta-band activity and frontal midline theta (FMÎ¸), along with phase-locked event-related potentials. However, most studies on electrocortical processing in reinforcement learning have used paradigms involving reward- rather than threat-related reinforcer. Consequently, the electrocortical processes in in threat-related reinforcement learning scenarios are widely unknown. Here n = 106 participants underwent one reward-related and one punishment-related three-armed bandit task. Feedback in the reward task signalled monetary reward (+10 Cent) versus non-reward (+0 Cent) and feedback in the punishment task signalled non-punishment (no noise burst) vs. punishment (noise burst titrated to match aversiveness of monetary non-reward). Single-trial regression analyses demonstrated that delta-band activity and FMÎ¸ both positively scaled with a computationally derived PE+ that was calculated using a state-action value function. In the punishment vs. reward task, there were no differences in the associations between PE+ and slow wave oscillations. However, it was found that the Reward Positivity (RewP) was stronger positively associated with reward vs. threat PE+, while the P300 was more sensitive to threat vs. reward PE+. It is possible that threat and monetary reward prediction errors are qualitatively different at the neural level or are represented more prominently by different hierarchies of prediction errors, such as reward vs. salience prediction error.

25 The motivation to exert effort under the pressure of a deadline.

M.Andrea Pisauro, Matthew Apps

m.a.pisauro@bham.ac.uk

How do people motivate efforts towards a deadline? Recent research has identified some of the key computational and frontal-striatal mechanisms that guide effort-based decisions: how people weigh the cost (effort) of an action against potential rewards (e.g money). This research shows that when offering people a magnitude of reward, requiring an amount of effort, the benefits are devalued, and people will almost always avoid rewards associated with high efforts. Yet, in the real-world people often exert high efforts for little immediate reward. What are the psychological and neural mechanisms that underpin this “effort paradox”? We look into one example of this paradox by examining the effect of deadlines on effort-based decisions. Deadlines cause a feeling of pressure, that leads people to forego rewarding activities, in favour of effortful actions in pursuit of the goal. Here, we developed a decision-making task to examine how people’s willingness to put in effort changes when they have to work under pressure to reach a long term goal. Subjects had to exert a certain amount of physical effort (grip force) across consecutive trials. On each trial, they choose between a more effortful (which makes more progress towards the goal) but less rewarding option, or a rewarding but low effort (low progress) option. Using computational modelling we find people turn effort from a cost into something valuable the more they feel under pressure to achieve goals. fMRI results show frontal-cingulate regions signal levels of pressure, helping shift the value of effort from an avoided cost to a valued benefit. These results show how looming deadlines serve as key-drivers of motivation.

26	**Error-induced shifts in selective attention are mediated by the posterior medial frontal cortex (pMFC)**	Tegelbeckers jana <jana.tegelbeckers@ovgu.de> (1), Schaaf theresa (1), Markus ullsperger (1)	1 - Otto-von-Guericke-Universität Magdeburg = Otto-von-Guericke University [Magdeburg] (Germany)	Efficient, goal-directed behavior requires continuous performance monitoring to flexibly recruit and assign available neural resources. If errors are detected, adjustments in selective attention are often crucial for continuous successful performance. In humans, these adaptations are presumably coordinated by a cognitive control network centered in the posterior medial frontal cortex (pMFC). How this network interacts with selective attention and arousal to implement post-error changes is not yet fully understood. Here we aimed to investigate the relationship between performance monitoring signals and adaptations of visual selective attention using functional magnetic resonance imaging (fMRI) and pupillometry. 33 adult human participants performed a new visual attention paradigm (color orientation interference task) that requires rapid visual decisions while task expectation and response interference are manipulated. We found that errors led to an increase in pupil dilation as well as prolonged response times (post-error slowing). These effects were accompanied by activity in the pMFC and bilateral insula. Moreover, multivariate pattern analyses revealed post-error increases of visual attention signatures in the bilateral superior parietal lobules. Taken together, these results indicate that cognitive control mechanisms mediated by the pMFC shift attentional resources after errors are detected.
27	**Examining the Error Cancellation Effect in Children with the Arrow Flanker Task**	Khoo joshua (1), Sapachlari christina (1), Pfister roland (2), Derrfuss jan (1), Danielmeier claudia <claudia.danielmeier@nottingham.ac.uk> (1)	1 - University of Nottingham, UK (United Kingdom), 2 - Trier University (Germany)	A frequently neglected metric of human performance is response duration, measured as the interval from key press onset to offset. A recent study by Foerster et al. (2022) showed that response durations are significantly shorter for erroneous compared to correct responses. This error cancellation effect suggests that performance monitoring mechanisms are rapidly initiated even as a response is still ongoing. The present study investigated whether young children show evidence of this effect. 102 children ranging from 4 to 12 years performed a version of the arrow flanker task. The results showed that response durations were significantly shorter for erroneous responses, providing evidence for the error cancellation effect in children. In addition, the study found no effect of congruency on response duration, suggesting that the need to resolve interference does not affect response duration. In summary, this research demonstrates rapid within-trial performance adjustments in children and highlights the relevance of considering response durations alongside more conventional metrics such as reaction time and accuracy.
28	**Exploring the causal relation between the anterior Midcingulate Cortex in Cognitive Control through an offline Transcranial Ultrasound Stimulation Protocol**	Agostino camila <camila.agostino@ovgu.de> (1), Carpino eleonora (2), Verhagen lennart (2), Ullsperger markus (1)	1 - Otto-von-Guericke University [Magdeburg] (Germany), 2 - Donders Institute for Brain, Cognition and Behaviour (Netherlands)	Rapid and effective decision-making is often crucial for our survival across different scenarios. The cognitive control system plays a pivotal role in shaping the quality of decisions and guiding our actions. This system is closely associated with tasks such as conflict monitoring, detecting errors, and selecting appropriate responses and its vast literature has pointed the anterior midcingulate cortex (aMCC) to be related to these processes. However, a causal relationship between this region and these mechanisms is yet to be established. In this pilot study, we applied transcranial ultrasonic stimulation, a non-invasive method which allows deeper brain stimulation, to investigate the role of aMCC in error processing in three participants (2 men, age -+24.33 years old) before they performed a Flanker Task (up to 600 trials each session). The volunteers took part in a four-session experiment: (1) fMRI session, in which we functionally localised the aMCC, while they performed the Flanker Task; (2) TUS session; (3) sham stimulation; (4) TUS over an active control region, here posterior cingulate cortex. We used a fundamental frequency of 250kHz (4 element transducer) in a 5Hz protocol (SD: 80s; 1/PRF: 0.2s; PD: 0.03s ramping) with ISPPA of 30W/cm^2, ISPTA 4.5W/cm^2, and 60 mm focus. Simulations were performed to ensure that the applied intensity was within the safety limits. We used linear mixed model analysis to investigate the effects of congruence and stimulation (fixed effects, number of trials, and subject as random effect) on response time (RT) and accuracy. For RT (Fig.1A), significant main effects were observed for congruence (F(1,5374)=864.83, p
29	**Exploring the potential of advances in reinforcement learning for modeling human behavior**	Haberland sabine <sabine.haberland@tu-dresden.de> (1), Goschke thomas (1), Ruge hannes (1), Frimmel holger (1)	1 - TUD Dresden University of Technology, Institut of General Psychology (Germany)	The human brain filters complex information from the environment and quickly transforms them into appropriate responses. However, our understanding of how humans process high-dimensional stimuli within a time-continuous environment remained somewhat limited, partly due to commonly employed study designs that rely on discrete temporal structures. Expanding upon the insights gained from these studies, in psychological research, deep learning in combination with reinforcement learning became increasingly important. Deep Q-networks (DQNs) enabled the investigation of time-continuous behavior. Recent advances in machine learning research have empowered DQNs to solve complex tasks reaching human level and beyond. However, do these advancements translate into improved quality of modeling time-continuous human behavior? To investigate this question, we recorded motor responses in human subjects (N=23) playing three arcade games. We used a DQN as a nonlinear, feature-generating mapping and a linear model to link stimulus activations of the top layer of the DQN to human motor responses. In order to assess progress in reinforcement learning, we considered two recently developed DQNs (Ape-X and SEED) and a baseline DQN, differing in network architecture, training procedures and model complexity. We compared their model performances using the features generated by these DQNs as predictors for human behavioral data. To evaluate prediction accuracy, we computed the correlation between the predicted and actual human time series using a cross-validation procedure. The results showed that all three DQNs predicted human behavior significantly above chance at a fine-grained temporal scale. Prediction accuracy increased with increasing neural network complexity, with the most advanced model, SEED, providing features for the highest prediction accuracy. These findings suggest that improved DQNs are suitable tools for modeling human behavior in arcade games, paving the way for further research in this direction.
30	**Feedback-based learning dynamics impact incidental memory for feedback stimuli in a probabilistic reversal-learning task**	Kuczka lena <lena.kuczka@ovgu.de> (1), Nickel mara (1), Kirschner hans (1), Ullsperger markus (1)	1 - Otto-von-Guericke-Universität Magdeburg = Otto-von-Guericke University [Magdeburg] (Germany)	Previous work has highlighted the involvement of the acetylcholine neurotransmitter system in performance monitoring, episodic memory and novelty detection processes. We have developed a combined probabilistic choice and incidental learning paradigm with an additional novelty component for use in an upcoming fMRI study to investigate cholinergic modulation of interactions between the posterior medial frontal cortex and the hippocampus. We collected behavioral data from 28 pilot participants in order to assess the feasibility of the task and used single-trial regression and computational modelling to investigate the impact of trial characteristics on participants' learning behavior, reaction times and recognition memory for face stimuli shown as feedback. Overall, subjects' choices followed the reward probabilities of the stimuli. Magnitude but not direction of reward prediction errors were found to slow responses on subsequent trials and to enhance incidental learning of feedback stimuli.

31 Frontal beta burst properties are an index of motivation and apathy in a macaque model of Parkinson's disease.

Wilson charlie <charles.wilson@inserm.fr> (1), Godet agathe, Langford zachary, Procyk emmanuel

1 - Institut cellule souche et cerveau (Centre de recherche Inserm 18, avenue du doyen lepine 69676 BRON CEDEX France)

Beta and gamma oscillations have a pivotal role in coordinating cognitive control in frontal cortex. We have shown that average prefrontal beta power tracks trial-by-trial levels of cognitive control, but also varies across trials within session reflecting the manner in which monkeys resist the effects of fatigue on performance (Stoll, Wilson et al 2016 Cerebral Cortex). This latter signal is therefore a potential biomarker of changes in motivation or increasing fatigue over time. It could therefore be of use in the context of pathologies that show motivational changes as a key symptom, for example Parkinson's disease. Detailed study of the raw signal of these oscillations shows that their true occurrence is as circumscribed bursts, and that analysis of the properties of the individual bursts can reveal the mechanisms behind their encoding of behavioural variables like motivation. Here we recorded prefrontal and sensorimotor ECoG from two monkeys learning a trial-and-error problem solving task in which they repeatedly moved between exploration and exploitation periods, using feedback to search for, find, and repeat rewarded responses. After an initial baseline period of recordings, the monkeys followed a longitudinal protocol of low dose injections of the neurotoxin MPTP, with daily behavioural scoring allowing us to cease injections when significant Parkinson-like motor symptoms emerged. The protocol was therefore designed to induce the slow progressive loss of the nigrostriatal dopaminergic pathway that characterises the pre-symptomatic phase of Parkinson's disease. We studied the properties of the bursts of frontal beta oscillations during the task, and specifically the changes in those properties across the session that appear to track motivational parameters. We show a double dissociation in the way beta oscillations encode the cognitive control for the task (by changing amplitude) and the way they track motivation or effort (by changing duration). We also showed nonlinear changes in motivational measures throughout the longitudinal MPTP protocol €“ monkeys showed a drop in motivation at protocol onset and at the end but recovered in the middle. This suggests potential compensatory mechanisms, and we make propositions based on the data for the neural basis of this compensation. Support: Marie Curie IEF to CREW: €œReversible Cognition€ 273790; LabEx Cortex: ANR-11-LABX-0042; Fondation Neurodis; ANR €œPREDYCT€ ANR-18-CE37-0016.

32 Greater wealth is associated with higher prosocial preferences and behaviours across 76 countries

Vanags paul <paulvanags@gmail.com> (1), Cutler jo (1)

1 - University of Birmingham [Birmingham] (United Kingdom)

Prosocial preferences and behaviours €“ defined as those that benefit others €“ are essential for health, well-being, and a society that can effectively respond to global challenges. Research has therefore focussed on factors that may increase or decrease them. How objectively wealthy an individual is, as well as how subjectively wealthy someone feels, may be crucial in determining prosocial motivations. However, previous studies have often relied on small non-representative samples and/or on a limited range of measures. Furthermore, experience of precarity, limited access to food and shelter, could change how wealth correlates with prosociality. Using data from 80,337 people across 76 countries, we show that both objective wealth (household income), and subjective wealth (financial well-being), are positively and consistently associated with higher prosociality. Objective wealth was positively associated with altruism, positive reciprocity, donating money, volunteering, and helping a stranger, but negatively associated with trust. Subjective wealth was positively associated with all aspects of prosociality, including trust. Experience of precarity reduced associations between wealth and prosocial preferences yet increased them for prosocial behaviours. These findings could have important implications for enhancing prosociality, critical for a healthy and adaptive society.

33 Impact of the sulcal pattern variability on the distribution of cytoarchitectonic areas in the medial prefrontal cortex in macaques

Morel Latour valentine <valentine.morel-latour@inserm.fr> (1), Amiez celine (1), Gandaux clémence (1), Misery pierre (1), Lamy camille (1), Procyk emmanuel (1), Sallet jérôme (1)

1 - Institut cellule souche et cerveau / Stem Cell and Brain Research Institute (France)

The Medial Prefrontal Cortex (mPFC) plays an important role in reward and error monitoring and in behavioural adaption. This heterogenous region is composed of multiple cortical areas, but their specific functions remain debated. As the structural properties of a brain region constrain the computations it could support, it is crucial to understand its organization. We hypothesize that a better grasp on the impact of the interindividual structural variability in the mPFC on the distribution of cytoarchitectonic areas will help interpreting results of MRI and electrophysiological studies in rhesus macaques. Based on recent studies on the sulcal pattern variability of the mPFC (Amiez et al. 2019; Lopez-Persem et al. 2019), we investigated the link between 4 different sulci, namely the Dorsal Extension (CGS-DE) or a Ventral Extension (CGS-VE) of the cingulate sulcus, the Rostral Sulcus (ROS-S) and the Accessory Supraorbital Sulcus (ASOS) to better understand the link between cytoarchitecture and sulci. Preliminary results have shown that i) ROS-S is not a boundary between areas 14m and 32 as previously suggested ii) CGS-DE is limiting between the area 10 and the area 9 and iii) The Accessory Supra Orbital Sulcus (ASOS) is an axial sulcus of area 10.

34 Impaired integration of subjective illusory contours in adults with ADHD

Kuznetsova elizaveta <elizaveta.kuznetsova@helsinki.fi> (1), Tammi tuisku (2), Postnova natalia (1), Palomà¤ki jussi (2), Cowley benjamin (1) (2)

1 - Faculty of Educational Sciences, University of Helsinki, Helsinki, Finland (Finland), 2 - Cognitive Science, Department of Digital Humanities, University of Helsinki, Helsinki, Finland (Finland)

Attention-deficit hyperactivity disorder (ADHD) in adults is associated with neuropsychological deficits in inhibition of interference, saliency processing, and sustained attention (Sergeant, et al, 2002). While these aspects of attention have been well-studied in isolation, their interaction is underrepresented in the literature on ADHD, despite this interaction being exactly what is required to perform complex naturalistic tasks. We have thus constructed a protocol which presents gestalt-stimuli targets with distractor primes to probe the interplay between these cognitive processes during visual attention task. The data was collected from 53 adults with ADHD (25 male, 28 female, aged 18-60) and 18 matched healthy controls measured with high- resolution electroencephalography. Growth curve modelling approach was used to analyse participant-wise reaction time (RT) and RT variability change over the time of the experiment. On the neural level minimum-width envelopes (MWEs) confidence bands were calculated to show whether event-related potentials (ERPs) are drawn from separate distributions. On the behavioural level, we found differences in the level of performance (speed and variability) between ADHDs and Controls, which are mostly coming from trials with abnormally slow responses. However, ADHDs were moving towards more stable and fast performance over time and alleviate the differences with the Control group at the end of experiment. Our data did not reveal any significant differences in the patterns of learning between ADHDs and Controls, although for ADHD group the learning period lasted longer than for Controls. On the neural level, ADHD adults demonstrated reduced activity in all experimental conditions in comparison with Controls, especially in the parietal area of the brain and in occipital area in response to targets.The morphology of the ERP waves looked similar for both groups along the whole length of epoch, but ADHDs responded with smaller amplitude and the deflection peaks of late components in frontal and occipital areas were delayed in time. The insights from the current research shed the light on visual attention processes in adult ADHD and demonstrate potential deficits in bottom-up and top-down mechanisms the group might experience. Sergeant, J. A., Geurts, H., & Oosterlaan, J. (2002). How specific is a deficit of executive functioning for attention-deficit/hyperactivity disorder?. Behavioural brain research, 130(1-2), 3-28.

35 Initial learning of S-R links: Instruction vs. Experience

Fregni sofia <sofia.fregni@tu-dresden.de> (1), Wolfensteller uta (1), Ruge hannes (1)

1 - Technische Universität Dresden = Dresden University of Technology (Germany)

In this study, we used fMRI to investigate the neural changes and representational dynamics associated with different learning modes. Participants engaged in a rapid stimulus-response (S-R) association task, where we compared instruction-based learning (IBL) and trial-and-error (TE) learning via a third condition that involved observing correct and incorrect S-R links along with post-rule feedback. During learning, neural changes were observed in the Frontoparietal Network (FPN) and Default Mode Network (DMN) across all learning modes, possibly reflecting task automatization. IBL and TE additionally exhibited condition-specific signal changes, which we interpreted in the context of covert motor preparation and increased cognitive demand in IBL and TE, respectively. Multivariate pattern analysis revealed decodable rules in bilateral prefrontal and parietal cortices for all learning modes, but differentially in the learning and implementation stages. A significant pattern similarity effect was found in the bilateral premotor cortex, with a stronger effect in the right IFJ during learning. In a left motor ROI, contralateral to response implementation, individual S-R rules were decodable across conditions as early as from the learning stage, with a significantly stronger effect in TE. Bilateral VLPFC, parietal, premotor, and left motor ROIs, all contained representations of individual S-R rules that were consistent from the learning to the implementation stage, with TE showing a significantly stronger effect in the left motor ROI. Together, these results suggest that covert motor preparatory mechanisms are engaged early during learning, even in the absence of overt motor implementation, as in IBL. Furthermore, rules are consistently represented from the learning to the implementation stage, possibly indicating an early, prior implementation abstract-to-pragmatic transformation.

36 Learning the landscape: Computational mechanisms for learning the opportunity costs of effort in different environments

Scholey emma <exs165@student.bham.ac.uk> (1), Apps matthew (1)

1 - Centre for Human Brain Health and Institute for Mental Health, School of Psychology, University of Birmingham (United Kingdom)

When you move to a new city, how do you decide which route to take to work? Should you go via the steep path in front of you, or should you spend a bit longer going via the flatter route? To make these decisions effectively, we have to learn over time whether its €˜worth it' to exert effort given the alternative options in the environment, otherwise known as the opportunity costs. Whilst prior research has investigated the computational mechanisms underlying the opportunity costs of reward in the environment, these models cannot account for effort. Here, we introduce a new time-based task where participants must decide whether to spend time exerting different levels of physical effort for reward, or to forgo the current option and wait for potentially less effortful alternatives. Participants complete this task in both easy environments (where options were less effortful on average) and hard environments (where options were more effortful). Critically, participants were not informed which environment they were in, so must learn the average effort of available options in order to adapt their decisions to the environment. We found that participants accounted for the opportunity cost of effort in their decisions; in harder environments, participants were more willing to exert moderate physical effort. We also show that this opportunity cost effect increases over time, as participants learned about the opportunity costs (and average effort) available in their environment. Extending previous opportunity cost models that only consider reward, we show that a reinforcement learning based model that tracks the opportunity cost of effort can explain changes in participant choices over time, compared to models that do not track opportunity costs. These findings provide a new computational framework for a broad class of decisions that were previously unexplored.

37 Link between flow and performance updated with physiological markers

Rudakov evgenii <evgenii.rudakov@helsinki.fi> (1), Lappi otto (2), Pettersson kati (3), Mà¤ntyjà¤rvi jani (3), Cowley benjamin (1) (2)

1 - Faculty of Educational Sciences, University of Helsinki, Helsinki (Finland), 2 - Cognitive Science, Department of Digital Humanities, Faculty of Arts, University of Helsinki (Finland), 3 - VTT Technical Research Centre of Finland (Finland)

Flow is an intrinsically motivating psychological state generated by the exercise of skilled control in a demanding activity. It is known to be highly interconnected with increased performance and lowered self-criticism [1]. Cowley et al [2] tested the hypothesis that the relationship between Flow and performance may not be driven by the absolute performance, but instead by the discrepancy between anticipated and observed performance outcomes (the so-called Flow deviation, or F˜d model); an effect which scales with task experience as anticipation of performance becomes more precise. The explanatory power of this model is strong but not perfect. Here, we examine how psychophysiological variance can help explain the remaining variance. Flow state is typically assessed through questionnaires, which are susceptible to biases due to subjective self-reporting. Similarly, anticipated performance is derived from projections based on past performances. While actual performance can be measured, its perception by participants remains difficult to quantify. In light of these challenges, we employed a data-driven methodology to identify psychophysiological markers that could contribute to bridging the gap in the F˜d model. We analyzed longitudinal data from 18 participants. They performed a steering task designed to reliably induce Flow by balancing skill and demand levels. During the sessions, we recorded a set of physiological signals from participants, including gaze positions, pupil sizes, blood volume pressure (BVP), and electrodermal activity (EDA). After each trial, participants were asked to fill out a Flow assessment questionnaire. From the gathered signals, a set of descriptive features were extracted, based on the first ten seconds of each trial to control for behavioural variance. Linear mixed models of Flow predicted by performance deviation were tested with added fixed effect of psychophysiology, adding one such features to each model to find which explained the most Flow variance. By incorporating physiological features into the F˜d model, we observed an increase in the explained variability for certain features. The most significant of which is gaze transitional entropy, a measure of complexity of gaze behavior. Features related to EDA and BVP did not significantly explain the variance in Flow. Neither of the markers associated with arousal states demonstrated a significant contribution to F˜d model. In addition, gaze transitional entropy may manifest enhanced peripheral vision, usually associated with relaxed states. While Flow is commonly linked to a high arousal state, our

38 Locus Coeruleus inactivation in rhesus monkeys disrupts performance in non-visual version of a search task

Perez pauline <pauline.perez2@icm-institute.org> (1), Bouret sébastien (1)

1 - Institut du Cerveau = Paris Brain Institute (France)

It has been showed in previous studies that the noradrenergic (NA) system, and more specifically the Locus Coeruleus (LC), was involved in physical effort (Borderies et al. 2020, Varazzani et al. 2020, Bornert et al. 2021). However, its role in cognitive effort is still to be demonstrated. To test it, we used a search task requiring working memory in three rhesus monkeys (Collin et al, 1982). The task consisted of a 5x5 matrix of 25 wells containing food rewards that were either visible through transparent doors or hidden behind opaque ones. In opaque, but not in transparent condition animals must use a mental representation of a constantly changing environment to keep track of past actions to infer reward availability. To assess the role of LC in that task, we specifically and reversibly inhibited the LC in two monkeys using chemogenetics, a technique that consists in activating with a pharmacological drug (DCZ) an inhibitory receptor (DREADD) previously implemented and expressed in the region of interest, here the LC. We showed that injection of the DCZ had an effect only in opaque condition and only in the two monkeys expressing the DREADD in the LC, but not in the control monkey. More precisely, we showed that the number of errors was affected by the inhibition of the LC but only in opaque condition, suggesting that the treatment affected the cognitive resource without affecting sensorimotor functions. This preliminary analysis is compatible with the idea that the LC plays a critical role in working memory, and further analysis should enable us to better understand its role in cognitive effort.

39 Meta-cognitive judgements of confidence in effortful tasks are susceptible to momentary fluctuations in fatigue

Dudzikowska katarzyna <kad001@bham.ac.uk> (1), Apps matthew (1)

1 - Centre for Human Brain Health and Institute for Mental Health, School of Psychology, University of Birmingham (United Kingdom)

As we engage in tasks we form metacognitive judgments of our performance and how confident we are to succeed. Classical theories suggest that meta-cognitive assessments of confidence are a read out of the probability of obtaining a successful outcome of an effortful process. However, other lines of research show that confidence may be susceptible to fatigue and that fatigue fluctuates from moment-to-moment during effortful tasks, even in situations where participants continue to successfully perform effortful behaviours sufficiently to achieve rewarding outcomes. Here, we present results from two studies where participants completed a physically effortful task which involved exerting prescribed levels of force on a hand-held dynamometer. On each trial, before performing each effortful exertion, they reported confidence in their ability to succeed (study 1) or confidence or subjective fatigue on interleaved trials (study 2). We find that despite participants maintaining high levels of success (mean success rate: 97.15%) confidence in the ability to succeed significantly decreased over the course of the task, and on a trial-to-trial basis as a function of effort. Moreover, we show that a modified version of a previous computational model of momentary fatigue can account for fluctuations in confidence judgments. These results suggest that, far from a read out of the probability of success, meta-cognitive judgements of confidence are susceptible to fluctuations in fatigue even in situations where people continue to succeed at a task.

40 Modulation of the Cognitive Stability-Flexibility Trade-Off by Instruction and Reward

Bartossek marie Therese <marie_therese.bartossek@tu-dresden.de> (1), Mà¶schl marcus (1), Knaup lara (1), Haynes john-Dylan (2), Goschke thomas (1)

1 - Faculty of Psychology, TUD Dresden University of Technology, Germany (Germany), 2 - Berlin Center for Advanced Neuroimaging, CharitÃ© €“ Universitätsmedizin Berlin, Germany (Germany)

In everyday life, some situations require us to react quickly to changes in our environment while others require us to focus our attention on a single task and shield it from distractions. The control-dilemma theory posits that in order to cope with changing situational demands, we need to balance cognitive stability and flexibility since both are presumed to incur complementary costs and benefits. While several studies have demonstrated individual performance costs and benefits of cognitive stability and flexibility, only few studies have empirically examined the notion of a stability-flexibility trade-off. With our study, we aimed to test for such an antagonistic relationship and investigated potential moderators of these control functions. We examined whether cognitive stability and flexibility can be regulated voluntarily in response to specific task instructions. Additionally, we tested whether a higher informative content of potentially distracting information facilitates a shift toward cognitive flexibility. Participants were assigned to one of two task-switching paradigms in which distractors were either informative of the upcoming target stimulus or irrelevant for task performance. In a within-subjects design, participants were either instructed to focus their attention on the current task (stability condition) or to shift their attention between tasks as flexibly as possible (flexibility condition) to maximize a monetary bonus. In line with our hypothesis, participants showed increased cognitive flexibility in terms of smaller task-switch costs in the flexibility condition. By contrast, the strategy instructions did not affect participants' cognitive stability as indicated by no changes in interference costs related to the conflicting target dimension. Importantly, however, we found evidence for a stability-flexibility trade-off in terms of reciprocal performance benefits and costs on an individual level. The effect of the strategy instructions further did not differ between the two paradigms, indicating that the task relevance of distractors did not moderate cognitive control regulations. Keywords: cognitive control, stability-flexibility dilemma, control dilemmas, meta-control, task switching.

41 NETWORK MODULATION BY PATHWAY-SPECIFIC CHEMOGENETICS IN FRONTAL CORTEX OF MACAQUE MONKEYS

Gandaux clémence <clemence.gandaux@inserm.fr> (1), Sallet jérôme (1), Procyk emmanuel (1), Wilson charles (1)

1 - Institut cellule souche et cerveau / Stem Cell and Brain Research Institute (France)

A critical advance in neuroscience is the ability to intervene reversibly in a pathway specific manner on interactions between brain regions. Such interventions provide understanding of the causal role of the interactions, but also set out routes towards therapies in cases where pathology is, to some extent, pathway specific. Pathway-specific DREADDs (Designer Receptor Exclusively Activated by Designer Drugs) provide a tool, only now emerging in primate species, that permits the targeting and modulation over a period of hours of a specific neural pathway. Here we present preliminary data on pathway-specific DREADDs in macaque monkeys with assessment of DREADD activation with a behavioral task, and validation of expression with histology. We targeted two different specific pathways in two groups of macaques (n=2 each). The targets were frontal cortex networks putatively involved in flexible decision making and exploratory behaviours. First, we targeted the cortico-cortical pathway from midcingulate cortex (MCC) to dorsolateral prefrontal cortex (dlPFC). To do so the floxed genetic material for the hM3Dq DREADD receptor carried by AAV was injected in the MCC, and then Cre Recombinase carried by canine adenovirus 2 (CAV-2) - a retrograde viral vector €“ was injected in the dlPFC. Only neurons transfected by both AAV and CAV-2 should express DREADDs. In the second group we sought to target noradrenergic Locus Coeruleus (LC) neurons projecting to MCC. Here we injected a single vector into MCC €“ CAV-2 €“ but with the hM3Dq DREADD under the PRS promoter that should limit DREADD expression to noradrenergic neurons. In both groups we sought to reveal a behavioural effect of pathway-specific DREADD receptor activation using the ligand Deschloroclozapine (DCZ). We tested the animals on a Spatial Foraging task (SFT25) in their homecages, to test patterns of foraging choices and decisions thereby assessing spatial exploratory behaviour though to implicate these specific pathways. We present results showing the effect of the DREADDs on this task in both groups. We also present detailed histological analysis of the brains of the first group, validating the DREADDs pathway-specific transfection of the MCC-DLPFC network.

42 Neural dynamics of dynamic effort allocation

Kukkonen nanne <nannekukkonen@gmail.com> (1), Braem senne (1), Mattioni stefania (1), Eayrs joshua (1), Steendam tabitha S. (1), Chai mengqiao (1), Krebs ruth (1)

1 - Ghent University (Belgium)

Effort is conceptualised as a decision-making problem: the inherent cost of effort is weighed against the incentives to expend effort. Effort allocation is based on this cost-benefit calculation. Until now, effort evaluation has not been systematically separated from the preparation stage where the aversive nature of effort is translated into invigoration to ensure successful task performance. Effort-based decision-making studies (where effort is not necessarily exerted after a decision about effort is made) have provided evidence of effort discounting of reward in the brain. However, effort-expenditure studies, where a cue informs participants of the reward and demand level of the upcoming task, uncovered that high demand can also motivate effort allocation. Most effort, as indexed by recruitment of neural structures underlying effortful control, is exerted in a high demand context when the incentive is high. In the present fMRI study we explored effort as a dynamic process involving both evaluation (decision-making) and allocation (preparation for task) in a within-participants study (n = 41) to reconcile the earlier, seemingly contradictory, findings in the effort literature. Participants completed a speeded cognitive control task, alternating between four cueing conditions that differed in the incentive level (high vs. low reward) and demand level (easy vs. difficult). A trial began with an €˜evaluation cue' that informed the participants of the condition, prompting evaluative processing of the upcoming effort condition. An evaluation cue was succeeded by an €˜allocation cue', during which preparation for the coming task took place, followed by the actual task (5 targets in a row). The whole-brain activity within the evaluation phase and the allocation phase were tested separately. Conceptualising effort as a multi-stage, dynamic process, enabled us to examine stages of effort in evaluative and attentional control networks. We hope this operationalization of effort provides researchers and clinicians a way to zoom in on the components of effort expenditure in both healthy and disrupted effortful behaviour.

43 Neural dynamics underlying self-control in the primate subthalamic nucleus

Pasquereau benjamin <benjamin.pasquereau@isc.cnrs.fr> (1)

1 - Institut des sciences cognitives Marc Jeannerod - Centre de neuroscience cognitive - UMR5229 (France)

The subthalamic nucleus (STN) is hypothesized to play a central role in neural processes that regulate self-control. Still uncertain, however, is how that brain structure participates in the dynamically evolving estimation of value that underlies the ability to delay gratification and wait patiently for a gain. To address that gap in knowledge, we studied the spiking activity of neurons in the STN of monkeys during a task in which animals were required to remain motionless for varying periods of time in order to obtain food reward. At the single-neuron and population levels, we found a cost€"benefit integration between the desirability of the expected reward and the imposed delay to reward delivery, with STN signals that dynamically combined both attributes of the reward to form a single integrated estimate of value. This neural encoding of subjective value evolved dynamically across the waiting period that intervened after instruction cue. Moreover, this encoding was distributed inhomogeneously along the antero-posterior axis of the STN such that the most dorso-posterior-placed neurons represented the temporal discounted value most strongly. These findings highlight the selective involvement of the dorso-posterior STN in the representation of temporally discounted rewards. The combination of rewards and time delays into an integrated representation is essential for self-control, the promotion of goal pursuit, and the willingness to bear the costs of time delays.

44 Neural underpinnings of affective forecasting in patients with recent suicide attempts

Deng wenrui <w.deng@umcg.nl> (1), Dickhoff justine (1), Opmeer esther M. (2), Marsman jan-Bernard C. (1), Aleman andre (1), Van Tol marie-José (1)

1 - Cognitive Neuroscience Center, Department of Biomedical Sciences of Cells and Systems, University Medical Center Groningen (UMCG), Groningen, Netherlands (Netherlands), 2 - Hogeschool Windesheim, Zwolle (Netherlands)

Objective: Suicidal risk is associated with feelings of hopelessness and pessimistic anticipation towards the future. This study aimed to investigate whether reduced vividness in future envisioning is a distinct characteristic among patients with recent suicide attempts and the underlying neural mechanisms. Methods: Task-fMRI data from the HOPES clinical study were analyzed, including three groups, patients with a recent suicide attempt (SP, N = 23), matched patient controls (PC, N = 22), and non-patient controls (NPC, N = 23). During fMRI scanning, participants performed the affective forecasting task to envision positive and neutral future events. Differences in the vividness of the imagination and brain activation were compared across groups by using ANCOVA. Association between suicidality, brain activation, hopelessness, and anticipatory pleasure were evaluated by using regression analyses. Results: Patients with recent suicidal attempts and PC showed reduced vividness during future imagination compared to NPC. Envisioning positive events was associated with increased activation in brain regions encompassing the default mode network and limbic areas, coupled with reduced activation in the dorsal attentional network and premotor cortex relative to imagining neutral events. During the imagination of positive events, both suicidal and non-suicidal patients exhibited increased activation in the left dorsolateral prefrontal cortex (DLPFC) and increased activation in the left insula, left middle frontal gyrus, and left DLPFC during the imagination of neutral events relative to NPC. Additionally, NPC showed stronger associations in regions at the right IPL, the right DLPFC, and the ACC with anticipatory pleasure, while patient groups showed a lack of brain activity associated with anticipatory pleasure when they were imagining positive events compared with neutral events. Conclusion: These findings suggest that suicidal and non-suicidal patients both have difficulties in vividly envisioning a positive future, which is associated with anhedonia and dysfunction in brain regions involved in emotional processes.

45 Neurocognitive predictors of individual differences in task switching - the role of working memory, fluid intelligence and neural updating efficiency

Brà¼ning jovita <jovita.bruening@ovgu.de> (1) (2), Mà¼ckstein marie (3) (4), Manzey dietrich (2), Stelzel christine (3)

1 - Otto-von-Guericke-Universität Magdeburg = Otto-von-Guericke University [Magdeburg] (Germany), 2 - Technical University of Berlin / Technische Universität Berlin (Germany), 3 - International Psychoanalytic University Berlin (Germany), 4 - University of Potsdam = Universität Potsdam (Germany)

Research on individual differences in multitasking has shown that individuals either prefer a more serial or a more parallel mode of task processing. So far, little is known about the underlying neurocognitive mechanisms guiding the task processing preference. However, previous results suggested working memory capacity and fluid intelligence as promising predictors for task switching costs so they might also be relevant for the preferred processing mode. In addition, it has been shown that fluid intelligence is associated with neural task-updating efficiency, which quantifies the distance between the fMRI connectivity matrix during resting state with the connectivity matrix during task state. Participants showing a smaller distance between rest and task tend to have higher scores on fluid intelligence. In our preregistered study, we combine those cognitive and neurocognitive parameters to predict the individual task processing preference. The task-processing modes can be assessed with the Task-Switching-With-Preview (TSWP) paradigm that allows but does not oblige individuals to pre-process the stimulus of the upcoming task switch in a predictable task sequence (AAABBB. . .). 67 participants were probed with the TSWP paradigm, with a listening and a complex operation span task, the figural relations subtest of a German Intelligence Test, and MRI connectivity-based measurement of brain resting state and task state, respectively. First results from a stepwise regression analysis suggest a positive relationship between intelligence and the parallel processing style for individuals with high task-updating efficiency. While this fits well with previous findings, participants with low task-updating efficiency surprisingly showed the inverse pattern. We would like to discuss the results in conjunction with exploratory analyses including other predictors of interest.

46 Older adults are more influenced by impulsive other people

Su zhilin <zxs203@student.bham.ac.uk> (1), Garvert mona M. (2), Zhang lei (1), Manohar sanjay (3), Vogel todd A. (1), Thomas louisa (4), Balsters joshua H. (4), Husain masud (3), Apps matthew A. J. (1), Lockwood patricia L. (1)

1 - Centre for Human Brain Health [Birmingham] (United Kingdom), 2 - Max Planck Institute for Human Cognitive and Brain Sciences [Leipzig] (Germany), 3 - Nuffield Department of Clinical Neurosciences [Oxford] (United Kingdom), 4 - Department of Psychology [Royal Holloway] (United Kingdom)

People's preferences and behaviours are substantially influenced by others. When individuals become aware of other people's preferences, they often adjust their own to align more closely with them. Intriguingly, research suggests that susceptibility to social influence might differ across the lifespan. For example, compared to young adults, adolescents are more sensitive to peer pressure and more likely to engage in risky behaviours when in the presence of others. However, how ageing affects susceptibility to social influence is unknown, despite a rapidly ageing population. Here, using a social discounting task and Bayesian computational models, we tested how susceptible young (aged 18-36, N=76) and older (aged 60-80, N=78) adults were to patient and impulsive social influence. Participants completed a temporal discounting task and then learnt about the economic preferences of two other people, one who was more impulsive, and one who was more patient, before making their own discounting choices again (Fig. 1A). We used the normalised Kullback-Leibler divergence (D_KL) derived from Bayesian computational models to quantify the magnitude and direction of social influence. We found that older adults were more susceptible to impulsive social influence than young adults (Fig. 1B). In addition, we also found that the more susceptible older adults were to impulsive social influence the higher their self-report levels of emotional motivation (Fig. 1C). Importantly, older adults showed comparable levels of learning accuracy about others' preferences compared to young adults, and their baseline impulsivity did not differ. All results remained the same when controlling for IQ, memory, and attention. Together, these findings may have important implications for understanding how susceptibility to social influence evolves with age in the context of an ageing population.

47 Pain and still no gain: Reduced pain sensitivity mediates the relationship between psychopathic traits and reduced learning from pain

Atanassova dimana <dimana.att@gmail.com> (1), Diaconescu andreea O. (2) (3) (4) (5), Mathys christoph (6) (7) (8), Madariaga victor I. (9), Oosterman joukje (1), Brazil inti (1) (10)

1 - Donders Institute for Brain, Cognition and Behavior (Netherlands), 2 - Krembil Centre for Neuroinformatics, Centre for Addiction and Mental Health (CAMH),Toronto (Canada), 3 - Department of Psychiatry, University of Toronto, Toronto (Canada), 4 - Institute of Medical Sciences, University of Toronto (Canada), 5 - Department of Psychology, University of Toronto, Toronto (Canada), 6 - Interacting Minds Centre, Aarhus University (Denmark), 7 - Translational Neuromodeling Unit, Institute for Biomedical Engineering, University of ZÃ¼rich and ETH ZÃ¼rich (Switzerland), 8 - Neuroscience Area, Scuola Internazionale Superiore di Studi Avanzati, Trieste (Italy), 9 - Radboud University Medical Centre (Netherlands), 10 - Forensic

Pain is a powerful warning signal that links prior behaviors with their outcomes to prevent future harm. People with elevated psychopathic traits display a range of decision-making deficits, seemingly driven by failure to learn from negative outcomes. Given evidence for a diminished pain experience in psychopathy, we investigated how pain sensitivity affects reinforcement-based decision-making as levels of psychopathic traits increase. Community-dwelling participants (n=111) completed a reinforcement learning task where choices could lead to positive, non-painful negative, and painful negative outcomes. The Self-Report Psychopathy Scale-Short Form (SRP-SF) was used to measure psychopathy across four core traits: Interpersonal, Affective, Lifestyle, and Antisocial. We used electric shocks as a choice-related painful outcome, and quantified individual pain sensitivity based on electrical pain threshold, tolerance, and scores on the Pain Sensitivity Questionnaire (PSQ). Finally, we used a computational model to estimate the latent cognitive processes underlying decision-making. Both Bayesian zero-order and non-parametric correlation analyses revealed that higher pain tolerance correlated positively with Interpersonal, Affective, and Lifestyle traits, and with increased uncertainty in beliefs. Moreover, in a structural equation model, a superordinate psychopathy factor was associated with reduced sensitivity to pain. Additionally, pain sensitivity mediated the relationship between psychopathic traits and increased belief resetting, representing a tendency to persevere and stick with the original stimulus-outcome associations as the level of pain tolerance increases. This is the first evidence directly linking disrupted physical pain processing and reduced learning from painful outcomes with higher levels of psychopathic traits. Our results provide new insights into the mechanisms underlying impaired learning in psychopathy as well as its link to pain processing.

48 Performance-contingent reward increases the use of congruent distracting information

Fröber kerstin <kerstin.froeber@ur.de> (1) (2), Lerche veronika (3)

1 - University of Regensburg (Germany), 2 - University of Cologne (Germany), 3 - University of Kiel (Germany)

In the Simon task, participants respond to a relevant target dimension while ignoring distracting spatial information. Target and distracting information are congruent or incongruent, causing a congruency effect. This effect is larger in mostly congruent blocks or following congruent trials (proportion congruency and congruency sequence effect, respectively), presumably because incongruent trials trigger increased focus on the target and inhibition of the distracting information. In two experiments, we tested how reward modulates these phenomena. Performance-contingent (but not non-contingent) reward increased the usage of the distracting information in mostly congruent blocks or following congruent trials, while the adaptation to incongruency was the same in all conditions. Diffusion model analyses found that the reward effect was captured by the drift rate parameter. These results suggest an increased focus on the target information by incongruent trials independent from reward, but the adaptation to (mostly) congruent trials is motivationally boosted: performance-contingent reward increased the use of congruent distracting information beyond a mere relaxation of the increased target-focus following (mostly) congruent trials.

49 Peripheral misreaching in a large stroke cohort

Smits anouk (1), Lugtmeijer selma <s.lugtmeijer@bham.ac.uk> (2), Raemaekers m (1), Hartung s (1), De Haan e (3), Van Zandvoort m (1)

1 - University Medical Center Utrecht (Netherlands), 2 - University of Birmingham [Birmingham] (United Kingdom), 3 - Radboud University (Netherlands)

A. Smits, M. S. Lugtmeijer, Raemaekers, S. Hartung, E. de Haan, M. van Zandvoort s.lugtmeijer@bham.ac.uk Aims: Damage to posterior parietal regions of the brain can lead to changes in visually guided actions, such as pointing, reaching, and grasping. Optic ataxia is a specific deficit in reaching to peripheral targets that is not caused by primary motor weakness or sensory loss. Peripheral misreaching is easily missed in standard neuro(psycho)logical assessment and may go unnoticed as a sign of parietal disfunction or disconnection. Most studies investigating optic ataxia involve case reports and small case series that examined hypotheses about the cognitive mechanisms underlying the disorder. Here, we systematically address peripheral misreaching in a large stroke cohort and investigate the diagnostic characteristics of optic ataxia. Methods: A standardized paradigm and scoring method were developed to assess visually guided reaching and grasping. Data from 90 patients who suffered unilateral stroke and 22 age-matched healthy controls were used for analyses. A peripheral misreaching index was calculated to screen for optic ataxia. Each patient also underwent an experimental visual battery and short neuropsychological assessment. Damage to white matter connections was quantified using tractography data from healthy controls to map the structural reaching network. Results: The developed paradigm is sensitive to individual differences in reach-to-grasp performance. Exploratory case-control comparisons showed that around one-third of stroke patients scored more than two standard deviations below healthy controls for the peripheral misreaching index. At group-level, peripheral reaching performance did not differ between right- or left-sided lesions. Structural disconnection mapping predicted disconnections associated with peripheral misreaching. Conclusions: Findings suggest that changes in peripheral reaching are common after stroke, though few cases met the full diagnostic criteria for optic ataxia.

50 Progressive changes in functional connectivity between thalamic nuclei and cognitive networks across learning

Jarrett chelsea <chelsea.jarrett@tu-dresden.de> (1), Von Kriegstein katharina (1), Zwosta katharina (1), Wang xiaoyu (1), Tabas alejandro (1), Wolfensteller uta (1), Ruge hannes (1)

1 - Technische Universität Dresden (Germany)

Recent research suggests that the thalamus has a critical role in cognitive functioning and goal-directed behaviour. To facilitate this, it is globally connected with cortical and subcortical regions, serving as a vital node within various cognitive networks and cortico-thalamo-striato-cortical loops. In addition, the thalamus is also a highly heterogeneous structure formed of functionally distinct subnuclei with unique functional connectivity patterns. However, the exact contributions of specific thalamic nuclei to cognitive functioning and goal-directed behaviour within specific networks and loops is poorly understood. The specific aim of the present study was to investigate how the functional integration of thalamic sub-regions within cortical and subcortical networks changes across learning whilst transitioning from more controlled or goal-directed behaviour towards more automatic or habitual behaviour. Consequently, we performed a re-analysis of fMRI data from a stimulus-response learning study by (Zwosta, Ruge, Goschke, & Wolfensteller, 2018) to investigate functional connectivity changes across learning between specific thalamic nuclei with cortical networks and subcortical structures in healthy subjects. Thalamic regions-of-interest (ROIs) were defined individually in native space via FreeSurfer, segmenting the thalamus into 47 subnuclei using a probabilistic atlas (Iglesias et al., 2018). Additionally, we extracted 38 subregions within the basal ganglia and the hippocampus using an atlas by (Tian, Margulies, Breakspear, & Zalesky, 2020). Cortical network ROIs were defined via maximum-probability network templates available from (Dworetsky et al., 2021). Learning-related connectivity changes were examined via ROI-to-ROI functional network analysis within the CONN toolbox. Our results show that learning was associated with decreasing functional connectivity between the frontoparietal network and higher order thalamic subregions, increasing and decreasing functional connectivity between the DMN and left and right mediodorsal subregions respectively, and increasing intrathalamic functional connectivity. Together, this suggests that numerous thalamic subnuclei are critical network nodes involved in the learning-related transition from more controlled to more automatic sensori-motor transformation.

51 Recurrent neural network models of the anterior cingulate cortex

Colin thomas <thomas.colin@ugent.be> (1), Ikink iris (1), Holroyd clay (1)

1 - Ghent University (Belgium)

Two recurrent neural network models of the anterior cingulate cortex (ACC) are presented, the second of which is ongoing work. Both models were trained on sequential decision-making tasks. The first model consisted in a shallow recurrent network supplemented by goal units. These goal units represented temporally extended, abstract task characteristics, and could be used to control the network. A representational similarity analysis was conducted to compare higher-order similarities between the activations of the hidden layer units of this model with the BOLD response in humans performing the same task while undergoing fMRI. This analysis revealed ACC as the brain region whose activity was most similar to the model, suggesting that ACC represents abstract patterns in decision-making. However, this model did not account for the role of other brain regions involved in decision making, nor for the literature showing that ACC lesions have relatively limited consequences on observed behavior. A follow-up model was designed to account for several limitations of the first model. In particular, it aims to be consistent with ACC playing a more supportive role in decision-making. This model uses two separate modules, one of which specializes in decision-making, and the other in the detection of temporally extended abstract patterns in the task; the latter is achieved by self-prediction. In ongoing work, we hope to validate the second model against human data using RSA.

52 Sensitized social hierarchy perception in social competition than cooperation

Su yaner <y.su@umcg.nl> (1) (2), Martens sander (1), Aleman andre (1) (2), Zhou jiali (2), Xu pengfei (3), Luo yuejia (2)

1 - University Medical Center Groningen [Groningen] (Netherlands), 2 - Shenzhen University [Shenzhen] (China), 3 - Beijing Normal University (China)

Social hierarchy is a typical feature of social organization. The ability to quickly recognize social hierarchy information is crucial for social adaptation. Although social contexts such as competition and cooperation have a different impact on the perception of social hierarchy, the findings are partly inconsistent. Here, we adopted fast periodic visual stimulation (FPVS) with electroencephalography (EEG) to assess the neural responses to social hierarchy during social competition and cooperation, respectively. Participants first learned hierarchical faces from a competitive game or cooperative game. We then sequentially presented the learned rank-specific faces with a specific frequency in a set of faces. Results showed participants rated the inferior player lower in the cooperative context than in the competitive context, which indicated that social context affects the judgment of others' rank. Besides, higher neural responses to high and low-hierarchy faces than to medium-hierarchy level faces, indicating that participants could rapidly discriminate social hierarchy from faces. Interestingly, in the cooperative context, the rank-locked neural response was more pronounced in the superior face than the medium condition, while there was no significant difference in activity between the inferior and the medium face, indicating a relatively reduced attention to inferior teammates in the cooperative context. This work provides behavior and neurophysiological evidence for the perception and the automatic processing of implicit social hierarchy information, supporting that the emergence of social hierarchy could be detected in a single glance. Importantly, individuals encode social hierarchical information in different ways under different social contexts.

53 Specificities of functional connectivity between midcingulate and lateral prefrontal cortex during performance monitoring in monkeys

Goussi-Denjean clément <clement.goussi@gmail.com> (1), Fontanier vincent (1), Procyk emmanuel (1)

1 - Institut cellule souche et cerveau / Stem Cell and Brain Research Institute (France)

Previous studies have suggested that the interaction between the midcingulate cortex (MCC, an agranular cortex) and the lateral prefrontal cortex (LPFC, granular) of primates contributes to adaptative behaviors in several contexts. The function of action and feedback monitoring is at the core of this adaptation but its brain distribution remains unclear. Indeed, these areas might have specific functional weight, and time course of activation, and should communicate in an organized fashion. Such dissociation and contribution might also be linked to different cortical layer organization, cell type proportions, and anatomical gradients. The primary assumption is that MCC evaluates action feedback and transmits this information to the LPFC to adapt decision or shift strategy. Here, we sought to determine how MCC and LPFC code for and interact during the monitoring of negative and positive outcomes used to select the course of action. We recorded in MCC and LPFC while 2 monkeys performed a 3-arm bandit task with a probabilistic reward schedule. The design is such that animals explore and exploit targets in successive blocks, the best target (in terms of reward probability) being changed every 40+-5 trials. We present preliminary data from 125 recordings from 2 monkeys. Each recording included two 16 contacts linear probes, one placed in the MCC and one in the LPFC. Single-unit activity was sorted and analyzed, and FS and RS units were defined based on the clustering of spike-wave metrics. In this poster, we show first-level analyses of spike and local field potential dynamics that reveal feedback encoding and connectivity between MCC and LPFC. Like spike encoding, frontal connectivity is not only driven by anatomy but seems to also be dependent on the information processed by the animals.

54 Stochastic choice drives human and animal foraging decisions

Scholey emma <exs165@student.bham.ac.uk> (1) (2), Apps matthew (1), Humphries mark (2)

1 - Centre for Human Brain Health and Institute for Mental Health, School of Psychology, University of Birmingham (United Kingdom), 2 - School of Psychology, University of Nottingham (United Kingdom)

When should a bee leave a flower and forage for pollen at a new one, or when should you leave a conversation and find a new person to talk to? €˜Patch €" leaving' foraging decisions like these, where the individual must choose between foraging current resources or seeking better options elsewhere, are fundamental across species, and form a subset of decision problems that the brain has evolved to solve. Ecological theories of optimal foraging behaviour, such as the marginal value theorem, assume we make deterministic choices. However, animals and humans make stochastic choices, sometimes forgoing the option to exploit immediate reward to explore alternatives. The predictions that models of stochasticity make for foraging behaviour have not been tested. Here, we show analytically that stochastic choice models can replicate the patch and environment predictions of the marginal value theorem. The models can also replicate overharvesting biases seen in human and animal foraging (staying longer in patches than is optimal). We further show that this model can account for counter-intuitive behaviour across two human experiments and one in rodents. We then extend our models to link levels of exploration to the background reward rate in the environment, where richer environments drive increased exploration. These results suggest that stochastic processes may be key to understanding foraging behaviours.

55 Testing the stability of ACC task representations: doing sequential tasks in a separate versus interleaved fashion

Ikink iris <iris.ikink@ugent.be> (1), Foinikianaki emmanouela (1), Benavides ricardo Alejandro (1), Colin thomas (1), Holroyd clay B. (1)

1 - Department of Experimental Psychology, University of Ghent (Belgium)

Introduction: Previous studies have shown that the anterior cingulate cortex (ACC) represents behavioral states, including hierarchical sequential task action states (Holroyd et al., 2018). However, it remains unknown how stable such task representations are. Here, we investigated (1) whether these representations are maintained when the steps of two different sequential tasks are interleaved, and (2) whether the potential changes in representations are associated with individual differences in task performance. Methods: While lying in the MRI scanner, participants (N=50) did two sequential tasks consisting of 6 separate steps in either a single (stand-alone) fashion or an interleaved fashion (such that e.g. first step 1 of task 1 was done, then step 1 of task 2, then step 2 of task 1, then step 2 of task 2, etc). Using a predefined ACC-RoI based on Holroyd et al. (2018), we conducted multivariate representational similarity analyses (RSA) to test whether the ACC represents the two sequential tasks differently, and specifically if and how ACC task representations might change in the interleaved compared to single condition. Results: As expected, doing the sequential tasks in the interleaved compared to single condition was more difficult, as evidenced by longer RTs, lower accuracy, and higher self-reported exerted effort. Neurally, we found that the ACC encoded the two tasks and conditions differently, by showing higher representational similarity between steps within-task/-condition compared to between-task/-condition. When comparing representational similarity of the steps within-task, the single and interleaved conditions were significantly correlated (r=.18), indicating that ACC task representations were partly maintained from the single to interleaved condition. Further, compared to the single condition, the more difficult interleaved condition showed a trend effect for increased within-task representational similarity. A trend interaction with task indicated that this effect was only significant in the more difficult sequential task. The more difficult task also showed overall significantly larger within-task representational similarity compared to the easier task. These findings together suggest that when a sequential task is or becomes more difficult, the ACC represents the separate task steps less distinctively. Interestingly, brain-behavior correlations suggest that putting in effort counteracted this effect: Participants that showed a smaller increase in within-task representational similarity from the single to interleaved condition were more likely to show a larger difference in exerted effort ratings for

56 The antagonist SB-258585 mainly reduces food motivation while blocking 5-HT6 receptors in the striatum: a behavioral and PET-imaging study in male non-human primates

Pitoy mathilde <mathilde.pitoy@isc.cnrs.fr> (1) (2) (3), Gauthier lisa (4) (5), Debatisse justine (6) (7), Maulavé julie (5) (8), Météreau elise (9) (10), Beaudoin Gobert maud (10) (11), Portier karine (12), Sgambato véronique (10) (11), Billard thierry (11), Zimmer luc (9) (11) (13), Lancelot sophie (11) (13) (9), Tremblay léon (14) (15)

1 - Hospices Civils de Lyon, Departement de Neurologie (France), 2 - Institut des sciences cognitives Marc Jeannerod - Centre de neuroscience cognitive - UMR5229 (France), 3 - UniversitÃ© Claude Bernard Lyon 1 (France), 4 - Institut des Sciences Cognitives Marc Jeannerod, UMR-5229 CNRS, 67 boulevard Pinel, 69675 Bron Cedex, France (France), 5 - UniversitÃ© Claude-Bernard Lyon1, 69100, Villeurbanne, France (France), 6 - Institut des Sciences Cognitives Marc Jeannerod, UMR-5229 CNRS, 67 boulevard Pinel, 69675 Bron Cedex, France (France), 7 - Centre de Recherche en Neurosciences de Lyon, CNRS UMR5292, INSERM U1028, Lyon, France (France), 8 - a Institut des Sciences Cognitives Marc Jeannerod, UMR-5229 CNRS, 67 boulevard Pinel, 69675 Bron Cedex, France (France), 9 - Centre de Recherche en Neurosciences de Lyon, CNRS UMR5292, INSERM U1028, Lyon, France (France), 10 - Institut des

Since the development of new 5-HT6 receptor (5-HT6R) selective agents, the diversity of these receptor roles in the brain has been evidenced in rodent studies in cognitive processing, goal-directed behaviors, anxiety regulation, and food intake. Although these studies focused on the behavioral effects of 5-HT6Rs modulation with regard to the prefrontal cortex, the hippocampus, or the amygdala, few studies focused on the striatum. However, in the non-human primate (NPH), with the development of the [18F]2FNQ1P specific PET radioligand, it has been shown that the striatum highly expresses 5-HT6Rs. Thus, we hypothesize that the inhibition of 5-HT6 transmission by SB-258585 will impact eating and spontaneous behavior, probably through action on 5-TH6 striatal receptors. This study, performed on six macaques, aimed to determine the effects of intramuscular injections of a 5-HT6R antagonist, SB-258585, on a food-choice task and on spontaneous behavior observations. In parallel, we controlled SB-258585 receptor occupancy in each striatal territory that may be linked to the pharmacologically-induced behavioral changes. Results showed that blocking 5-HT6 transmission decreased food intake at the group level and individually in five out of six animals. All animals decreased their speed of consumption. The drug also affected variably the spontaneous behavior of individuals. It increased the behavioral switch and/or movements' frequency in half of the individuals, and it affected the duration or frequency of anxiety-related behaviors in four out of five individuals. However, at the group level, we only observed an increase in object-directed behaviors. PET imaging whole-brain analysis on six animals showed that the molecule mainly affected the antero-posterior putamen and caudate nucleus, striatal regions that could account for the SB-258585-induced changes. To conclude, in NPH, the blockage of 5-HT6Rs by SB-258585 can modify spontaneous behavior in a subject-dependent manner toward hyperactivity, anxiety-related behavior production or reduction, and the loss of food motivation.

57 The effect of sugar and caffeine on motivation and cognitive control

Eriksen rikke (1), Mccutcheon james (1), Pfuhl gerit <gerit.pfuhl@ntnu.no> (1) (2)

1 - UiT The Arctic University of Norway (Norway), 2 - Norwegian University of Science and Technology (Norway)

Cognitive effort is a decision-making process about starting or continuing to work on a mentally demanding task. Stimulants of the central nervous system may affect this decision. Caffeine, which is a widely consumed stimulant, affects alertness and arousal and is thus a likely candidate to increase cognitive effort. Glucose is the primary source of energy and low blood sugar can negatively affect cognitive functioning. We investigated whether the stimulant caffeine in combination with sugar would lead to more effort spent on a cognitive effort task compared to a placebo drink. We employed a mixed, repeated measures, double-blind, placebo-controlled experiment. Participants (n = 61, 34 women, Mage = 22.6 years) were tested three times in a lab and were served an artificial energy drink each time. We used the Cognitive Effort Discounting Task to assess effort spent. Neither sugar nor caffeine significantly affected effort spent, motivation or performance on the Cognitive Effort Discounting task. In addition, both substances failed to affect subjective affect and subjective activation measured with the Positive and Negative Affect Schedule. Thus, neither subjective nor objective motivation and effort were positively affected by caffeine or sugar intake. Given the elusive nature of measuring cognitive effort, our study should be replicated using other tasks reliable assessing cognitive effort as well as recruiting caffeine-naÃ¯ve individuals.

58 The manipulation of agency affects pro-active cognitive control in a color-discrimination task

Arnau stefan <arnau@ifado.de> (1), Liegel nathalie (1), Wascher edmund (1), Schneider daniel (1)

1 - Leibniz Research Centre for Working Environment and Human Factors [Dortmund] (Germany)

The manipulation of agency affects pro-active cognitive control in a color-discrimination task Stefan Arnau, Nathalie Liegel, Edmund Wascher, & Daniel Schneider Leibniz Research Centre for Working Environment and Human Factors Dortmund (IfADo), Dortmund, Germany Cognitive performance substantially depends on the degree to which an individual is engaged in a task. The exertion of cognitive control depends on the expected benefit obtained from successful task-performance, the efficacy to which an increase of control increases this benefit, as well as on the subjective sense of agency. The latter describes the sense of being able to control the outcome of an action. In an EEG experiment, we investigated how a manipulation of agency affects behavior and how it is reflected in the electrophysiological responses to task-cues and performance feedback. 39 participants performed in a two-alternative forced choice color-discrimination task in which the difficulty of each trial was cued before target onset. To manipulate the sense of agency, the subjective reliability of the response recording was manipulated in a block wise manner. For three of the experimental blocks, the recording was reliable. That means, that the feedback regarding the response always corresponded the response that was given. For the other three experimental blocks the feedback regarding the given response was flipped for a randomized selection of 30% of the trials. The behavioral performance in terms of response times and accuracy was significantly decreased in the flip-blocks compared to response-consistent feedback, indicating a decreased effort due to a reduced sense of agency. In the EEG, this was reflected by a diminished CNV amplitude during the cue-target interval. Flipped feedback was also accompanied by a Pe-like parietal positivity in response to the feedback cue.

59 The neurocognitive dynamics of task reconfiguration

Ritz harrison <harrison.ritz@gmail.com> (1), Cohen jonathan (1)

1 - Princeton Neuroscience Institute [Princeton] (United States)

We can flexibly shift information processing to accommodate a wide array of cognitive challenges. The shift between different task sets is often modeled as a dynamical system, but the evidence supporting this account is controversial or incomplete. Here, we rigorously test the use of the dynamical systems approach to model cognitive flexibility through a combination of empirical and analytical innovations. First, we explore whether task reconfiguration is continuous or discrete, a long-standing debate in the literature. Using a modality-switching task, we find that people discreetly shift between different dynamical modes, offering a potential reconciliation. Consistent with both accounts, people discreetly transition from a €˜static state' (potentially reflecting recall) into a dynamic state in which switch costs are reduced with more preparation time. Second, we explore the correspondence between cognitive dynamics and neural dynamics during task reconfiguration. Borrowing methods from systems neuroscience, we've adapted a method for fitting latent dynamical systems to whole-brain EEG/MEG activity. Using open data from task-switching experiments, we find that linear dynamical systems provide a good account of single-trial EEG activity. However, we find that task representations change dramatically within a trial, with very different encoding during task preparation and execution. Together, these findings support the dynamical systems approach to modeling task configuration. However, they also reveal complexities of these dynamics that are unaccounted for by current theories, motivating the development of richer process models of cognitive flexibility.

60 THE NEUROPHYSIOLOGICAL BASIS OF LEARNING TO LEARN IN MACAQUE MONKEYS

Ducret marion <Marion.ducret@inserm.fr> (1), Procyk emmanuel, Wilson charles R. E.

1 - Stem cells and Brain Research Institute (France)

Learning to learn is a separate function from classical learning, which makes our learning more efficient and flexible. It has been particularly associated with primate species (Harlow, 1953), and lesions disconnecting lateral prefrontal cortex (LPFC) in macaque monkeys lead to a selective loss of this ability (also referred to as Learning Set), whilst sparing simple learning (Browning et al., 2007). LPFC forms an interacting circuit with the midcingulate cortex (MCC), and the MCC plays an important role in error/reward and performance evaluation (Procyk et al., 2016), necessary steps in efficient learning. Most electrophysiological recordings are made after extensive training of the animals, so recordings are made after animals have learned to learn on the task, thereby completely ignoring neurophysiological changes that permit learning to learn. Here we seek to identify these crucial changes thanks to a longitudinal recording approach, starting with task naÃ¨ve animals. We recorded a monkey with 256 chronic intracortical electrodes (FMA, Microprobes): 64 in the LPFC and 64 in the MCC across both hemispheres. The monkey performed two tasks on a touchscreen with eye movement monitoring. In the first €œtask€ with very little cognitive demand, the Check Touch Object task, the monkey touched a lever for required delay and then touched a target that appeared to obtain reward. The second task was Object Discrimination learning, in which monkeys learn which of a pair of concurrently presented objects is rewarded, for a large number of pairs presented serially. This classical learning task requires monkeys to initially learn by trial and error €" so task naÃ¨ve animals have to learn that some responses are incorrect, and therefore the nature of an incorrect response. Later the task provides scope for learning to learn, in that extremely efficient performance can be obtained by acquiring a win-stay lose-shift strategy. Our aim was to investigate the longitudinal changes in the neural correlates of choices and feedback processing before, during, and after the animal learned to learn. We performed muti-unit activity and local-field potential analysis to track neurophysiological characteristics prior to learning in the control task, and then during initial learning. We found that correct and incorrect evoked feedback responses at the population level in both LPFC and MCC are undifferentiated at the very first stages of learning, when the animal is encountering incorrect feedback for the first time. Correct and incorrect feedback responses then show gradual differentiation during the early phases of learning on the task,

61 The representational geometry of cognitive maps under dynamic cognitive control

Park seongmin <park@isc.cnrs.fr> (1) (2), Zolfaghar maryam (2), Russin jacob (2), Miller douglas (2), O'reilly randall (2), Boorman erie (2)

1 - Institute of Cognitive Science (France), 2 - UC Davis (United States)

Recent work has shown that the brain abstracts non-spatial relationships between entities or task states into representations called cognitive maps. Here, we investigated how cognitive control enables flexible top-down selection of goal-relevant information from multidimensional cognitive maps retrieved from memory. We examined the relationship between cognitive control and representational geometry by conducting parallel analyses of fMRI data and recurrent neural network (RNN) models trained to perform the same task. We found both stable map-like representations in a medial temporal lobe and orbitofrontal cortical network that reflected both task-relevant and irrelevant dimensions and dynamic, orthogonal representations of only relevant task dimensions in a frontoparietal network. These representational motifs also emerged with distinct temporal profiles over the course of training in the RNN, with map-like representations appearing first. We further show that increasing control demands due to incongruence (conflicting responses) between current task-relevant and irrelevant dimensions impact the geometry of subjective representations, and the degree of this effect further accounts for individual differences in cognitive control. Taken together, our findings show how complementary representational geometries balance stability and behavioral flexibility, and reveal an intricate bidirectional relationship between cognitive control and cognitive map geometry.

62 The role of expectations (vs. experience) when evaluating the benefits of investing mental effort

Prutean nicoleta <nicoleta.prutean@ugent.be> (1), Boehler nico (1), Notebaert wim (1)

1 - Ghent University (Belgium)

Neuroeconomic theories propose that whether we invest mental effort (and to what extent) reflects a decision-making process in which the costs associated with a challenging task are offset by potential incentives it may yield (Shenhav et al., 2013). This cost/benefit trade-off implies that effort investment is preceded by a preliminary evaluative phase, in which mental effort is generally evaluated negatively, but to a lesser extent when substantial rewards are involved. In line with this, Vermyelen et al., (2019) showed that cues which had anticipated (more difficult) task-switching trials in a separate task were evaluated more negatively compared to repetition cues. In our pre-registered study (https://osf.io/nxdvh), neutral nonword cues predicted a combination of difficulty (easy/hard) and reward levels (small/large) in a Random Dot Motion (RDM) task. Following the procedure in Vermeylen et al., we used the Affect Misattribution Procedure (AMP; Payne et al., 2005) to measure the affective evaluation of those cues. We measured evaluations before instructing participants on the meaning of the cues (AMP baseline), after instructions (AMP instructions), and after participants had experienced the predictive meaning of cues in the RDM task (AMP experience, as in Vermeylen et al). We expected to observe reward benefits on RDM task performance, especially on hard trials. Moreover, we hypothesised this would be reflected in more positive evaluations of the cues predicting those trials (AMP effect). Crucially we expected an AMP effect after experiencing the cues in the RDM task compared to baseline, and possibly compared to instructions only. Results in the RDM task showed that participants adapted their performance based on reward prospects and were more accurate on large reward trials. Our analyses on their evaluations showed that this performance benefit was accompanied by more positive judgements of large reward cues compared to small reward cues. Crucially, compared to baseline measurements, the effect was present both following instructions on the meaning of the cues (AMP instructions) and after participants had experienced the predictive values of cues in the random dot motion task (AMP experience), with no difference between these two phases. Our data suggest that the actual experience of receiving reward is not required as participants evaluate high reward cues as positive even before they received a reward. This fits with the general idea that the cost benefit analysis operates on expected, not experienced, costs and benefits.

63 The role of frontal eye field in response inhibition and self-control

Veit stuphorn <veit@jhu.edu> (1), Elsey jacob (1)

1 - Johns Hopkins University School of Medicine [Baltimore] (United States)

In daily life, we must often interrupt or suppress a behavior in favor of another that is more appropriate in the current circumstances. Two key aspects of such behavioral control are response inhibition and self-control. Response inhibition is the ability to deliberately stop a prepared motor response. Self-control is the ability to inhibit self-defeating behavior in the face of temptation. Clinically, failures of response inhibition and self-control are commonly treated as signs of deficits in behavioral control. Currently, it is unknown whether the neural mechanisms underlying response inhibition and self-control are shared or distinct. Here, we trained macaque monkeys to perform saccade stop-signal (countermanding) and self-control tasks presented. The monkeys reliably switched between stop-signal and self-control tasks. During the countermanding task, the monkey made a saccade to a peripheral target. On a subset of trials, a visual stop signal was presented after a variable stop-signal delay, requiring the inhibition of the ongoing saccade preparation. During the self-control task, the monkey made a saccade to indicate their choice between a smaller, sooner (S) and a larger, later (L) reward. On a subset of trials, termed temptation trials, the unchosen option remained available, requiring self-control to resist switching from the more costly, but optimal, L option to the suboptimal S option. Critically, in this situation of heightened need for self-control, the monkey was sometimes able to resist temptation and sometimes failed to do so. Temptation trials provide therefore a clear behavioral marker for the level of self-control exerted on a trial-by-trial basis. Frontal eye field (FEF) generates signals sufficient for the generation and inhibition of saccadic eye movements. Further, firing rates from functional cell-types in FEF have been fit to the STOP and GO processes used by the Interactive Race Model (Logan & Cowan, 1984) to predict whether the animal will successfully inhibit a motor action. Thus, FEF is an excellent candidate region to investigate the extent to which the neural circuitry underlying motor inhibition is shared or dissimilar from the one governing the inhibition of a temptation. Data collection is ongoing, but preliminary data from simultaneous recordings using multi-contact linear probes shows that some FEF neurons are modulated by the animal's level of self-control, suggesting that motor and motivational control may share a common neural circuit.

64 The role of the ACC in shifting between foraging strategies

Alejandro ricardo <Ricardo.AlejandroBenavides@UGent.be> (1), Ikink iris (1), Foinikianaki emmanouela (1), Colin thomas (1), Holroyd clay (1)

1 - Ghent University (Belgium)

When foraging, animals and humans make sequential decisions to maximize rewards (e.g., food, money, etc.) while minimizing the costs (e.g., effort, money, etc.) of doing so. The anterior cingulate cortex (ACC) is believed to facilitate this process, but its specific role in foraging remains a subject of debate, with theories suggesting that the ACC encodes the value of the environment (alternative choice), or that it encodes choice difficulty. We investigated whether a proposed role for ACC in hierarchical reinforcement learning contributes to foraging. This idea holds that ACC function is organized hierarchically on a rostral-caudal gradient, with rostral structures monitoring the status and completion of high-level task goals (e.g., find food), and caudal structures overseeing the execution of lower-level actions (e.g., grab an apple). Fifty participants engaged in a simulated foraging task across two fMRI sessions. They explored an environment with two regions: lakes and forests, and each region contained several foraging patches with depleting sources of reward (fruit and fish, respectively). In order to collect as much food as possible (i.e., high-level goal), participants had to navigate the environment strategically engaging with the two activities (i.e., subgoals, collecting fruit and fishing), where each activity consisted of individual sequences of (low-level) actions (3 steps). Rewards and penalties were designed such that participants had to decide whether to stay or switch high-level strategies (fish vs. forage fruit), stay or switch low level-strategies (individual patches), or (continue to) harvest from the current patch. Univariate analyses show increased rostral ACC activation for high-level (versus low-level) switches. Caudal ACC activity was higher for decisions to switch (between/within regions) as compared to decisions to stay. Moreover, caudal ACC showed greater activation when facing high-level decisions (stay, switch within-, switch between activities), while contrary to our predictions, rostral ACC activity was higher when performing low-level actions.

65 Transdiagnostic markers of pathological fatigue and mental health, and their relation to computational mechanisms of momentary fatigue in effortful tasks.

Dudzikowska katarzyna <kad001@bham.ac.uk> (1), Mueller tanja (2), Apps matthew (1)

1 - Centre for Human Brain Health and Institute for Mental Health, School of Psychology, University of Birmingham (United Kingdom), 2 - Zurich Center for Neuroeconomics, Department of Economics, University of Zulˆrich (Switzerland)

Fatigue, a subjective sensation that arises during effortful exertion, occurs in the healthy population but also in a more severe, persistent form is a symptom of many psychiatric and neurological conditions. However, few attempts have been made to map how the computational mechanisms underlying the development of fatigue from moment-to-moment during effortful tasks, relates to pathological fatigue and psychiatric traits. Here, participants performed an online task, performing different amounts of effortful button-clicks, or resting, to obtain rewards. Crucially, on each trial they rated their level of fatigue. Using a novel computational model of fatigue we were able to show that fatigue ratings fluctuated from moment to moment with an unrecoverable €“ gradually increasing €“ and a recoverable €“ constantly fluctuating €“ component. Going beyond previous work we were able to show that this recoverable component is not only a function of how much someone's fatigue increases after effort, and reduces through periods of rest, but also independently depends on how much recovery people can obtain during periods of low effort activity (i.e. active recovery). Moreover, we show that latent parameters from this model are associated with symptoms of chronic fatigue and transdiagnostic dimensions identified across psychiatric diagnostic categories.

66 Understanding the developmental trajectory of learning and adjusting to the perceived efficacy of one's efforts

Prater Fahey mahalia <mahalia_prater_fahey@brown.edu> (1), Grahek ivan (2), Shenhav amitai (2)

1 - Brown University (United States), 2 - Brown University (United States)

Background: When deciding how hard to work on a task, a person needs to weigh the potential reward for performing well (e.g., college admission) and the extent to which they think this reward is determined by their performance versus factors outside of their control (the €˜efficacy' of their effort). People therefore must track how efficacious their effort is in a given environment, and adjust accordingly. As young children move into adolescence, increased independence creates more opportunities to decide when and how to allocate effort. Previous research has examined how perceived rewards bias effort adjustments as children age, but less is known about how they do so based on perceptions of efficacy. Here we examine whether there are age-related differences in the utilization of perceived efficacy in allocating effort. Methods: To examine this, we recruited participants aged 10-17 years old to play a novel orchard game (Planned N=80, Current N=60). The game consists of an incentivized picture-word-interference task performed in 3-5s self-paced intervals in a gamified context for our developmental population. This allowed us to examine how productive participants were in each interval (trials completed correctly), and whether they achieved this productivity by prioritizing speed, accuracy, or both. Over the session, we varied whether the reward participants got at the end of the intervals was determined based on their performance (accuracy watering the trees: 'high efficacy') or at random ('low efficacy'). Crucially, participants were not told how likely it was that a given interval would be low or high efficacy, but instead, they had to learn this based on feedback. To measure learning, every 2-4 intervals we asked participants to predict the efficacy of the upcoming intervals. Results: Measures of perceived efficacy showed that across this age range participants were able to dynamically update their estimates of the efficacy of the environment based on recent feedback, with estimates reflecting feedback up to 5 trials back (all ps

67 Willingness to engage in antisocial efforts towards out-groups declines from childhood to adulthood

Hogg tabitha <t.c.hogg@bham.ac.uk> (1), Vogel todd A. (1), Pfirrmann janine (1), Gueguen margot (1), Apps matthew A. J. (1) (2), Lockwood patricia L. (1) (2)

1 - University of Birmingham (United Kingdom), 2 - University of Oxford (United Kingdom)

Antisocial behaviours, actions that cause harm to others, pose a significant challenge to society. Adolescence is associated with an increase in disorders of antisocial behaviour such as conduct disorder, but the willingness to engage in antisocial behaviours has not been studied across typical development. One crucial aspect of antisocial behaviours is that they are effortful, yet humans find effort aversive. In addition, group-membership is a critical driver of willingness to be prosocial, yet how group membership can shift one's willingness to be antisocial is unknown. Here we examined willingness to engage in effortful antisocial acts across three developmental samples: children (aged 7-11, N=55), adolescents (aged 12-17, N =36), and young adults (aged 18-35, N=69). Participants were given chances to exert effort to take away rewards from in-group and out-group members, or simply to do nothing and not take away rewards. Offers varied in level of effort (50%-95% of maximum thresholded button clicks in 10 seconds) and magnitude of harm (2, 6, or 10 reward credits taken away). We found that all participants were overwhelmingly willing to take points away from out-group members, but rarely did so for in-group members. Willingness to harm out-group members declined from childhood to young adulthood. Intriguingly, participants showed aversion to exerting higher levels of effort to inflict harm, but showed a preference to choose options that were higher in harm magnitude for out-group members. Together, these findings provide new insights for understanding when people engage in antisocial behaviours, and how this willingness changes across development.

68 Working memory and reinforcement learning dynamics: correlation or causation?

Janssen lieneke <lieneke.janssen@ovgu.de> (1) (2), Kirschner hans (1), Kramer lara (1), Klymentiev ruslan (1) (3), Ullsperger markus (1) (4)

1 - Institute of Psychology, Otto-von-Guericke-Universität Magdeburg (Germany), 2 - Department of Neurology, Max Planck Institute for Human Cognitive and Brain Sciences (Germany), 3 - Institute for International Research on Criminal Policy, Ghent University (Belgium), 4 - Center for Behavioral Brain Sciences (Germany)

Working memory (WM) plays an important role in instrumental learning when reinforcement histories of multiple options must be integrated. In addition to maintenance, the ability to update and shield items against interference are key to good WM; functions conceivably also essential to instrumental learning in an ever-changing environment. We have previously shown that dynamic changes in people's learning rates in a reversal learning paradigm were more pronounced with higher WM capacity. This was accompanied by better performance and a stronger representation of learning rates and reward prediction errors in cortical activity. Whether or not WM modulated learning in this task, is an open question that we aim to address in an online study (n=300; preregistration: https://osf.io/ujrt8). WM load was manipulated in the reversal learning task by varying the number of stimuli for which changes in reward probability had to be followed (1 to 4 stimuli, n=75 per condition). As expected, task performance scaled with WM load, whereby higher load negatively contributed to performance. Response switching following misleading feedback increased with WM load, but so did spontaneous response switching. Response times were unaffected. An interaction between WM load and capacity (OSPAN score) was not observed for performance, response times, or response switching. To understand the effect of WM load on trial-to-trial learning dynamics we will construct a nested model set built from reinforcement learning models. The results show a complex relationship between WM and reinforcement dynamics in a volatile context and are discussed within current theories of instrumental learning.

69 Ventromedial prefrontal cortex lesions disrupt learning to gain prosocial rewards

Margot Gueguena, Jo Cutlera, b, Daniel Drewb, Matthew A. J. Appsa, b, Deva S. Jeyaretnab, Masud Husainb, Sanjay Manoharb & Patricia L. Lockwooda, b

University of Birmingham, b University of Oxford. Email:mxg121@student.bham.ac.uk

Background. The ventromedial prefrontal cortex (vmPFC) has long been associated with learning and decision-making as well as social cognition. Human neuroimaging studies have repeatedly shown that the vmPFC encodes computational parameters relevant for self-benefitting learning, including value, prediction errors, and learning rates. A separate line of research suggests that the vmPFC is linked to social processing, with damage to this area associated with abnormal social behaviours including greater utilitarianism. However, neuroimaging studies cannot show a causal role of this region in learning and decision-making, and studies of vmPFC damage have so far often relied on small samples or patients with diffuse damage. Objective. The current study aimed to test whether vmPFC damage affected learning to help oneself (self-benefitting learning), learning to help another person (prosocial learning), or learning in the absence of reward (learning for neither individual, control condition). Methods. The sample comeconds) and magnitude of harm (2, 6, or 10 reward credits taken away). We found that all participants were overwhelmingly willing to take points away from out-group members, but rarely did so for in-group members. Willingness to harm out-group members declined from childhood to young adulthood. Intriguingly, participants showed aversion to exerting higher levels of effort to inflict harm, but showed a preference to choose options that were higher in harm magnitude for out-group members. Together, these findings provide new insights for understanding when people engage in antisocial behaviours, and how this willingness changes across development. al-by-trial basis. Frontal eye field (FEF) generates signals sufficient for the generation and inhibition of saccadic eye movements. Further, firing rates from functional cell-types in FEF have been fit to the STOP and GO processes used by the Interactive Race Model (Logan & Cowan, 1984) to predict whether the animal will successfully inhibit a motor action. Thus, FEF is an excellent candidate region to investigate the extent to which the neural circuitry underlying motor inhibition is shared or dissimilar from the one governing the inhibition of a temptation. Data collection is ongoing, but preliminary data from simultaneous recordings using multi-contact linear probes shows that some FEF neurons are modulated by the animal's level of self-control, suggesting that motor and motivational control may share a common neural circuit.sk representational similarity from the single to interleaved condition were more likely to show a larger

70 Deciding when to help others depends on the expected value of the environment

Vogel, T. A., Priestley, L., Cutler, J., Khalighinejad, N., Garrett, N., Apps, M. A. J., Rushworth, M. F. S., & Lockwood, P. L.

University of Birmingham, b University of Oxford. Email:mxg121@student.bham.ac.uk

In everyday life, decisions are not presented as choices between binary options. Rather, ongoing behaviours are interrupted with alternatives such as being asked to cook dinner while watching TV. Current experimental paradigms, however, rarely capture these types of context-dependent decisions that our brains evolved to solve. Computational accounts across several fields highlight that one's environment influences decisions of whether to act, yet the mechanisms that drive these decisions when they benefit another person are unknown. Here we examined when people will interrupt their ongoing behaviour to help themselves or another person when placed in different environments based on the average rate of reward. We collected data from three groups of participants (Study 1 (online, pre-registered) n = 323, Study 2 (online, pre-registered replication) n = 301; Study 3 (in-person) n = 55). Participants were shown opportunities to make effortful actions to earn rewards for themselves or another person while watching a movie. Participants made decisions to interrupt the movie and earn rewards either for themselves or others in two different environments: in "poor" environments where average reward values and probabilities were lower, and in "rich" environments where average reward values and probabilities were higher. The quality of the environment was signalled to participants at the beginning of each block. We found that, for all groups, the richness of the environment more strongly influenced decisions for others compared to decisions for oneself. Specifically, for matched offers, participants were more likely to interrupt their behaviour in poor environments compared to rich ones (ps < .001). As the expected value (reward value * probability) of the offer increased, this difference between environments was amplified when deciding for another person relative to oneself (ps < .004). That is, there was a greater difference in decisions to act between the poor and rich environments when deciding to help another person compared to oneself. Computational modelling also revealed that people separately track opportunity costs for self and other when in different environments. Opportunity cost parameters were weighted less strongly when deciding to act to help others in poor environments. These robust findings show that a previously reported ecological mechanism, whereby people accept worse options in poorly rewarded environments, is enhanced when deciding whether to help others out. These findings could have important implications for understanding prosocial and self-