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Mechanisms of Collective Decision-making for Cooperative Actions

14th Dubrovnik Conference on Cognitive Science

Mechanisms of Collective Decision-making for Cooperative Actions

PROGRAM AND ABSTRACTS

18th – 21st May 2023

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INVITED TALKS

Bahador Bahrami (Ludwig Maximilian University, Germany)

What is so great about working with stupid, useless people?

Friday, 19 May, 9:00 – 10:00

In *The extraordinary and popular delusions and madness of crowds*, Charles Mackay chronicled a colourful and prolific history of humankind's collective follies. Mackay's doubt about the popular belief that 'two heads are better than one' has since then guided numerous disciplines interested in human collective decision-making from political sciences to economics and social psychology. Many studies have shown that together, we can do terribly and we can do terrible things. This raises the question why do we do things together at all? In my talk I examine the various motives for and benefits of collective decision making that go beyond wisdom of crowds.

Liran Samuni (Harvard University, US)

Pathways to costly collective action in chimpanzees

Friday, 19 May, 11:30 – 12:30

Collective actions allow individuals to reach goals that are otherwise unattainable as single individuals and can promote the survival and wellbeing of group members, thereby offering an adaptive pathway to reach positive-sum outcomes. However, when the collective act inflicts costs to actors and results in a commodity that is available also to non-actors (i.e., public good), collective action becomes evolutionarily unstable. In such situations, free riding would be the optimal strategy – sitting aside and letting others assume the costs of participation while also reaping the benefits of the act. Chimpanzees (Pan troglodytes) exhibit some of the most remarkable examples of collective action in non-human animals during between-group conflict. Despite the high costs associated with this collective act, males and females coordinate their actions to protect their territory borders. Combining behavioral and physiological data, I examine the underlying mechanisms supporting chimpanzee collective action during between-group conflict. I demonstrate how between group conflict shapes within-group coordination, tolerance, and aggression and how the social relationships that individuals maintain within their groups inform contributions to the costly collective act. Finally, I explore the involvement of the highly conservative oxytocinergic system in mediating coordination and supporting collective action in the face of the between-group threat.

Arianna Curioni (Vienna University of Technology, Austria)

Better Together: What motivates our decisions to cooperate?

Friday, 19 May, 14:30 – 15:30

Humans are the most motivated cooperative agents among any other species. We engage in collaborative activities to reach goals that we would not be able to attain individually. But we often choose to cooperate when there is no instrumental advantage, whether it be monetary or reputational. How do humans decide to cooperate or not? From utility-based to evolutionary, motivational, and embodied decision-making, various models have been used to describe human cooperative decision-making process. In this talk, I will discuss how combining these different levels of explanation helps study human cooperative preferences and their implications for real-life decisions and learning. I will present my work on whether human adults and infants represent the costs and rewards of individual and cooperative actions differently, whether these cognitive representations are grounded on rational models of action, and some recent work on the role of expected risk and uncertainty in adults' cooperative decisions. Finally, I will propose how my findings provide insights for designing artificial agents that collaborate with humans in real-life collaborative scenarios, such as industrial and rehabilitation settings.

Ophelia Deroy (Ludwig Maximilian University, Germany)

Human collectives vs. hybrid collective: What changes?

Friday, 19 May, 17:00 – 18:00

Intelligent robots are far from being up to fully replace humans in the workplace, at home or on the streets. Humans still increasingly draw on smart systems to fulfil tasks formerly reserved to humans, and also tend to draw on their social cognition and interactive repertoire to do so. In this talk, I propose to consider this as an instrumental use of social cognition, and show how it conceptually, cognitively and neurally differ from the evolutionary social cognitive skills we use for genuine social interactions.

Bahar Köymen (University of Manchester, UK)

Ontogeny of human reasoning and collaborative decision-making

Saturday, 20 May, 9:00 – 10:00

Recent accounts highlight that reasoning is a fundamentally social skill enabling partners to produce and evaluate one another's arguments to reach joint decisions, benefiting all parties involved. In this talk I will present series of studies in which young children produce and evaluate reasons (verbal as well as non-verbal reasons) with partners to reach joint decisions. The findings suggest that children as young as 3-year-olds are able to reason with others; they get better at reasoning in late preschool ages; and they eventually become very "strategic" reasoners at school ages. Overall, the results support the view that children's reasoning is a fundamentally cooperative enterprise aimed at making joint rational collective decisions.

Jennifer Misyak (University of Warwick, UK)

The virtual bargaining framework for joint action, conventions, and language

Saturday, 20 May, 14:30 – 15:30

Collective decision-making is pivotal to much phenomena that compose human social and cultural systems. Coordinated decisions support joint actions, and the formation of norms, conventions and complex societal structures. How is such social decision-making possible? Following work with colleagues, I outline an approach that we call 'virtual bargaining.' The theoretical framework of virtual bargaining provides a rational explanation, and highlights the intrinsically joint or distributed nature of the processes involved.

Of particular focus for this talk, virtual bargaining is considered as the underpinning for the decisions comprising human joint action, and the conventions instantiated through such actions (as coordinative solutions). Using the tools of game theory, albeit in a nonstandard way, virtual bargaining addresses the challenge of how social interactants can spontaneously - and even 'instantaneously' - choose and coordinate upon the same social equilibria, from among a vast space of possible conventions. Applications of this perspective have been explored across diverse domains, including, for instance, experimental games, automobile driving, and human communication.

Language requires joint action, and is governed by the complex layering and entrenchment of patterns of language use. Accordingly, in support of a foundational role for virtual bargaining, I discuss in further detail empirical studies demonstrating peoples' abilities to jointly create 'instantaneous' communicative conventions, and even systems of such conventions, in a non-linguistic experimental paradigm.

Iain Couzin

(Max Planck Institute of Animal Behavior, University of Konstanz, Germany)

The Geometry of Decision-Making

Saturday, 20 May, 17:00 – 18:00

Running, swimming, or flying through the world, animals are constantly making decisions while on the move—decisions that allow them to choose where to eat, where to hide, and with whom to associate. Despite this most studies have considered only on the outcome of, and time taken to make, decisions. Motion is, however, crucial in terms of how space is represented by organisms during spatial decision-making. Employing a range of new technologies, including automated tracking, computational reconstruction of sensory information, and immersive 'holographic' virtual reality (VR) for animals, experiments with fruit flies, locusts and zebrafish (representing aerial, terrestrial and aquatic locomotion, respectively), I will demonstrate that this time-varying representation results in the emergence of new and fundamental geometric principles that considerably impact decision-making. Specifically, we find evidence that the brain represents space in a non-Euclidean way and that this aids in spontaneously reducing multi-choice decisions into a series of abrupt ('critical') binary decisions in space-time, a process that repeats until only one option—the one ultimately selected by the individual—remains. Due to the critical nature of these transitions (and the corresponding increase in 'susceptibility') even noisy brains are extremely sensitive to very small differences between remaining options (e.g., a very small difference in neuronal activity being in "favor" of one option) near these locations in space-time. This mechanism facilitates highly effective decision-making, and is shown to be robust both to the number of options available, and to context, such as whether options are static (e.g. refuges) or mobile (e.g. other animals). In addition, we find evidence that the same geometric principles of decision-making occur across scales of biological organisation, from neural dynamics to animal collectives, suggesting they are fundamental features of spatiotemporal computation.

YOUNG RESEARCHERS' PRESENTATIONS

Saturday, 20 May, 11:30 – 12:30

Investigating group coordination in captive ravens (Corvus corax)

Leoma Williams[1], Keith Jensen[1], Thomas Bugnyar[2]
[1] University of Manchester, UK; [2] University of Vienna, Austria

Cooperation is an important and challenging problem for group-living animals. Most studies involve pairs of individuals, but an important question is, how do larger groups solve coordination problems? Common ravens (Corvus corax) have succeeded at the 'loose-string task' but cooperation and coordination have not been tested beyond the dyad. Here group coordination was tested in ravens in dyads and triads. We hypothesised that in larger groups task failure would increase, as synchrony became more demanding. We also predicted that successful coordination would be limited by both poor inhibitory control and social intolerance.

17 captive ravens between the ages of approximately 3 and 13 years participated in the study. They were presented with a food tray which required the coordination of 2 to 3 individuals to access food rewards. The tray could only be successfully pulled forward when the required number of birds were pulling at the same time. In an open group setting, the ravens were first introduced to an individual board, then a dyadic set-up, and finally triadic.

Social intolerance was a major barrier to successful coordination in dyads and triads. Dyads ultimately succeeded regularly, but triads were much less successful. Group size was negatively correlated with success. This is the first study in which triadic collaboration has been shown in ravens and it joins a small number of studies examining coordination beyond the dyad. Further analyses will examine the relationship between group size and aspects of coordination such as latency to success and efficiency, as well as look at how factors such as inter-individual tolerance, dominance hierarchies, and kinship might affect coordination success. We will also examine behaviours like waiting and extraneous pulling to see whether the ravens were attentive to and aware of the necessity of each other's presence for success.

The importance of response time asymmetry in collective decision making

Alan Tump[1], Tim Pleskac[2], Pawel Romanczuk[3], Ralf Kurvers[1]

[1] *Max Planck Institute for Human Development, Germany;* [2] *University of Kansas, US;*
[3] *Humboldt University, Germany*

Behavioural cascades through social reinforcement are ubiquitous in human and animal groups. Nonetheless, we only have a rudimentary understanding of which choices are more likely to initiate cascades. Here we investigate the role of response time (RT) asymmetries in shaping behavioural cascades. RT asymmetries, where one choice alternative being selected faster than other, are commonly observed in decision-making contexts, such as police shooting tasks, risky choice, and cooperation. How they shape collective dynamics, is, however, unknown. Evidence accumulation models can account for these RT asymmetries. They assume that decision makers gather evidence over time until they reach a threshold and make a decision. We apply these evidence accumulation models to investigate what cognitive mechanisms shape asymmetric RTs and, in turn, behavioural cascades in three steps. First, we use a sequential choice task to study how asymmetric RTs influence human group dynamics and find that rapid choices are likely to be socially reinforced. Second, we fit an evidence accumulation model to our data and find that start point biases in the evidence accumulation process (and to a less extent varying evidence accumulation rates) drive cascades, as they lead to rapid choices for one choice alternative. Third, with simulations, we investigate how the cognitive processes driving asymmetric RTs are expected to shape choice biases in collectives in other experimental contexts (e.g., shooting task, risky choice, cooperation). Overall, the results emphasize the importance of fast choices in collective dynamics and that the characteristics of these fast choices are determined by the individual-level evidence accumulation processes. This framework can be used to predict collective dynamics by having a good understanding of the temporal aspects of the decision-making processes in situations such as police officers holding a subject at gunpoint or panicking crowds.

Social stakes affect decision confidence

Jamal Esmaily[1], Elham Abharzad[2], Simon Knogler[1], Bahador Bahrami[1], Ophelia Deroy[2]

[1] *Ludwig Maximilian University, Germany;* [2] *Institute for Cognitive Science Studies, Iran*

Decision confidence is often defined and studied only in terms of individual components, i.e., as the subjective probability of having made a correct choice given the uncertain information that is available to the agent, the actions they could take to execute their choice and their potential outcomes (e.g., success or failure). But shouldn't confidence depend on social components, for instance the collective significance of our decisions? Intuitively, one should feel less confident of the same decision, given the same information, if their decision has large social effects for others. We set out to examine this hypothesis empirically.

Participants made perceptual decisions under low- vs high social stakes conditions. The perceptual decision was to categorize the direction of a Random Dot Motion (RDM) stimulus. Under low social stakes, the participant's performance was recorded for research purposes, with no further consequences. Under high social stakes, participants were told that if their performance were not high enough this would negatively impact a program aimed to help blind children. The results showed that participants (N=28) decided more slowly but more confidently under high (vs low) responsibility conditions while decision accuracy remained similar. This pattern of behavior is not easily explained by traditional models of decision-making, such as sequential sampling models and speed-accuracy trade-off.

Inspired by these non-trivial results, we are currently running an online experiment to examine the robustness and generality of our findings. At this stage, we have designed the experiment and verified the stimulus and experiment in a pilot phase. We will present the results from experiment 1-3 in the meeting.

POSTER SESSION 1

Friday, 19 May, 10:00 – 11:30

PS1-1 Testing the relation between salivary oxytocin and the infant altercentric bias

Velisar Manea, Victoria Southgate

University of Copenhagen, Denmark

Southgate (2020) proposed that human infants have an altercentric bias; a priority for others' perspectives over their own. A signature limit of the bias should be visible when infants co-witness, with an agent, an object in some state, and then see a new state of the same object without the agent. Infants are predicted to misremember the object in the co-witnessed state.

In direct tests of this hypothesis (Manea et al., under review), 8-month-olds watched an event in which an agent watches an object hiding in one location, and then the object is moved to a new location. The second hiding is witnessed by the infant alone. Infants are shown the object to be absent at either the first or second location. As predicted by the bias, infants look longer to the absence of the object at the co-witnessed location. 12-month-olds look equally to both outcomes.

Southgate further suggested oxytocin as a neurochemical mechanism mediating the bias. High concentrations of oxytocin during infancy may increase attention to social stimuli, decrease self-related processing, or both.

While as a group, 12-month-olds looked equally to both outcomes, we hypothesised that individual differences in oxytocin may predict degree of altercentric bias. We collected salivary oxytocin from the participants in this sample, and plan to have a final sample of n = 48. As of today, we have valid oxytocin data from 32 participants. The correlation for the difference in looking time between outcomes and oxytocin concentration is r = 0.275: infants with higher oxytocin tend to look longer to the absence of the object at the co-witnessed location.

PS1-2 **Social learning leads to inflexible strategy-use: a multicultural comparison**

Wilson Vieira, Sarah Pope-Caldwell, Luke Maurits, Daniel Haun
Max-Planck-Institute for Evolutionary Anthropology, Germany

Humans' ability to strive in diverse environments relies on our capacity to learn behaviors socially or individually and to update our strategies to the demands of the environment. Cognitive flexibility, the ability to switch between known and novel strategies mediates flexible strategy use. Already young children excel at switching away from strategies that no longer work (responsive flexibility). However, when familiar strategies are still effective, we exhibit difficulty updating to a better one (elective flexibility). It is possible that elective flexibility varies due to exogenous factors such as age, eco-cultural context, and how strategies are learned, but little research has been conducted in this topic.

In this study, we used four elective flexibility games that participants solved by using a learned time-demanding strategy acquired either socially or individually and then were presented with a better alternative. We conducted this study in children (4-14 years of age) from two small-scale societies living in the same village in the Republic of the Congo that differ in social structure and means of subsistence: egalitarian, hunter-gatherer BaYaka (N = 51), and hierarchical, horticulturalists/fisherman Bandongo (N = 54); as well as with urbanized German children (N = 52).

Our results showed marked differences in elective flexibility with age and across the three cultures. Interestingly, when the learned strategy was acquired socially, elective flexibility was suppressed. In all cultures and ages, social information increased the willingness of children at all age to use the learned strategy, when compared with their peers that learned it individually. This effect holds true across the four games. Taken together, our results show that social information is a powerful force in shaping our flexible decision-making processes by reducing elective flexibility. Independently of contexts, we seem to prioritize social information over better alternatives, even when it is detrimental to us.

Mary Beth Neff[1], Laura Anderson[2], Liam Crowley[3], Alia Martin[3]
[1] *University of Oslo, Norway;* [2] *University of Konstanz, Germany;* [3] *Victoria University of Wellington, New Zealand*

Imagine someone were to ask about your recent doctor's visit. Coming from a friend, this should not be strange. However, it would be unsettling coming from a stranger who should have no knowledge of your appointment. Assumptions of what people know change the nature of communicative interactions (in this case, determine whether they are comforting or creepy). The ability to track this knowledge during communication is, therefore, vital for successfully coordinating these social exchanges.

Rubio-Fernandez et al. (2019) recently examined adults' knowledge-tracking ability via a self-paced reading task. Participants read scenarios where an imagined stranger vs. close friend discussed personal information about themselves or the participant. Participants' reading times were slowest when strangers referenced personal information about the participant, which the authors argue demonstrates adults' automatic knowledge-tracking in communicative interactions. However, because the information discussed was deeply personal (e.g., participants' ulcer, father's death), it is unclear whether participants evaluated individuals' knowledge per se or relied on normative assumptions about what strangers should generally discuss.

We investigate how adults track knowledge during communicative interactions by replicating and extending Rubio-Fernandez et al. (2019). In Study 1, we successfully replicated the second experiment of Rubio-Fernandez et al. (2019), $t = 2.04$, $p < 0.05$. In Study 2, a stranger always comments on the participant's personal information, but we manipulate the accessibility of this information (e.g., stomach ulcer vs. facial acne) to investigate whether participants are tracking the knowledge in these exchanges or are simply reacting to the broader violation of communicative norms. We predict that if participants are truly tracking others' knowledge, their reading times should only be slower in response to a stranger

discussing inaccessible information about the participant (e.g., discussing participants' stomach ulcer but not their facial acne). Results of Study 2 will be presented at the conference.

PS1-4 **Co-actors integrate the costs of different types of actions in joint action planning**

Georgina Török[1], Natalie Sebanz[2], Gergely Csibra[2,3]
[1] Max Planck Institute for Human Development, Germany; [2] Central European University, Austria; [3] Birkbeck, University of London, UK

In repeated joint actions, people take the expected group effort into account and choose action options that minimize it (i.e., are co-efficient). This study investigated how people plan joint action sequences when co-efficiency would require the integration of the costs of different types of actions. In a within-subjects experiment, participants (N=40) played a touchscreen-based game in which they collected objects by choosing one of two actions (tapping or dragging). We manipulated the number of taps and lengths of paths to be dragged over. We measured the participants' tapping and dragging durations, estimated the individual relative costs of these actions, and evaluated their efficiency in a 2AFC condition. We then analyzed participants' decision-making when the same task was embedded in a joint context. When playing alone, the participants tended to minimize movement durations. Decisions in the joint task were best explained by a model incorporating both the decision-maker's and the co-actor's relative action costs: The higher the combined costs of a dyad's tap-and-drag sequence, the less likely that it was the chosen course of action. Thus, conditional on individually efficient decision-making, people integrate the relative costs of different actions available to themselves and their partner in joint action planning.

PS1-5 **Priming abstract quantifier meaning in children**

Magdalena Roszkowski, György Gergely, Ernő Téglás
Central European University, Austria

The question of how the acquisition of logical concepts is related to the acquisition of language is a matter of on-going debate. While some have argued that already young children are equipped with the mental vocabulary that underlies the meaning of linguistic expressions like "and", "or" and "every" (Crain, 2012), other theories assume that certain logical concepts become available only through the acquisition of the corresponding expressions (Xu, 2019). Our study targets the abstract representation that preschool-aged children deploy when interpreting plural sentences like e.g. "Two girls are holding three puppets" which are ambiguous in at least two ways: On a cumulative interpretation, the sentence describes a situation in which two girls are holding three puppets in total. On a distributive interpretation, the sentence is true of a situation with two girls each holding three puppets. These interpretations have been argued to correspond to two different structures at the level of Logical Form, whereby the latter is derived from the former through a covert operator which introduces universal quantification over atomic individuals (Link, 1983). By means of a picture-selection task (Maldonado et al., 2017) the present study particularly investigates whether these two interpretations may be activated, i.e. primed, in children between 4 and 6 years - at an age where children are just about to master the truth-conditions of overt universal quantifiers (Crain et al., 2004; besides the problem of quantifier spreading see Philip, 1995; 1996). If such abstract representations are available to children, we expect the rate of distributive choices to differ significantly between conditions, which would also suggest that the inconsistencies previously observed in preschoolers' interpretation are rather due to a mapping problem than to their lack of conceptual capacities. However, it is also conceivable that quantification at an abstract level is tied at this stage of acquisition to overt linguistic material, i.e. that without elements like "each" or "every" such an operation cannot be deployed and we therefore will not find priming effects, pointing to the possibility that in this case conceptual development is indeed intimately linked to language development.

Eavesdropping in dogs: Dogs with a vocabulary of object labels can learn new labels by observing social interactions

Shany Dror, Ádám Miklósi, Andrea Sommese, Claudia Fugazza
Eötvös Loránd University, Hungary

18-month-old infants can learn words by observing 3rd-party interactions. Label learning by observation has also been demonstrated in Gray Parrots and a bonobo. Word-knowledgeable (WK) dogs learn object labels (e.g., dog toy names) by engaging in playful social interactions with their owners. To examine whether WK dogs also learn object labels by observing 3rd-party interactions, and how this compares to their typical learning context, we exposed them to two conditions. In the Observational Learning Condition (OLC), dogs (N=4) observed two of their owners as they engaged in a triadic interaction with a toy. One of the owners named the toy, gave it to the other owner, and asked him/her to hand it back. While doing so the owners looked at each other and the toy in an ostensive manner. These one-minute-long interactions were repeated for 4 days, after which the process was repeated with a second toy. In the Active Learning Condition (ALC), dogs (N=4) were exposed to the same process but instead of observing the owners, one of the owners played with the dog with the toy. To test the learning outcome, after the completion of each condition, the pair of the new toys were placed together and the owner asked the dog to retrieve each of the toys, six times, in a semi-random order. In each condition (ALC and OLC) 2 out of 4 dogs performed significantly above chance (binomial test; chance level = 0.5, p≤0.02). These results show that similarly to Gray Parrots and bonobos, WK dogs can learn labels by observing 3rd-party interactions. The findings suggest that when learning labels, WK dogs employ flexible learning mechanisms and can identify, and interpret ostensive cues, even when those are not directed toward them.

PS1-7 **The feeling of connectedness during shared emotional experiences predicts the desire of strangers to interact with each other in the future**

Victor Chung[1], Rocco Mennella[2], Elisabeth Pacherie[1,3], Julie Grèzes[1]
[1] *PSL University, France;* [2] *Nanterre University, France;* [3] *EHESS, France*

Emotional gatherings (e.g., protests, demonstrations, music festivals) are paramount events for societies, because they fuel social bonds and collective action on a large scale (Páez & Rimé, 2023; Pizarro et al., 2022). Accordingly, experiments showed that shared emotional experiences, such as watching videos together, led participants to experience more intense emotions (Shteynberg et al., 2014), which in turn predicted their feelings of closeness (Rennung & Göritz, 2015). Could shared emotional experiences also account for individuals' motivation to interact with each other? We hypothesized that experiencing connectedness during shared emotional experiences would predict willingness-to-interact. To test our hypothesis, we recruited 56 pairs of unacquainted individuals who jointly watched emotion-eliciting videos. We asked participants to report their desire for future interaction (Coyne, 1976) at the beginning and end of the experiment, as well as their feeling of connectedness (Gabriel et al., 2019) after each video. The results confirmed that feeling more connected during the videos predicted increased desire for future prosocial interaction (partial mediation), which suggests the importance of shared emotional experiences for large-scale cooperation. Finally, we will propose ideas for a new study testing the effect of shared emotion on other aspects of joint action, namely motor coordination and strategic cooperation.

PS1-8 **How do chimpanzees solve a pure coordination problem?**

Shona Duguid[1], Esther Herrmann[2], Johanna Eckert[3], Michael Tomasello[4]
[1] *University of St Andrews, UK;* [2] *University of Portsmouth, UK;* [3] *Max Planck Institute for Evolutionary Anthropology, Germany;* [4] *Duke University, US*

Coordinating decisions with others is fundamental to daily life for social species such as chimpanzees. We know that chimpanzees cooperate with others in many

important social contexts, yet, we still have limited knowledge of how they coordinate decisions to achieve this. In the current study we presented pairs of chimpanzees in a captive setting with a pure coordination problem. The task was for the pair to release food from one of four identical bridges. They could only do this by both pulling on strings attached to the same bridge. All bridges contained the same reward and were spaced far enough apart so that the chimpanzees could potentially use the position of their partner to infer their decision. Thus, in the simplest form of the task, the chimpanzees could solve the problem by following each other's actions. We tested this by granting access to the task either simultaneously or with a slight delay (5s) between partners, predicting that in the latter case following a partner should be easier. All pairs were highly successful at releasing the food in both conditions. Notably, they all converged on using the same apparatus, despite showing differing preferences in individual training. Thus, we explored the flexibility of their coordination in a second phase of the study by only baiting two of four options per trial. The chimpanzees were able to maintain success in this phase, even after changing partners. We discuss these results in contrast to a previous pure coordination task in which body position could not be used as an indicator of choice and chimpanzees struggled to coordinate.

PS1-9 **Precise tactile stimulation of worker ants by a robotic manipulator reveals that individual responses are density- and context-dependent**

Matthias Rüegg[1,2], **Alba Motes-Rodrigo**[2], Nathalie Stroeymeyt[3], Thomas O. Richardson[3], Mahmut Selman Sakar[1], Laurent Keller[2]
[1] École Polytechnique Fédérale de Lausanne, Switzerland; [2] University of Lausanne, Switzerland; [3] University of Bristol, UK

Ant workers are often specialized in performing certain tasks in the colony and it is well established that the main task an ant performs can be used to predict its sensitivity and responses to task-associated stimuli. An often-overlooked aspect of ants' task performance is that individuals often switch tasks throughout the day and are not always engaged in functional tasks. Furthermore, task performance is often correlated with other context-specific factors such as worker density, which

also influences individuals' behaviour. Given this intra-individual variation in task performance and its interdependence from density, it is currently unknown whether and how these two factors interact to modulate ants' sensitivity and responses to stimuli. To address this question, we built a robotic manipulation system that allowed us to teleoperate a magnetically tethered dummy inside ant colonies and to provide simulated antennations to ants when performing different tasks in areas with different worker densities. We coupled this system with an automated tracking system that tracks individual identities and locations as well as records the ants' responses to the dummy stimulation. We found independent effects of task and density on ants' responsiveness and alarm towards the dummy. Ants were less likely to respond and be alarmed when stimulated in areas with high worker density. Responsiveness but not alarm was further influenced by the task being performed, with ants doing broodcare being the least responsive. Our results suggest that ants' responses are density-dependent and that ants experience a process of habituation to tactile stimulation. Additionally, ants' responsiveness is modulated by the task they are performing, which shows that sensitivity to stimuli is context-dependent. Our robotic set up constitutes a valuable tool to systematically investigate social insect behaviour under unprecedented experimental control to unravel the individual-level behavioural rules that underpin the organization of social insect colonies.

PS1-10 **Implicit collective decisions: The case of hate speech**

Jimena Zapata[1], Ophelia Deroy[1,2], Bahador Bahrami[1]
[1] Ludwig Maximilian University, Germany; [2] University of London, UK

When is a decision considered collective or individual? A critical place where this question arises is hate speech: Philosophers have argued that when a hate speaker verbally attacks a victim in front of a silent audience, he is seen as expressing a collective attitude rather than his own. In other words, silent bystanders could unintentionally play a role as co-deciders or co-actors in the hate speech act. To test this normative hypothesis, we created a series of visual scenes, allowing participants to comprehensively evaluate hate speech incidents in a context with

many actors involved and bystanders present. We found empirical evidence supporting that bystanders' reactions play a pivotal role in people's perception of the harm caused by hate speech to victims and society. Especially, presenting third-party observers with the same bystander's reaction in a collective setting made them realise that those who remain silent could be increasing the damage while those who oppose the attack could be helping to reduce it. Our results highlight the importance of investigating harmful individual behaviours in the social context they occur and exploring responses to societal problems such as hate speech from a perspective that allows us to compare the benefits they offer when setting out individually and collectively.

PS1-11 **Modeling behavior composition of a chimpanzee group in temporal planning**

Junyu Li, Manuel Bohn, Daniel Haun
Max Planck Institute for Evolutionary Anthropology, Germany

Planning is ubiquitous in human activities and facilitates group coordination. Previous research provides evidence of temporal planning in wild chimpanzees by showing that foraging journeys start earlier when the target food source is farther away. However, whether anticipation happens on a group level and how the cognitive demand is distributed across individuals are not understood. In this study, we first investigate a chimpanzee group's response to a novel reward appearing at a fixed-interval, using object detection and agent-based modeling to quantify the presence of anticipation in the group; secondly, if anticipation exists, we will investigate the roles of individuals in the task by identifying anticipatory individuals. We place a juice fountain among a chimpanzee group (N=21) in their home enclosure at Leipzig Zoo; the fountain ejects juice for 10 seconds every 15 minutes (6 cycles x 15 days). We record an overview video and detect the animals' locations with a MaskRCNN model, which has been trained and has good performance on the group. The group's response to the reward is described with a time series of the group's average distance to the fountain. With agent-based modelling, three single-strategy models are simulated: only-

reactionary, only-anticipatory and only-indifferent, from which mixed models are created, representing various compositions of the three strategies in a group. The group strategy mix will be inferred by fitting the experimental time series. Data collection is undergoing and is planned to finish by April. Exploratory analysis will aim to show the prevalence of anticipation in the group and how the group behavior composition changes over more exposure to the reward. Baseline is described by the location data over 3 months before experiment. If applicable, we'll identify anticipatory individuals to investigate whether leader-follower roles emerge.

PS1-12 The role of infants' emerging self-perspective in memory development

Dora Kampis
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What leads to young children begin remembering details from their lives, such as where they know something from? Episodic or 'source' memory is part of our everyday lives as adults, but its development is still a puzzle. Young infants' memory does not always store specifics, which may serve an essential learning function, by facilitating infants' acquisition of generic knowledge. However, as knowledge accumulates, it becomes important to remember from where we know something (source memory, Tulving, 1983); and to remember past events as individual memories in space and time and later flexibly retrieve them (episodic memory, Johnson, 1993).

In this theoretical poster we propose that social cognition has a unique and essential role in the shift from learning generics to remembering specifics, marking the emergence of episodic and source memory. In particular, the emerging understanding of self-other perspective may play a crucial functional role in memory development. We propose that the developing understanding that oneself and others can have different thoughts and perspectives, helps infants appreciate that events are remembered differently by those who experienced

them - including themselves. We will outline how infants' interactions with others, and how they begin to track people's different perspectives and become aware of their own, may be linked developmentally to development of source and episodic memory. Studying children from infancy to toddlerhood may give a unique insight into how the understanding of 'self and others' relates developmentally to episodic remembering.

PS1-13 **Access to inner language enhances memory for events**

Louise Connell[1], Briony Banks[2]
[1] *Maynooth University, Ireland;* [2] *Lancaster University, UK*

Events are temporally-bounded experiences involving people, objects and actions that can be segmented into sequences of smaller meaningful events (e.g., the steps involved in constructing a piece of furniture). We investigated whether inner language enhances memory for events in a naturalistic, non-verbal task where participants constructed simple models from memory. Across three experiments, we used linguistic suppression in a dual-task paradigm to test whether inner language improved overall memory performance and completion time, additionally exploring the number of events that could be recalled. We found that access to inner language at encoding consistently affected memory performance: when inner language was disrupted at encoding, participants were poorer at recalling the models and remembered fewer events. This effect was present whether or not the number of events to be recalled exceed event memory capacity (estimated to be approximately 7-8 events). Critically, the effect of linguistic suppression on memory performance was greater than a control secondary task that did not affect access to language; that is, poorer performance was not solely due to dual-task effects. The results support the proposal that inner language enhances event memory via a mechanism of linguistic bootstrapping, which in turn extends theories of event memory and adds to a growing body of evidence that inner language is a highly valuable cognitive tool.

PS1-14 Visual-Spatial Dynamics of Social Learning in Immersive Environments

Charley M. Wu[1], Dominik Deffner[2], Benjamin Kahl[2], Björn Meder[3], Mark H. Ho[4], Ralf H. J. M. Kurvers[2]

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A key question in social environments is when to innovate individually and when to learn from others. While an intermediate balance is often shown to yield the best outcomes, it is still largely unknown how people negotiate this balance under realistic conditions and how they adapt to different environmental contexts. When foraging for resources, developing marketplace innovations, or engaging in scientific research, other people can be both valuable sources of social information, but also competitors for the same limited resources. Here, we study how people dynamically adapt their learning strategies to different environmental structures, where the best strategy depends on a dynamically changing fitness landscape, with emergent properties based on visual-spatial interaction structures.

We present an immersive collective foraging experiment implemented in the Minecraft game engine. The virtual environment imposes a limited field of view, creating a natural trade-off between allocating visual attention towards individual search or looking towards peers for social imitation. Participants were tested across different social conditions (solo vs. group) and resource distributions (random vs. smooth), where only smooth environments with clustered resources offered benefits for social learning. Our analyses leverage automated transcriptions of visual field data combined with high-resolution spatial trajectories to gain new insights into the dynamics of social learning.

Our results show that people are highly adaptive and selective social learners. When resources were randomly distributed, participants actively avoided each other to reduce competition, decreased their visual reliance on social information, and were less susceptible to social influence. In contrast, when resources were smoothly clustered (offering traction for social learning), participants adaptively leveraged social information depending on individual performance and selectively

directed their social learning towards successful individuals and those who relied more heavily on individual learning. This work provides new perspectives about the cognitive mechanisms that make people such powerful social learners.

PS1-15 **Praised but not Blamed: How AI systems shape collective decision-making**

Louis Longin, Bahador Bahrami, Ophelia Deroy
Ludwig Maximilian University, Germany

Is there something special to collective human decisions? To test the responsibility-sharing hypothesis (El Zein, Bahrami & Hertig, 2019), we compared how responsibility would be shared when a human decides to act based on the advice given by another human, an intelligent machine, or a mere mechanical system. Therefore, we conducted two preregistered vignette-based experiments using a between-subject experimental design to clarify to which degree AI. We first established, in study 1, the conditions under which an AI-powered support system for driving would be held responsible along with the human driver. We examined (n = 746) three main factors of (1) status (AI-system ON or OFF), (2) outcome (positive or negative), and (3) modality (verbal vs tactile AI instructions). At the most basic level, responsibility sharing would entail the AI system to be held more responsible when it is ON (vs OFF). If the AI is considered as a mere tool, we would expect the AI to be judged similarly (not) responsible when ON or OFF, while the human should be as responsible in both cases or even more responsible when assisted by a tool. If the AI is seen as a co-agent or as capable of doing otherwise, there should be a sharing of responsibility and the human user should be held less responsible when the AI system is ON (El Zein et al., 2019, Forsyth et al., 2002, Strasser, 2021, Williams, 2013). We found that human participants attribute shared responsibility to the AI system even though, in debriefing, they predominantly described the AI system as a tool.

PS1-16 **Promises and competition: The effect of social factors on children's delay of gratification**

Charlotte Savill, Bahar Köymen, Keith Jensen
University of Manchester, UK

Delay of gratification is, among other things, a key component of cooperation. Children from 4 to 6 six years-of-age struggle to resist eating an available reward despite the potential gain of an extra one if they can wait (Mischel et al., 1972). Recent research has begun to look at the relationship between social factors and children's ability to delay gratification (e.g., Koomen et al., 2020; Grueneisen et al., 2023). Here, we look at the role of promises and social comparison on the ability to wait for rewards.

We set up online, interdependent delay of gratification experiments with 5- to 6-year-old children. Children must wait 10 minutes to get a 2nd reward, but the outcome depends on the actions of a partner: both children must wait. If either one eats the first treat, neither get an extra reward (interdependence). Since the studies are online (Zoom) we use a confederate partner.

In the first study, we explored the influence of promises on children's inhibitory control. Children either received a promise from the confederate that they will not eat their cookie (promise condition) or a statement that they 'might' eat the cookie (social risk condition). Children who heard a promise tended to wait longer than children in the social risk group.

In the second study, which is ongoing, we are investigating the influence of fairness on children's inhibitory control. Children are presented with either a fair or unfair (disadvantageous) outcome: either both children get a reward if they wait 10 minutes (fair), or the participant gets 1 extra reward while the partner gets 5 more (unfair). Our hypothesis is that disadvantageous inequity aversion will reduce children's motivation to delay gratification in the 'unfair' condition. Preliminary results will be presented.

These studies contribute to our understanding of how social factors influence delay of gratification.

PS1-17 **How noise impacts decision making in triadic conversations**

Ingvi Örnolfsson, Torsten Dau, Axel Ahrens, Tobias May
Technical University of Denmark, Denmark

More than a billion people worldwide currently live with some degree of hearing loss, and with an ageing world population, this number is likely to rise. Hearing loss is associated with depression and is one of the top risk factors for developing dementia. This might be caused by increased difficult with communication, which can lead to social isolation.

While a person's ability to communicate efficiently relies heavily on their ability to hear, it is not solely determined by it. The current paradigm of diagnosing hearing loss relies heavily on passive listening test, where no conversational partner is present. This makes it impossible for these tests to inform us about the interactive aspects of communication, and about whether or not a given individual is having trouble communicating.

In this study, we investigate the potential of using task-oriented dialogue to distinguish between hard and easy communication scenarios. The difficulty was increased by adding background noise designed to resemble a so-called cocktail party scenario. Ten young normal hearing triads participated in the experiment, which took place in three phases. First, they privately answered a series of binary general-knowledge questions individually (e.g., "Which of these two countries has the most inhabitants?"). Afterwards, they discussed the questions as group, and finally were asked to answer the same questions individually again. Using these pre- and post-conversation answers, we propose a formal cognitive model to infer how participants weight the pre-conversation answers of each group member into their own post-conversation answer. We show that around half of the participants in our study exhibited some degree of change in their member weights when background noise was present. This might indicate that these individuals are experiencing some degree of difficulty when communicating in this scenario, causing them to weigh members differently than they would ideally do.

POSTER SESSION 2

Friday, 19 May, 15:30 – 17:00

Thoughts falling apart: Disorganized schizotypy predicts stress-induced psychotic-like experiences in daily life

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Schizotypy is a multifaceted phenomenon with cognitive disturbances at its core. It has been suggested that individuals with disorganized (incoherent cognition and behavior) and negative (negative affects and anhedonia) schizotypy are prone to exhibit stress-dependent psychotic-like experiences (PLEs). In contrast, positive schizotypy (magical thinking and unusual perceptual experiences) was connected to PLEs independently from stress-exposure, defined as "happy schizotypy". However, these findings still need to be tested within individuals: in this study, we aimed to analyze the associations between momentary psychotic-like experiences, perceived stress and schizotypal traits in daily life. We conducted an experience sampling study (8 two-hourly prompts daily for max. 28 days) where participants were asked to repeatedly report their PLEs and the perceived pleasantness of a recent significant event. Positive, negative, and disorganized schizotypal traits were measured by Multidimensional Schizotypy Scale (MSS) across individuals at the beginning of the study. Our dataset contained 7706 observations from 181 participants (N[Females] = 136, Median[Age] = 42) from the general population. Multilevel models were used to examine the interaction of schizotypal traits and perceived stress in predicting PLE within individuals. Our preliminary results indicated that individuals with higher disorganized schizotypy experienced more intense stress-related PLEs in daily life. In addition, positive schizotypy per se predicted PLEs if perceived stress was held constant. The negative schizotypal trait did not show significant association with momentary PLEs. These results may imply that prior cross-sectional findings also hold within individuals: momentary stress-related PLEs were associated with trait-level disorganized thinking and behavior that underlies disorganization's importance in schizotypy and subjective well-being. In addition, our results may confirm the MSS's ecological validity in predicting PLEs in daily life.

PS2-2 How sure are you? Kinematic readout of confidence in collective decision-making

Laura Schmitz[1], Mariacarla Memeo[2], Andrea Cavallo[3], Bahador Bahrami[4], Cristina Becchio[1]

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Research on collective decision-making has shown that groups can outperform their best individual members through "confidence sharing": individuals communicate how confident they felt in their individual judgements so as to arrive at a collective decision [1]. However, such explicit communication of confidence estimates can be noisy, biased, and cognitively demanding [2,3]. Yet, replacing interpersonal communication by simple heuristics also comes with difficulties [3]. In the present study, we put forward another, implicit way of confidence sharing. We test the hypothesis that, in the absence of explicit communication, two individuals are able to infer each other's subjective confidence through simple action observation [4,5], and thereby achieve a group benefit. To this end, we ask two participants to solve a 2AFC perceptual task, with individual decisions being followed by a collective decision. Participants indicate their decisions by performing observable aiming movements to one of two targets [5], while movement kinematics are recorded. Preliminary results from a pilot study suggest that individuals read out confidence from each other's movements and rely on this inferred confidence in the collective decision-making process. With data acquisition still ongoing, we expect the final results to reveal how action observation can inform collective decision-making.

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PS2-3 **Shared neural codes of recognition memory**

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One of the main goals of cognitive neuroscience is to understand the nature of the neural codes subserving memory processes. The aim of this work was to investigate if EEG signatures of recognition memory generalize across a wide range of conditions, including stimulus type and sensory modality, experimental paradigm, and the age of the memory trace.

For this purpose, a data-driven approach, cross-experiment multivariate pattern analysis was used. The training datasets included two face recognition experiments, an experiment using familiar and unfamiliar music, a study involving remembered and forgotten scene/object associations, and an experiment on object familiarity and recollection. A personally familiar/unfamiliar face experiment served as the test dataset. The total number of participants included in the analysis is ca. 120 volunteers of both sexes.

Results of this analysis revealed a shared late effect between ca. 400 and 600 ms that was present for all training datasets, demonstrating a stimulus-independent recognition signal. Additionally, an early, ca. 200 to 400 ms effect was seen for face stimuli, as well as for objects judged as familiar. Also, early face-recognition patterns (ca. 200 to 500 ms) were found to be more similar to familiarity, and late (>600 ms) signals are more indicative of recollection. Furthermore, signals related to subjective memory-related experiences, such as those for false alarms, forgotten items, and incorrect responses, give rise to recognition signals similar to correctly identified old/new stimuli.

These findings highlight the usefulness of multivariate cross-classification in investigating the neural dynamics of memory processes and their potential impact on models of memory and person perception.

PS2-4 **Interdisciplinary conceptual framework for collective decision making**

Olgierd Borowiecki
Nicolaus Copernicus University in Torun, Poland

In this theoretical work, collective decision making is operationalized with terms from computational neuroscience (Dolan & Dayan, 2013; Geerts et al., 2020), evolutionary biology (Laland et al., 2015; Odling-Smee et al., 2003), and ecological psychology (Chemero, 2009; Gibson, 2014). Collectives are understood as well trained multiagent dynamic systems where agents mutually create niches for themselves. Interactions between the agents are captured with relations (e.g., affordances), which are distributed along an exploration-exploitation spectrum. Niche is understood as underpinned with the exploitative end of the spectrum of relations (e.g., when following relations repeatedly yield the same outcome). The framework is grounded in the brain circuits around limbic/associative striatum for explorative actions/relations and sensorimotor striatum for exploitative actions/relations. Further, the framework is related to two interpretations of the Free-Energy Principle: representational interpretation combined with Bayesian Inference about hidden causes of the sensory input (Constant et al., 2021) and ecological/enactive interpretation grounded in direct perception (Bruineberg et al., 2018). This framework is a part of broader theoretical studies on instrumental actions done by H. Sapiens aiming for developing universal computational operationalization of instrumental actions.

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PS2-5 **Measuring individual differences in social-cognitive development**

Julia Prein, Manuel Bohn, Luke Maurits, Steven Kalinke, Daniel Haun
Max Planck Institute for Evolutionary Anthropology, Germany

To navigate the social world and interact with others, we use social cognition: we represent and reason about their perspectives, knowledge states, intentions, and beliefs. While much research has been devoted to studying the average age at which a certain social-cognitive ability emerges in development, individual-level variation has often been overlooked.

To study individual differences, variability in task performance needs to be reliable (i.e., systematically order individuals in the same way) and meaningful (i.e., differences in test scores correspond to differences in ability). Few studies using traditional measures (e.g., false belief change-of-location tasks) address these issues: they rely on low trial numbers, dichotomous measures, and lack satisfactory psychometric properties. This has profound implications on what these studies can show: poor reliability of measures on an individual level may conceal relations between different aspects of cognition, and obscure developmental change. We argue that a systematic individual differences perspective on social-cognitive development is needed.

To address this issue, we are creating a new test battery to capture the development of individual differences in social cognition. We designed an interactive web interface that works across devices and enables in-person and

remote testing. Crucial design features of all tasks include a spatial layout that enables continuous outcome measures. Our first task focuses on gaze understanding – the ability to locate and use the attentional focus of an agent. We found inter-individual variation in a child (N = 387) and an adult (N = 236) sample, and substantial developmental gains. High internal consistency and test–retest reliability underline that the captured variation is systematic. Our second task is currently under development and focuses on children's ability to understand partial knowledge states.

Taken together, this work shows that a focus on individual-level variation is critical to understanding the nature and dynamics of social-cognitive development.

PS2-6 **Does power influence reason-giving?**

Hanna Schleihauf[1], Antonia Langenhoff[2], Esther Herrmann[3], Jan Engelmann[2]
[1] *Utrecht University, Netherlands;* [2] *UC Berkeley, US;* [3] *Portsmouth University, UK*

Disagreements can be resolved competitively – by using force or dominance, or cooperatively – by using reason. While coercive decision-making processes indicate hierarchical structures between interaction partners, it is often claimed that the exchange of reasons signals a respectful exchange between equals. The presented research is part of a preregistered cross-cultural project (https://doi.org/10.17605/OSF.IO/QVFCH) that examines how power dynamics influence the exchange of reasons. We investigate children's reason-giving in (a) conversations at eye-level compared to (b) conversations with unequal power dynamics across two distinct cultures – Kenya and the Netherlands. While Kenya is a culture with steep hierarchies and authoritarian values, the Netherlands is a culture with flat social structures that center around egalitarianism.

Dyads of 5-to 9-year-old children (N=80 dyads) are either given equal power (both children have the power to make decisions) or unequal power (only one child has the power to make decisions) in a decision-making task. After both parties have received disagreeing evidence relevant for the problem at hand, they are prompted to collectively make a decision. We hypothesized that with

increasing age, children exchange more reasons (referring to the respective piece of evidence) in the equality compared to the inequality condition, with this effect being stronger in Kenya than the Netherlands.

While data collection in the Netherlands is still ongoing, we can report the findings for the Kenyan sample. Although children did provide more reasons as they got older (Chisq (1) = 10.71, p = .001), an unequal distribution of power did not reduce their exchange of reasons (Chisq (1) = 1.28, p = .258). Thus, even in a rather authoritarian culture like Kenya reason seems to trump power. By May we will also be able to report the results of the Dutch sample.

PS2-7 **The commitment loop**

Francesca Bonalumi[1,2], Christophe Heintz[1]

[1] Central European University, Austria; [2] Max Planck Institute for Human Development, Germany

One of the most efficient means to induce cooperation involves committing and trusting that commitments will be respected. In this socio-cognitive process, people cooperate when they have good evidence that the cooperative venture will be beneficial. But how do people recognise situations in which it is beneficial to rely on their social partners? What evidence do people take into account? We answer these questions by describing the cognitive processes of belief formation about what others will do as well as these others' motivations. We argue that they feed each other and thus constitute a "commitment loop". The commitment loop involves the following socio-cognitive events: (1) Actor A forms the belief that actor B relies on them to do X; (2) Actor A is therefore motivated to do X; (3) Actor B forms the belief that actor A will do X; and (4) Actor B is therefore motivated to rely on A doing X; and so on.

The looping process explains why very minimal evidence about one's commitment is sufficient for people to actually commit and trust. The process is such that, as soon as one enters the loop, trust and commitment reinforce each other. We will discuss this and other consequences of this socio-cognitive theory.

PS2-8 Influence of positivity/negativity biases on cooperation in a social-ecological dilemma

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Germany

Climate change requires urgent cooperation to reduce carbon emissions, and yet most of us, from citizens to states, are tempted to defect. Overcoming this social dilemma might prove to be crucial to a sustainable future. Recently, Barfuss et al. have introduced a model of cooperation under the threat of collapse [W. Barfuss et al., *PNAS, 117*(23) (2020), 12915-12922.], in which defecting agents increase the risk of transitioning to an undesirable hothouse-Earth state. They show that, in this social-ecological dilemma, agents learn to cooperate if they sufficiently care for future rewards.

Our work seeks to examine the effect of cognitive biases on cooperation in such a social-ecological dilemma. In experimental studies of decision-making, it is now established that human, and even animal agents, tend to update positive information with a higher weight than negative information. This positivity bias (also known as "optimism") has been modeled within a reinforcement learning framework, using asymmetric updating of prediction errors. To this day, little is known about the effects of optimism on cooperation. In particular, it is uncertain whether optimism facilitates cooperation in a social-ecological dilemma. To answer this question, we adapt Barfuss et al.'s approach to biased agents. We first derive analytical expressions for state-action values in the biased case, in order to identify critical parameter values that separate different game regimes. Then, we use these expressions to run simulations with Barfuss et al.'s deterministic-limit method, which allows a visualization of strategy trajectories in phase space. Ultimately, we compare optimistic, pessimistic, and unbiased agents, in order to determine which condition has the most positive impact on cooperation.

PS2-9 The contribution of statistical learning to language ability: a structural equation modeling study

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Statistical learning is assumed to be a central skill in language acquisition, and individual differences in statistical learning are expected to contribute to individual variation in language ability. In the present study, we aimed to explore more specific relationships between statistical learning abilities and linguistic skills relying on a diverse set of language tasks (vocabulary size, predictive processing of sentences, processing of grammatical or semantic violations and complex sentence structures). We also wanted to control for the contribution of processing speed, short term memory and cognitive control which might mediate between linguistic ability and statistical learning and explain some amount of shared variation between statistical learning and language tasks. To address these questions, we used structural equation modeling on data from a large pool of Hungarian speakers (300 participants). Our results suggest that the contribution of statistical learning abilities to linguistic skills is not systematic, and most of the observed associations are mediated by general cognitive abilities. These suggest that the role of statistical learning may be most prominent at earlier stages of language acquisition. They also draw attention to the importance of methodological aspects in the assessment of cognitive abilities behind language: the psychometric properties of tasks, the inclusion of control tasks and the age of participants.

PS2-10 Self-Other Overlap in Interpersonal Synchrony

Elisa Wiedemann, Thomas Wolf, Günther Knoblich, Natalie Sebanz
Central European University, Austria

Moving in time with others has been shown to lead to increased cooperation, stronger affiliation, and better coordination between co-actors. One of the proposed mechanisms underlying these effects is an increase in self-other overlap, or a decrease in self-other distinction, induced by the performance of the same movements at the same time as another person. Across three pilot studies, we investigated whether interpersonal synchrony modulates motor-level self-other distinction and perceived self-other overlap.

Participants (N=40) performed a coordination task, in which they moved either synchronously or asynchronously with a task partner, followed by an automatic imitation task, measuring motor-level self-other distinction, and a continuous version of Inclusion of Other in Self (IOS) scale, quantifying perceived self-other overlap. The studies followed a within-subjects design, and the order of conditions (synchronous vs. asynchronous coordination) was counterbalanced across participants. Participants responded to images of their task partner's and the experimenter's hand in the automatic imitation task, and they performed the IOS ratings for their task partner and the experimenter in random order.

We predicted that participants would show less motor-level self-other distinction, indexed by a stronger imitative tendency in the automatic imitation task, and higher levels of perceived overlap, indexed by higher IOS ratings, with their task partner following synchronous compared to asynchronous movement. Contrary to our predictions, we did not find an increase in imitative tendencies for the task partner's hand, nor were participants' IOS ratings higher after synchronous compared to asynchronous coordination blocks.

This suggests that moving in time with others may have a smaller effect on motor-level self-other distinction and perceived self-other overlap than previously assumed. The prosocial effects of interpersonal synchrony may not be the result of an increase in self-other overlap at the motor level, and may rely on different mechanisms, such as group identification, instead.

Deceptive behavior towards familiar and unfamiliar peers in relation to theory of mind and executive functions in young children

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The ability to balance cooperative and competitive behaviors to meet their goals has important implications for children's social development. Resorting to deception is frowned upon within social interactions, while at the same time serving as an indicator of socio-cognitive competence throughout childhood. However, there is little experimental evidence of how this behavior is employed in relation to peers. The current study examined children's decision to deceive familiar and unfamiliar peers in relation to their theory of mind (ToM) and executive functioning (EF: spatial working memory, inhibitory control, and shifting). Our participants were 75 school-age children (6-9 years; M_{age} = 90.67 months, SD = 6.63; 40 girls).

Children played a new computerized hide-and-seek game against two peer opponents: a familiar peer (the best classmate) and an unfamiliar peer (a child from another school). Participants had to hide cards with favorite and unfavorite stickers in one of two available boxes, and they could involve deceptive pointing to mislead the opponents towards searching in the incorrect box.

Preliminary results showed that truth-telling was not significantly associated with children's ToM or EF, $F(6)$ = 0.55, R^2 = .046, p = .76. Instead, children's lie-telling was positively predicted by first-order false belief understanding (β = 0.271, p = .037). Second-order lying (i.e., alternating between truths and lies when the player didn't trust them) was positively predicted by second-order false belief understanding (β = 0.425, p = .000) and negatively by the RT in the shifting task (β = -0.291, p = .017). Surprisingly, children lied slightly more to their familiar peers, while it took them significantly more time to tell a lie than telling the truth when the opponent trusted them, $F(1,74)$ = 4.2, p = .006, partial η^2 = .154. Implications for understanding children's early deceptive behavior in competitive contexts will be proposed.

PS2-12 Discovering the Unknown: Investigating How Information Delivery and Instruction Type Affects Children's Exploratory Play

Rebeka Zsoldos, Ildikó Király

Eötvös Loránd University, Hungary

Children are motivated to explore their environment, taking into account information provided by their partners. A growing body of literature suggests that the nature of information provision influences children's learning. For example, it has been shown that children play with a novel toy for shorter periods and explore fewer possible functions following pedagogical instruction than non-pedagogical demonstration (Bonawitz et al., 2011). However, little is known about what happens when it is the child, instead of an adult, who delivers the information by discovering it, and the adult provides only feedback on the discovery.

The present study examines how the mode of information delivery (child-directed discovery, adult-directed demonstration) and the instruction's type (pedagogical, non-pedagogical) affect children's exploration. Our aim is to replicate the classic study by Bonawitz and colleagues (2011) in a Hungarian sample and extend its findings by investigating how children's active involvement in information discovery modulates their learning.

PS2-13 Collective Turn in Moral Decision Making

Anita Keshmirian[1], Sofia Bonicalzi[2]

[1] Ludwig Maximilian University, Germany; [2] Roma Tre University, Italy

Moral issues are often the topics of lively interactions in our life. In many cases, we process morally relevant information together, persuade each other, signal inclinations, compromise, and reach a consensus on a highly debated moral issue. But how are our collective moral decisions different from individual ones? To answer this question, in this paper we review the specific group dynamics that possibly lead to significant differences in collective moral decisions, comparing to

the statistical aggregate of individual decisions in the group. Focusing on the factors that emerge in collective moral contexts, e.g., collective moral emotions and moral reasoning, virtue signaling, and diffusion of moral responsibility, we discuss the cognitive mechanisms at work when people deliberate about moral issues, aggregate their opinions, or reach a consensus on morally divisive issues.

PS2-14 Outcome feedback determines children's cooperation in a water threshold game

Patricia Kanngiesser[1], Jahnavi Sunderarajan[2], Sebastian Hafenbrädl[3], Jan K. Woike[1]
[1] University of Plymouth, UK; [2] Flame University, India; [3] IESE Business School, Spain

Cooperation in social dilemmas has been widely studied in adults, but few studies exist with children. We developed a novel, child-friendly variant of a threshold public goods game: a water game (using real water) that children played in groups of three over multiple rounds. At the start of each round, each child received a fixed water endowment and decided how much water to release into a common pool. If the group reached a fixed threshold in the common pool, every group member received a water bonus. Each child also kept all water they did not contribute. Children later exchanged their collected water for rewards.

In two conditions, we investigated effects of outcome feedback (between-subjects): children either only observed how much water they accumulated (individual feedback) or how much water all group members accumulated (relative feedback). We predicted that relative feedback would increase competition and lead to a decline in cooperation over rounds (as cumulative effects became more pronounced). We also investigated children's communicative strategies during gameplay. Children aged six to ten years from Germany (n=117) and India (n=123) participated in the study.

Cooperation rates (i.e., reaching the threshold) were high in both locations. However, we observed a significant interaction between condition and round: cooperation declined in the relative feedback condition, but not in the individual feedback condition. In addition, females cooperated more than males. We also

transcribed children's conversation (14,374 codable utterances total). Detailed coding revealed, for example, that children talked about giving water and made social comparisons. Our findings show that children from Germany and India cooperated in threshold public goods game, but that feedback about others' outcomes decreased cooperation. Our new paradigm allows children to experience social dilemmas in an interactive way and opens new avenues for studying children's cooperation and sustainable resource use.

PS2-15 **How do work songs stabilize the tempo of rhythmic joint actions?**

Thomas Wolf, Natalie Sebanz, Günther Knoblich
Central European University, Austria

Recent research has shown that people engaged in rhythmic interactions have a strong tendency to increase their tempo. This is also known as joint rushing. However, successful joint action often requires interpersonal coordination at a stable tempo. When performing long and exhausting joint actions, the co-actors need to pace their actions to not exceed the limits of physical effort they can exert. One way to achieve a joint stable tempo despite the joint rushing tendency is the use of vocalizations as observed in actual work songs accompanying straining joint actions. Two characteristics of actual work songs may be particularly effective in controlling joint tempo: the use of solo passages and metric subdivisions of the intervals between instrumental actions. The aim of the present study was to test whether these two characteristics help pairs of participants to overcome joint rushing and to maintain their tempo during a rhythmic interaction.

Participants performed a joint synchronization-continuation finger tapping task, in which they first synchronized with a metronome and then continued tapping after the metronome faded away. Instead of singing work songs our participants were vocalizing numbers while tapping. Participants either heard the other's taps or not. In three experiments we tested the effect of solo counting and metric subdivisions separately, as well as in combination (the "work song"-condition). Only in the "work-song"-condition, where a solo participant introduced metric

subdivisions by vocalizing, were pairs of participants able to maintain a stable target tempo. The results indicate that vocalizations can indeed stabilize the tempo of rhythmic joint actions. We suggest that there may be other aspects of work songs and other types of vocalization during joint action that can support achieving joint goals.

PS2-16 Object equivalence and memory in a virtual environment by a lexigram-proficient bonobo

Sarah Koopman[1], Catherine Hallsten[1], Matthias Allritz[2], Francine Dolins[3], Josep Call[1]

[1] University of St Andrews, UK; [2] Max Planck Institute for Evolutionary Anthropology, Germany; [3] University of Michigan-Dearborn, US

Technological advancements have enabled the use of virtual environments to study cognition in non-human animals. Virtual environments allow us to study spatial and social cognition with greater experimental control than in the wild, and on larger scales than have previously been possible in captive settings. However, it is largely unknown whether apes associate objects rendered in virtual environments with their real-life counterparts. We investigated object equivalence with Kanzi, a lexigram-proficient bonobo, using a cross-modal match-to-sample task that took place in a virtual environment presented on a touchscreen. The sample was the spoken English word for an object, and the target and distractor stimuli were lexigrams (visual symbols), photographs, or 3D renderings of objects. If Kanzi connected 3D renderings of objects to their real-life counterparts, we expected above-chance accuracy on those trials. Accuracy on each stimulus type, including 3D objects, was significantly above chance. Moreover, Kanzi's accuracy did not significantly improve over time, indicating that he did not need to learn the associations between the object concepts and their 3D renderings.

In a second experiment, the stimuli were not visible when the sample was presented. Accuracy on each stimulus type decreased, with accuracy on 3D objects dropping to chance level. We investigated this further in a third experiment where

the stimuli were only visible either before, during, or after sample presentation. Kanzi performed above chance in every condition except when the stimuli were only visible before the sample was presented, consistent with previous research showing a decrement in performance on prospective memory tasks. Importantly, there was no difference in performance between trials with photographs and with 3D object stimuli. Our results suggest that Kanzi recognized that 3D renderings of objects in a virtual environment corresponded to their real-life counterparts and showed similar memory capacities for these items as for photographs of objects.

PS2-17 **You should have checked! The importance of epistemic intentions in ascription of responsibility**

Katarina Kovacevic, Francesca Bonalumi, Christophe Heintz
Central European University, Austria

We investigated the role of epistemic factors in responsibility ascription. Would protagonists who did not know their actions would have negative consequences be judged responsible, nonetheless? We found that people hold those protagonists responsible if they had an opportunity to acquire information about the potential consequences of their actions, especially if that could have been done easily.

In Study 1 we tested the prediction that responsibility is ascribed in view of the agents' epistemic states. The scenarios we used varied following three conditions: a) Knowledge - agent had the relevant information; b) Full Ignorance - agent did not have such information; and c) Willful Ignorance - agent did not have the relevant information but could have acquired it. Participants (N = 151) were recruited via Prolific, they read three stories each implementing a different condition, and rated on a Likert scale to what extent they agreed that the agent was responsible for the bad outcome. A Kruskal-Wallis test showed the effect of agents' epistemic states on responsibility ascription (H(2) = 163, p < .001, ε2 = .383), i.e., participants hold Wilfuly ignorant agents more responsible than the Fully ignorant ones, but less than the ones who had the knowledge. In Study 2 we tested

the prediction that effort needed to acquire the relevant information influences responsibility judgments. Participants (N = 306) read one story, answered responsibility question, and assessed the difficulty to acquire the information. Mann-Whitney test (U = 8645, p = .002, rrb = .194) revealed that participants ascribed more responsibility to agents who could have easily acquired knowledge and did not (Low effort condition), than to agents for whom that was difficult (High effort condition). We discuss that when people ascribe responsibility, they consider not only epistemic states, but also epistemic actions and intentions behind those epistemic states.

POSTER SESSION 3

Saturday, 20 May, 10:00 – 11:30

PS3-1 **The effect of virtual space for theory of mind in 4-year-olds**

Alexandra Kelemen, András Sziklai, Krisztina Andrási, Rebeka Zsoldos, Réka Schvajda, Ildikó Király

Eötvös Loránd University, Hungary

The Covid-19 pandemic has ushered in an unprecedented shift away from the physical towards the virtual. The proliferation of daily digital interactions invites us to more thoroughly explore the ways in which we understand social partners in this novel context. Capacity for Theory of Mind expands rapidly during the early years of childhood. In short, children begin to grasp on the one hand that social partners have access to information whilst present in a situation, and on the other that said partners cannot follow how events transpire if they are absent. However, our understanding of how children follow and process others' potential mental states in virtual space remains limited.

The present study aims to examine theory of mind in 4-year-olds, during an object-transfer experiment, with a "social partner" either fully absent or present via a virtual medium. The first phase of the experiment involves the social partner (i.e., assistant) introducing themselves to the child via zoom videochat or by face-to-face interaction. The experimenter then hides the assistant's toy in one of two boxes. Whilst the assistant is either present virtually or physically (i.e., true-belief) or leaves the situation (i.e., false-belief), the experimenter transfers the toy to the other box. Subsequently, the child is asked about the social partner's knowledge on the location of the toy. We hypothesise that access to information will be more limited for children in the virtual presence group, and thus, theory of mind attributions will be affected.

Data collection is still undergoing (n=24, planned sample size n=50); we aim to share the results from our finished larger sample at the conference.

PS3-2 **Deciding together with AI: A compatibility challenge**

Isabelle Ripp[1], Maximilian Moll[2], John Dorsch[1], Ophelia Deroy[1], Merle Fairhurst[3]
[1] Ludwig Maximilian University, Germany; [2] University of the Bundeswehr Munich, Germany;
[3] Technical University Dresden, Germany

Humans can decide together and learn to adjust their decision strategies in new contexts. But as artificial intelligence becomes more integrated into our lives, we have the opportunity of combining human and AI decision-making in hybrid collective contexts. And in fact, decisions taken together with artificial assistants are often better than single decisions and can even avoid some of the biases affecting collective decisions between humans. AI assistants are therefore increasingly offered as the best decision partners that humans can have. However, artificial intelligence decides and learns on very different grounds than humans.

In this presentation, we suggest that understanding the similarities and differences between human and machine RL is critical in the development of such hybrid decisions, as it allows for the design of systems that are more compatible with human decision-making processes. Deep reinforcement learning (DRL) has been shown to be structurally, functionally, and behaviourally similar to human RL, making it particularly suitable for tasks requiring human-machine cooperation in high-dimensional and complex state spaces. We conduct a systematic comparison of human RL and DRL using AlphaGo Zero as an example DRL algorithm. Through this approach, aspects of comparability will be studied on a structural, functional and behavioural level using methods from comparative neuroanatomy and comparative psychology. We highlight new ways of comparing brains and machines while minimizing comparative biases like anthropomorphism, anthropocentrism, and anthropofabulation in this review.

PS3-3 **Mechanisms underpinning efficiency in joint action**

Shaheed Azaad, Natalie Sebanz

Central European University, Austria

Contemporary research on efficiency in joint action has found that individuals in a dyad will choose a more effortful action for themselves or their partner so long as it results in a lower combined effort for the dyad. However, joint efficiency paradigms often confound visual cues, such as the distance between an object and its goal, with the effort required to perform a particular action. We sought to test whether actors indeed choose courses of action based merely on efficiency or whether they also use heuristics, such as distance, to make their decision. To this end, we asked pairs of participants to complete a task where they dragged objects to one of two locations of different distances. Depending on their choice, participants would either need to move alone to a further goal or with their partner to a closer one. Critically, the relative distances to the two goals varied so that the total expenditure for the joint option was either more, less, or the same than that of the solo action. Participants were more likely to choose the nearer, joint option, with the relative effort expenditures not modulating their likelihood of doing so. Rather, participants' likelihood of choosing the joint option was only reduced when the two goals were equidistant.

PS3-4 **Inverted U-shaped Development in Social Attribution Skills across the Lifespan**

Dorottya Dobó, Ágnes Lukács

Budapest University of Technology and Economics, Hungary

Research on age-related changes in Theory of Mind (ToM) shows improvement in childhood, peak performance in young adulthood, followed by a gradual decline with ageing (e.g., Giovagnoli, 2019; Moran, 2013). While this developmental pattern seems to be consistent across tasks, it is not yet clear whether changes in other cognitive functions like executive functioning (EF), memory and language,

which contribute to performance on ToM tasks to different degrees, affect this process.

In this study, we tested ToM using the Social Attribution Task - Multiple Choice II (SAT-MC-II) across the lifespan, controlling for the contribution of other cognitive factors with the inclusion of 321 (140/181 male/female) participants between the ages of 8-92. Our results confirmed previous findings suggesting an inverted U-shaped curve in the development of ToM, peaking in young adulthood, indicating a continuous improvement from childhood followed by a slow decline in ageing. Differences in EF and processing speed had a significant effect on ToM performance, but the predictive effect of age on SAT-MC-II performance remained significant after controlling for these factors. The developmental trajectory of ToM showed sex differences, with a more robust improvement in females in adolescence, and with a more gradual improvement in males, even though performance levels in childhood and young adulthood were at the same level. While visual processing speed contributed significantly to SAT performance in both men and women, the contribution of EF was significant only in women.

In conclusion, our results confirmed previous studies in the inverted U-shaped developmental trajectory of ToM performance, with sex differences in slopes. Changes and sex differences were affected, but not entirely accounted for by age differences in EF and processing speed. Further studies are needed to clarify the factors behind differences between the sexes in developmental curves.

PS3-5 Usually, I don't ruminate, only from time to time: the predictive value of trait and state measures of rumination for the intensity of affective states

Flóra Hann[1], Levente Rónai[1], Szabolcs Kéri[1], Bertalan Polner[2]
[1] Budapest University of Technology and Economics, Hungary; [2] Eötvös Loránd University, Hungary

Emotions and their regulation are essential in adapting to our environment. Individuals differ in regulatory ability, which also fluctuates over time. Repeated

measures designs appear suitable to capture this within-individual variability. Rumination is the cognitive emotion regulation process of dwelling on negative feelings and their consequences. Results suggest only a weak correlation between state and trait rumination. Also, increased state (but not trait) rumination is associated with higher emotional reactivity, the emotional response to a negative occurrence. However, the temporal, within-person examination of rumination may predict emotional reactivity more accurately.

We aimed to confirm that state rumination is a stronger predictor of emotional reactivity than trait rumination. We also investigated the association between state and trait rumination. 247 individuals provided data for 28 days in an experience sampling study. They received 8 short questionnaires daily, assessing their momentary affective states, emotion regulation, and perceived stress. 14265 observations were obtained, then analyzed using mixed-effects models. Results suggested that state, mean state, and trait rumination have independent predictive validity for emotional reactivity. However, the magnitude of effects overlapped; thus, their importance could not be ranked. But when considering negative affect regardless of stress, mean state rumination was the strongest predictor. It can be considered an indicator 'halfway between' trait and state, possibly combining advantages of both. We found only a moderate positive correlation between trait and state rumination. Psychometric and contextual differences could account for this, and the different self-report techniques tapping different information sources.

Our findings provide insight into the within-individual dynamics of emotion regulation and their relationship with affectivity, overcoming limitations of the common trait approach. They corroborate the need to re-evaluate the traditional measurement of psychological constructs. Our findings have clinically relevant implications for the personalized prediction of emotional responses to stress through self-report tools applicable in everyday contexts.

PS3-6 **Physiological underpinnings of confirmation bias in reinforcement learning**

Germain Lefebvre, Jamal Esmaily, Zahra Rezazadeh, Bahador Bahrami
Ludwig Maximilian University, Germany

Confirmation bias is a well-documented phenomenon in which individuals tend to ignore evidence that contradicts their beliefs. While this bias has traditionally been observed in higher-level cognitive processes, recent research has shown that it can also affect low-level cognitive processes such as visual perception and reinforcement learning. In probabilistic learning tasks, subjects tend to take more into account feedback that confirm the choice they just made even when the later is not intrinsically better than any other choices they could have made. However, the underlying physiological mechanisms of this bias remain unclear. To address this gap in knowledge, we collected data from subjects performing a classical reinforcement learning task while wearing an eye-tracking device. We then modelled their behaviour with a reinforcement learning model accounting for confirmatory biases through the implementation of different learning rates, for confirmatory and disconfirmatory feedback, and measured subjects' gaze as well as pupils size throughout the experiment.

We first replicated previous findings and found that subjects exhibited a higher learning rate for confirmatory compared to disconfirmatory information, indicating that they were indeed affected by confirmation bias when updating their beliefs in the task. Second, we found that pupil size following reward onsets also reflected a confirmation-biased feedback processing. Indeed, pupil size correlated with feedback subjects received in an opposite direction for the chosen and unchosen option. We found that the "surprise effect" commonly observed in pupillometry analyses (i.e., pupil size increases with the amount of surprise) was entirely choice dependent. Furthermore, valenced prediction errors also affected pupil size in an opposite direction for chosen and unchosen option, giving further evidence in favour of a confirmation bias hypothesis in reinforcement learning. These results further emphasise the deep roots of confirmation bias at the core of human information processing.

PS3-7 **The Perceptual Antecedents of Collective Decisions**

Mustafa Yavuz, Jamal Esmailly, Bahador Bahrami, Ophelia Deroy
Ludwig Maximilian University, Germany

Collective decision-making differs from individual decision-making by incorporating communication and coordination with others. What about making individual decisions, but by incorporating others' perception? Present work aimed to investigate whether observing the same stimuli with others would change visual perception and subsequent decisions.

Participants (N = 40, in total) completed a modified version of the random dot motion task, with trials in which the stimulus and their responses were visible to an observer and trials in which they were not. The experimental session consisted of 640 trials with 5 levels of task difficulty. In half of the trials (Private condition), only the participant (but not the observer) could see the stimulus. In the other half (Public condition), both the participant and the observer viewed the stimulus. We compared the participants' behavioral performance, metacognitive sensitivity, and neural activity in these two conditions.

Pilot results with 10 participants showed higher metacognitive sensitivity at the level of behavior and higher centro-parietal positivity amplitude in EEG when perceptual stimulus is shared with the observer (vs private). Importantly, accuracy and reaction times were comparable between the two conditions, ruling out key confounds. Based on these findings, we have conducted a larger pre-registered experiment with 30 new participants, incorporating pupillometry and ECG measures to investigate potential effects of arousal levels.

We plan to present the results of this experiment in the meeting, which will report on replication of the pilot study, together with new findings from pupillometry and heart-rate variability.

PS3-8 Where is the car I saw someone hide on the screen? Investigating 18-month-olds' understanding of online communication

Réka Schvajda, **Krisztina Andrási**, Rebeka Zsoldos, Ildikó Király

Eötvös Loránd University, Hungary

Due to the COVID-19 pandemic, interactions via online communication platforms have become ubiquitous in the lives of infants and children. Recent research revealed that toddlers represent screen events as representations that are decoupled from the immediate environment, and thus reject animation-reality crossovers. However, understanding online communication would require children to handle it as happening in the here-and -ow, and grasping that in the case of online channels, there is a crossover between the screen and reality.

In this current study, we investigate how 18 months old infants reason about the consequences of events observed on a screen may have on off-screen settings. During the experiments, children play a warm-up game with an experimenter (E), during which a bear is hidden in one of two boxes, and the participants are prompted to search for it. Once they select the correct location at least 3 times, things proceed to the test phase. At this point, children observe a protagonist (P) first hiding a car and then a star in one of two boxes either in the room (Live Condition), on a pre-recorded video (Video Condition) or during an interaction via video chat (Video Chat Condition). After each hiding event, children receive the boxes from E and then P, and are prompted to search. We record if they search for the object at the shown location. Our hypothesis is that the performance of children would be better in the Live and the Video Chat conditions, compared to the Video Condition.

Data collection is still ongoing (current n = 50, planned sample = 72). In the Live Condition (n = 14), children search at the shown location in 71% of the trials. In the Video Chat condition (n = 18), they do so in 50% of the trials. In the Video Condition (n = 18), they search there in 44% of the trials.

PS3-9 The rise and fall of epistemic authorities: a cognitive and information theoretical model

Mauricio Martins[1], Stefano Palminteri[2]

[1] *University of Vienna, Austria;* [2] *École Normale Supérieure, France*

In his book *'The Square and the Tower'* the historian Niall Ferguson discusses how trust in different sources of information varies with time, and describes the historical shifts in whether people prefer to gather information from hierarchical elite groups or from networks of peers. For instance, in the early 16th century, Luther translated the bible into German after the invention of the printing press, allowing religious information to spread directly from peer to peer, and bypassing the catholic church's monopoly over the interpretation of the gospels. Conversely, periods of increased society centralization (e.g., imperial, absolutist and dictatorial regimes) often lead to information monopolies. Even within modern democratic societies, consensus around official state communication can increase during periods of conflict (rally-round-the-flag effect), and alternative views can be perceived as hostile and marginalized.

In this paper, we explore the cognitive processes underlying how and why trust in informational sources fluctuates. If information from experts and mainstream media is broadly more accurate than peer networks', why do we sometimes lose trust in the experts? Counterintuitively, why do we often prefer information from authoritative sources, even if they become distrusted. Our goal was to build a computational model of these dynamics. The model includes a decision process that is sensitive to information processing costs and a learning process driven by prediction error minimization. We hypothesized that human information-processing biases can explain why experts are preferred as default sources of information, but also why their legitimacy is less resilient than peer networks' when both provide inaccurate information. We ran simulations over a wide range of parameters and found that the processing advantages of following experts can be outweighed by an overreaction to their mistakes. This effect is particularly pronounced when the environment is unstable and when the epistemic authorities are biased.

PS3-10 **Diversity in collective problem solving: an informational benefit of neurodiversity**

Justin Sulik, Bahador Bahrami, Ophelia Deroy
Ludwig Maximilian University, Germany

Cognitive diversity has the potential to improve collective problem solving. However, evidence for whether it lives up to this potential has been rather mixed. We propose that cognitive diversity is most beneficial for specific aspects of collective problem solving—such as ensuring that a broader range of relevant information is generated at the group level—and that focusing on such aspects will help elucidate the value of cognitive diversity in this context.

Problems differ on numerous dimensions, but a salient dimension for collective problem solving is whether solvers' perspectives on the problem align or diverge. We thus manipulate perspective alignment and group composition to compare the range of information generated by different groups for different types of problems.

We hypothesised that cognitively diverse groups would produce a broader range of relevant information across problem types. We tested this hypothesis using a communication game where perspectives could align or diverge. We manipulated group diversity by sampling based on (n=250) participants' scores on two measures of neurodivergent traits. We analysed the variety, uniqueness and relevance of the generated information.

We found that homogeneous groups (either uniformly low or uniformly high neurodivergence scores) showed complementary patterns of performance, doing better on some metrics for some problem types and worse for others. For instance, for problems where perspectives diverged, high-neurodivergence groups produced information that was less unique but more relevant; low-neurodivergence groups did just the opposite. Diverse groups (mixed high- and low-neurodivergence scores) combined the strengths of both across problem types, though were not uniquely strong at any particular type.

Unless a group is only going to encounter one specific kind of problem in the future (which seems unlikely), cognitive diversity is a good way to ensure that the broadest range of relevant information is available for collective problem solving.

PS3-11 Encourage is a Verb: The Use of Agentic Cues Increases Text Concreteness and Persuasiveness Among Authors and Readers Alike

Magdalena Formanowicz[1], Marta Witkowska[1], Marta Beneda[2], Jan Nikadon[1], Caterina Suitner[3]

[1] SWPS University of Social Sciences and Humanities, Poland; [2] University of Cambridge, UK; [3] University of Padova, Italy

Action coordination and the ability to form shared representations of tasks is considered a "cornerstone of social cognition", because it allows for functional human interactions. We examined whether communication intended to mobilize others contains 1) agency - related to evoking an action intention necessary for undertaking any activity, and 2) concreteness - related to how to execute this action intention. We hypothesized that communicative goal of mobilizing others is related to the use of action-oriented and concrete language and that the use of such language drives both the authors' and readers' perception of the text and its persuasive appeal. In Study 1 (N = 445) we asked participants to produce a text encouraging others to do something (volunteer or act for the environment) or expressing participants thoughts on these topics, and to evaluate their own text. Texts aiming to encourage others used more language pertaining to agency and concreteness and participants' evaluation of their texts was driven by these linguistic factors. In Study 2 (N = 339), we used texts produced in Study 1 and asked a different set of participants to evaluate agency and persuasiveness of these texts. Readers' perceptions of texts agency and persuasiveness were also driven by linguistic agency and concreteness of the evaluated texts. Overall, mobilizing communication has common linguistic strategies recognized by authors and readers alike. Knowing which features increase action intention can be useful to mobilizing others and to inform how to be immune to that strategy when employed in a manipulative manner.

PS3-12 **Interpersonal Coordination in Joint Multiple Object Tracking**

Basil Wahn[1], Peter König[2], Alan Kingstone[3]
[1] Ruhr University Bochum, Germany; [2] Osnabrück University, Germany; [3] University of British Columbia, Canada

People often perform visual tasks together, for example, when looking for a misplaced key. When performing such tasks jointly, people coordinate their actions to divide the labor, for example, by looking for the misplaced key in different rooms. This way, they tend to perform better together than individually—they attain a group benefit. A crucial factor determining whether (and to what extent) individuals attain a group benefit is the amount of information they receive about each other's actions and performance. We systematically varied, across 8 conditions, the information participant pairs received while jointly performing a visual task. We find that participants can attain a group benefit without receiving any information (and thus cannot coordinate their actions). However, actions are coordinated and the group benefit is enhanced if participants receive information about each other's actions or performance. If both types of information are received, participants are faster in creating efficient labor divisions. To create divisions, participants used the screen center as a reference to divide the labor into a left and right side. When participants cannot coordinate actions, they exhibit a bias toward choosing the same side, but they forgo this bias once action coordination is possible, thereby boosting group performance.

PS3-13 **Does Sharing a "We" Perspective Facilitate Young Children's Attribution of False Beliefs?**

Laura Anderson, Marco F.H. Schmidt
University of Konstanz, Germany

Understanding and reasoning about others' mental states plausibly develops during social interactions. In particular, joint attentional episodes where a child and another individual share a perspective on an event may facilitate children's reasoning, both about aligned epistemic states ('We' both know that X; e.g., Tomasello, 2018) and

then about future discrepancies from the initially aligned epistemic states (as in traditional false belief [FB] tasks). Using an interactive joint-action task, we investigate whether active experience sharing the protagonist's perspective improves young children's ability to detect a change in the protagonist's epistemic state, and thus successfully reason about their FB. To examine whether FB reasoning is improved by initially sharing a perspective, we investigated how children who would traditionally fail these tasks (3-year-olds, first-order task; 5-year-olds, second-order task; Wellman et al., 2001; Osterhaus & Bosacki, 2022) considered a protagonist's FB. In the shared perspective condition, children and a protagonist first complete a task with a shared goal as a team. In the individual condition, the protagonist completes the task alone while children watch from a third-party perspective. Then, children participate in a change-of-location task where they are asked to reason about that protagonist's FB. If prior experience sharing a perspective with the protagonist helps young children to recognise a change in the protagonist's epistemic state, children in the 'shared perspective' condition should successfully reason about the protagonist's FB more often than children in the 'individual' condition, who did not experience this initial shared perspective. Theoretically, we propose that understanding discrepant individual mental states hinges on prior experience and active engagement with joint ('we') mental states. Thus, we predict that enhanced FB reasoning should occur both for first-order and second-order tasks. First results for both tasks will be presented at the conference.

PS3-14 **Helping the researcher: Automating reliability analyses**

Tamás Szűcs, Attila Krajcsi

Eötvös Loránd University, Hungary

Experimental effects in cognitive science have been shown to have varying levels of reliability (Hedge et al., 2018) which can lead to a decrease in statistical power. Measuring and reporting reliability on the other hand are often omitted in current research practice. Statistical packages offer a wide range of methods for reliability analyses to choose from, however this choice is not straightforward. Which metric should we use? Does the software calculate confidence intervals? How can I visualize

the reliability of my data to get a better understanding of it? What are the assumptions of the various reliability analysis methods? How can I test these assumptions?

We present an automated solution for reliability analyses in the open-source statistical analysis software CogStat. CogStat is based on two key features: (1) automatic analysis: the software chooses what analyses to run depending on the question, the measurement level of the variables and the results of the assumption tests, and (2) optimized output: the results are shown in a structured format clearly separating sample statistics and inferential statistics to aid intuitive understanding, as well as providing multiple visualizations to help avoid blind analyses. From the current state of the literature on reliability and the drawbacks of currently available software solutions, we hope to pave the way for clear analysis pipelines to be used in future research.

PS3-15 The role of working memory in the occurrence of involuntary thoughts about the past and future: An experimental investigation

Krystian Barzykowski[1], Ewa Ilczuk[1], Lia Kvavilashvili[2]
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Previous research has demonstrated that although involuntary autobiographical memories (IAMs) and involuntary future thoughts (IFTs) occur spontaneously with minimal effort, their frequency is significantly reduced during cognitively demanding activities, which leaves their precise underlying mechanism(s) yet to be revealed. Across two experiments, we tested the hypotheses that the frequency of IAMs and IFTs may be reduced due to (1) the limited working memory capacity that enables the processing of only a finite number of thoughts and/or (2) the reduced likelihood of noticing incidental, task-irrelevant cues that may potentially trigger IAMs and IFTs. To this end, participants completed a laboratory vigilance task with irrelevant cue-words to trigger IAMs and IFTs, and random thought-probes to measure their frequency. Study 1 (240 participants) manipulated the level of working memory load (none, low, high) while participants performed a letter version of the N-back task

during the vigilance task. The presentation of working memory task-items and incidental cue-words in the vigilance task was also manipulated (simultaneous vs. sequential). Study 2 (240 participants) further manipulated the type of working memory load by using either verbal or visuo-spatial N-back task while using a sequential presentation of working memory task items and cue-words. In both studies, to further examine levels of incidental cue-noticing, participants also completed an unexpected cue-recognition task after completing the vigilance task. The results provide new insights about the underlying mechanisms of IAMs and IFTs in terms of their dependency on cognitive load and open interesting avenues for future research.

PS3-16 **Compromising improves forecasting**

Dardo N. Ferreiro, Ophelia Deroy, Bahador Bahrami
Ludwig Maximilian University, Germany

Predicting the future can bring enormous advantages. Across the ages, reliance on supernatural foreseeing was substituted by the opinion of expert forecasters, and now by collective intelligence approaches which draw on many non-expert forecasters. Yet all of these approaches continue to see individual forecasts as the key unit on which accuracy is determined. Here, we hypothesize that compromise forecasts, defined as the average prediction in a group, represent a better way to harness collective predictive intelligence. We test this by analyzing five years of data from the Good Judgment Project and comparing the accuracy of individual vs. compromise forecasts. Furthermore, given that an accurate forecast is only useful if timely, we analyze how the accuracy changes through time as the events approach. We found that compromise forecasts are more accurate, and that this advantage persists through time. Contrary to what was expected (i.e. a monotonous increase in forecasting accuracy as time passes), forecasting error for individuals and for team compromise starts its decline around two months prior to the event. Overall, we offer a method of aggregating forecasts to improve accuracy, which can be straightforwardly applied in noisy real-world settings.

PS3-17 **Working memory sub-processes behind divergent and convergent thinking**

Petra Csizmadia[1,2], Boglárka Nagy[1,2], Lili Kővári[2], Györgyi Balla[2], Zsófia Anna Gaál[2]

[1] Budapest University of Technology and Economics, Hungary; [2] Research Centre for Natural Sciences, Hungary

Results of previous studies examining the relationship between creativity and working memory (WM) are often contradictory. It can be caused by, for example, ignoring the domain specificity of creativity, the variety of tasks examining WM, the variability of the used creativity tests, in which particularly important whether divergent (DT) or convergent thinking (CT) is measured. DT requires flexibility, CT requires persistence. The dopaminergic system plays a central role in the regulation of cognitive flexibility and persistence and in maintaining a balance between them. The striatal dopamine level plays role in DT, while the prefrontal dopamine level plays role in CT. Dopamine also plays a key role in controlling the gating mechanism of WM, the basal ganglia (BG) project to the prefrontal cortex (PFC) through dopaminergic pathways: the PFC is responsible for maintenance within the WM, while the BG controls the gate. Accordingly, it can be assumed that certain subprocesses of WM may play a different role in CT and DT, they can be decisive in different stages of creative problem solving. Our aim was to examine the relationship between WM and CT and DT within the visual domain, to explore whether WM has a different role in the two types of creative thinking and whether the sub-processes of WM contribute differently to CT and DT. For this purpose, we recorded EEG and behavioural data during the reference-back paradigm, with the participation of 48 young adults, who were divided by the Matrix Reasoning subtest of the WAIS-IV (measuring CT) and the Figural Subtests of the Torrance Test of Creative Thinking (measuring DT). Based on our findings, we observed differences in WM sub-processes (updating, substitution, gate opening, and closing) between groups during the 300-600 ms range of the ERPs, indicating that these sub-processes operate differently in individuals with varying levels of creativity.

POSTER SESSION 4

Saturday, 20 May, 15:50 – 17:00

PS4-1 It was a complete justice nightmare! Investigating the linguistic shortcut hypothesis in understanding novel conceptual combinations

Dermot Lynott, Dounia Lakhzoum, Louise Connell
Maynooth University, Ireland

What is a cactus beetle, a justice nightmare, or a mole report? Previous work has found that people are sensitive to the distributional patterns in language and can use that knowledge as a "linguistic shortcut" to facilitate rapid comprehension (Connell, 2019). Findings suggest that people use this linguistic shortcut to quickly decide if novel word combinations or sensible, or to quickly reject them as nonsense. Connell and Lynott (2013) found that people's response times and their likelihood of accepting/rejecting novel noun-noun combinations were well predicted by first-order co-occurrence information (i.e., how often the constituent nouns co-occurred in close linguistic contexts).

In the current studies, we extended this work by investigating if both first-order and second-order linguistic co-occurrence information are useful in predicting responses in novel conceptual combination tasks. Furthermore, we considered if sensorimotor experience associated with the concepts independently predicted responses patterns, as has been found with other language processing tasks (Lynott et al., 2020). Using two conceptual combination tasks (a shallow sensibility judgment [N = 40], and a deeper interpretation-generation tasks [N = 40]), we examined variables related to both linguistic distributional information (measured as distributional distance and word co-occurrence frequency) and sensorimotor knowledge (measured using sensorimotor profiles from the Lancaster Sensorimotor Norms) on the comprehension of novel conceptual combinations. We expected that both linguistic and sensorimotor variables would predict people's processing, but the extent would depend on whether they were simply judging how sensible they are or having to provide a full interpretation. Results suggest a role for linguistic and sensorimotor information in conceptual combination, which we consider through the lens of the theory of embodied conceptual combination (Lynott & Connell, 2010).

PS4-2 **Co-efficiency as a potential focal point in coordination problems**

Georgina Török[1], Gergely Csibra[2,3], Natalie Sebanz[2]

[1] Max Planck Institute for Human Development, Germany; [2] Central European University, Austria; [3] Birkbeck, University of London, UK

We investigated whether people use co-efficiency as a focal point when they lack information about their partners' decisions in repeated coordination games. In two online experiments (N=50 in each), participants collected object pairs with a remote partner. They were told that each object choice that matched with the partner's would score a point, but no feedback was provided about the decisions of the partner. We analyzed object choices regarding their co-efficiency and other potentially salient features. In both experiments, choices were best explained by models including the participant's and the partner's individual action costs, and the initial distance between an object and the participant's cursor. Co-efficient choice proportions positively correlated with coordination success: The more often participants chose co-efficient objects, the likelier their choices were to match with other participants' choices. Co-efficient object pairs tended to be recognized as focal points by some even when they were not required to perform the action sequences (Experiment 2), although this effect was smaller than in the case of the "real" action sequences, where the effect was moderate (Experiment 1). These findings indicate that co-efficiency could act as an abstract rule to select focal points for coordination.

PS4-3 **The influence of generating alternative representations on children's planning ability**

Demet Sirolu, Begum Ozdemir

Maltepe University, Turkey

Planning is a complex cognitive process which includes generating possible alternatives leading to the desired outcome and making a choice among them. Previous research has shown that planning ability continues to develop throughout the preschool years. The goal of the current study is to explore

whether 4- to 6-year-old children's performance in planning could be enhanced using hypothetical prompts (e.g., "What would happen if I do this?"). The study has a a pre- and post-test design, measuring planning ability via Tower of Hanoi task. The training phase involves pre-recorded video of an actor making an erroneous move with one of the rings. In the test phase, children are presented with a still image showing the actor prior to the erroneous move, and asked to choose among three alternative moves in response to the question, "Where should the actor put the red ring to avoid a mistake?" Children's executive function (DCCS) and language skills (PPVT) were also measured. Performance was determined by task completion, the number of moves enacted, and the duration of the test. The pilot study based on 12 children showed that the percentage of children who successfully completed the task increased from nearly 17% to 50%. There was no significant difference between pre-test and post-test in terms of number of moves and test duration (p > .05). Data collection is still ongoing. These preliminary findings suggest that hypothetical prompts might have an enhancing effect on children's planning abilities.

PS4-4 Let's Jam: Music Improvisation, Collective Decision-Making, and the Process of Attunement

Christophe Novak[1], Toma Strle[2]

[1] University of Vienna, Austria; [2] University of Ljubljana, Slovenia

Music improvisation has been an integral part of human experience across cultures and provides a rich ground to explore creative collaboration (Veloso 2017), self-organisation (Schiavio 2018) and improvisational cognition (Sol 2021). In this line, this paper aims to integrate the current state of research on music improvisation, and enactivist conceptions of social cognition, with emphasis on autopoietic free improvisation (Mohammadi 2019). Moreover, the research and presented findings are based on a case study which investigated the lived experience and sense-making of a group of musicians with different musical backgrounds improvising together.

The case study was designed to explore collective music improvisation, identifying moments of interpersonal synchronisation and group flow. Particular attention was afforded to the process of attunement, tracing strategies of decision-making used by the group to lay down a common path in musicking. Deprived of the certain ground of established music traditions and guided by a shared intention to perform a 'good' improvisation, how is music utilised to establish 'meaningful' communication? What can we learn from music improvisation about the self-organising processes of social cognition and collective decision-making? What are the necessary conditions to enable a shared scaffolding to emerge? The study was conducted in the author's music studio and followed a three-fold design, including three improvisation sets, micro-phenomenological individual interviews, and a group review session. All sets were recorded in audio and video and complemented by time stamps. Participants included a Sitar player trained in classical Indian music, a Balafon player trained in traditional Senegalese music, and a TaKeTiNa rhythm practitioner playing the Berimbao. The author conducted participant observation, playing drums.

Preliminary findings highlight the ability to create common ground, constituted by intra- and interpersonal attunement, as quintessential to transdisciplinary music improvisation, guiding decision-making. In their optimal equilibrium, these elements enable autopoietic musicking, i.e., musicopoiesis.

PS4-5 **Sentence context manipulation's effect on semantic processing of metaphors (an EEG study)**

Márton Munding, Alex Roland Ilyés, Forgács Bálint
Eötvös Loránd University, Hungary

Neuroimaging, behavioral and clinical studies originally linked semantic processing of metaphors with right hemisphere (RH) activity, however later studies with better controlled stimuli could only find RH involvement for novel metaphors, while left hemisphere (LH) and bilateral activity were also observed (reviewed by Bohrn et al. 2012). Another important factor is the processing of sentential context,

due to context sensitivity taxing the RH (Vigneau, 2011) and syntactic parsing involving the LH (Faust, 1998) concurrently. An open question is how the interaction of sentence constraint and the figurativeness of concepts explain hemispherical differences, for which no existing lateralization models account for. We hypothesize that novel metaphors involve the RH because of broadened meaning processing with coarse semantic coding (Jung-Beeman, 2005), while sentence context may activate additional figurative meanings if it has a low constraint on a concept or help suppressing additional literal meanings if it has a high constraint (lexical pragmatic model, Wilson & Carston, 2008). In this study we measure event-related potentials upon participants seeing novel metaphorical or literal word pairs presented in a divided visual field paradigm (Huang et al., 2010), which allows us to investigate the processing in two hemispheres separately. We also manipulated sentence context based on a preliminary study, where we created two groups with significantly different predictive values (measured in cloze probability) for the target words: high-constrained sentences that help predicting the ending strongly and low-constrained ones, that do not narrow the semantic space. Careful control of both word pairs and sentence context will allow us to offer new models of hemispherical differences in metaphor processing.

PS4-6 **Teleology as our folk psychology can explain helping behaviour in 18-month-olds**

Anna Krämer[1], Beate Priewasser[2], Josef Perner[1]
[1] *University of Salzburg, Austria;* [2] *PMU Salzburg, Austria*

Cooperation is a key feature of our human nature, not only in pursuit of our own goals but also when we help others achieve theirs. This helping behavior develops early in life, and 18-month-olds already help in a various situation (Warneken & Tomasello, 2006). But why do infants help? These behaviours might be rooted in our folk psychological understanding of actions, which we claim is telic in an Aristotelian sense: We act intentionally in order to improve things. Teleology theory (Perner & Esken, 2015; Perner & Roessler, 2010; Roessler & Perner, 2013) argues that in most everyday cases, actions can be explained drawing on objective

facts: A person carrying books tries to open a cabinet. Why? To put the books inside. The books being in the cabinet is thus a desirable goal state (value fact), and opening the cabinet is necessary to bring about that goal (instrumental fact). These facts hence provide objective and good reasons for acting, not only for the agent itself, but for everybody including the observer child. Thus, teleology has an inbuilt mechanism for cooperation. Perner and Esken (2015) proposed a multiple step model of how children acquire this teleological understanding, presuming that children at around 18 months begin to understand that actions are done for good reasons, i.e., effecting a change to the better. We want to empirically test this assumption. In a newly developed paradigm, we show 12- to 24-month-olds an animated agent (task 1) or the experimenter (task 2) intentionally going to or taking something from box A but not box B, respectively. We test whether children expect "something good" to be in box A as opposed to box B by asking "In which box are the stickers?". In addition to that, we do several helping tasks. According to teleology theory, children who expect the goodies to be in box A should also show more helping behavior.

PS4-7 **Group affiliation influence on information processing during collective decisions**

Marwa El Zein[1,2]
[1] Max Planck Institute for Human Development, Germany; [2] Sciences Po, France

Belonging to a group helps maintain a shared social identity. Individuals can belong to a political party, to a country, to a union of countries etc. How do these multiple group affiliations shape collective decisions? Previously established experimental paradigms in human individual behaviour are applied to group decision-making to test the prediction that group affiliation changes the learning and updating of new information during collective decisions. We used minimal group paradigm to create multiple levels of group affiliations (first level in-group, second level in-group and outgroup) and participants completed majority vote group decisions with these three different groups in addition to solo decisions in two online studies on Prolific. In the first study (N=159 and then pre-registered

https://osf.io/5xy8h N=380), they performed a learning task that required them to select gambles (among two choices) with higher probabilities of winning. In the second study (N=99 and then pre-registered https://osf.io/tscrq N=300), participants did a perceptual task where they judged the direction of random dots twice allowing us to evaluate how initial group decisions influenced updating mechanisms based on new information. Results show that group affiliation does influence alignment to the group decision in the learning task and shifts of decisions based on previous group decisions in the perceptual task. However, no effect of group affiliation on the learning process is observed: learning was only affected by being in a group in general, with lower learning rates in all three groups as compared to individual decisions, but no difference between the three groups. These results contribute to discussions about which group configurations may hinder (or not) information and misinformation processing (for example online). As a next step, these experiments will be evaluated in the political European context with real life group affiliations (belonging to a country, to Europe).

PS4-8 **A Common Pool Resource Dilemma for Great Apes (Pan troglodytes)**

Kirsten Sutherland, Alejandro Sánchez-Amaro, Daniel Haun
Max Planck Institute for Evolutionary Anthropology, Germany

Group-living animals inevitably encounter situations where the interests of the individual and the group are in conflict, including Common Pool Resource (CPR) Dilemmas. In CPR dilemmas, individuals can cooperate by resisting selfish short-term gains, to prevent over-exploitation of a collapsible resource, an outcome that is detrimental to the whole group. Prior work with chimpanzees (Pan troglodytes) suggests that in dyads, this type of dilemma may be resolved with dominance and tolerance relationships. However, it is currently unknown how these dynamics shift as group size increases beyond the dyad. Testing chimpanzees at Leipzig Zoo (N=15) between 2022 and 2023, the present study uses a novel paradigm to examine CPR dilemmas in groups for the first time. Subjects from two populations are assigned to a possible 27 within-population testing groups of two or four apes.

Each of the groups are tested 36 times (18 test conditions, 18 control). In the test condition, participants encounter a large pool of yoghurt which they can dip into using sticks provided, the number of which are equal to the number of players in the test group (two or four). However, the sticks also support a lid which, if all of the supporting sticks are removed, will close, making the yoghurt irreversibly inaccessible (representing system collapse). We expect (i) larger groups will have more difficulty sustaining the CPR (shorter collapse latencies), (ii) participants will approach and extract from the common pool more quickly in the absence of the social dilemma (control condition), (iii) groupings with heterogenous dominance will be more successful than those with similarly-matched dominance rankings, (iv) performance of groups will improve over sessions, and (v) the proportion of participants interacting with the apparatus will be lowest in dyadic groups with heterogenous dominance. Currently, data collection is 82% complete and video coding is underway.

PS4-9 **Shared perceptual decisions exhibit an animacy bias**

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Most of our perceptual decisions are not strictly individual but are affected by the presence or input of others. Yet most prior cognitive research has placed participants in an experimental quarantine, away from any social confounds. Here we examine whether joint perception has an effect on the percept of animacy. For living beings, including humans, it is important to identify other animate entities, as these could be prey, predators, or mates. The most important cues to animacy are visual, with goal-directed motion being a key indicator of animacy as well as agency. We expect participants to be more biased (response frequency and response times) to perceive a motion as goal-directed in the presence of another person who shares the same intention (of completing the same task). Further, we will explore whether under this condition participants are also more accurate at detecting actual goal-directed motion. To test these hypotheses, we developed a

joint perceptual decision paradigm where participants are presented with blocks of short animations of goal-directed motions. In one block participants perceive the animations alone, in another block they perceive them in the presence of another person who is performing the same task on a separate screen. Focusing on changes in perception that are brought about just by knowing that the animations are experienced with another person, instruction, interaction, and cooperation with the other person are absent. Goal-directed motion is operationalised by animations of a blue and a red moving disk that interact in a way that the blue disk appears to chase the red disk. There are four different levels of sensory evidence of chasing. After each animation participants indicate via button press whether the blue disk chased the red disk. Our results comparing individual decisions vs. shared decisions will inform whether social perceptual decisions exhibit an animacy bias.

PS4-10 **Investigating Deliberate Ignorance in 8- to 13-year-old children**

Francesca Bonalumi[1,2], Ralph Hertwig[2], Azzurra Ruggeri[1,2]
[1] *Central European University, Austria;* [2] *Max Planck Institute for Human Development, Germany*

Knowledge has always been valued and desired–it gives power, opens up opportunities and, more generally, it's instrumental to survival and thriving. It is thus not surprising that investigating people's motivation to gain knowledge and learn has attracted the attention of researchers from many fields, from psychology to philosophy, and economics. However, the motivation not to know and not to learn also manifests itself frequently and across various contexts. While adults have been found to deliberately avoid seeking information about the negative impact of their choices on others, and even to be willing to pay a cost not to be exposed to such information (Dana et al. 2007, Larson & Capra, 2009), we do not know anything about the emergence and developmental trajectory of deliberate

ignorance, that is, what decisions children make about deliberately ignoring a piece of information.

In our study we investigate whether 8- to 13-year-old children systematically prefer to ignore information that could have bad emotional repercussions, jeopardize a long-term cooperative venture, or impact their own reputation. We present children with short stories illustrating a social situation in which a peer or themselves are involved in a misdeed (e.g., 'your favorite toy was broken') and two agents who could be responsible for it. Would the child want to know what happened, e.g., who broke their toy? We manipulate the type of relationship and level of friendship between the child and the two agents presented; their intentions (e.g., one of the agents is a bully); and whether the child can decide to know (or not to know) without the two agents knowing.

Data collection (N = 294, Mage= 9.44) is in progress and expected to be completed by March 2023. This pioneer contribution is the first study investigating what factors motivates children's deliberate decisions not to know, and it sets the ground for a more detailed investigation of the cognitive processes behind deliberate ignorance and its development.

PS4-11 **Hunting in VR: Chimpanzees and bonobos chase moving prey in virtual environments**

Emilie Rapport Munro[1], Sarah Koopman[1], Kenneth Schweller[2], Henrik Röhr[3], Sean Anderson[4], Brandon Klein[4], Max Kleiman-Weiner[5,6], Matthias Allritz[7], Richard Lewis[4], Lauren Robinson[4], Francine Dolins[4], Josep Call[1]

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Apes require high volumes of energy-rich foods, which tend to be patchily dispersed across their environment, creating evolutionary pressures for flexible and complex spatial cognition. Several ape species also hunt moving prey, placing higher demands on working memory, and selecting for social cognitive abilities

such as the capacity to predict prey behaviour. The cognitive mechanisms by which apes overcome these challenges are difficult to elucidate. Field investigations provide rich observational datasets, but usually lack experimental control, limiting the gamut of questions they can answer. Experiments can be conducted with captive populations, but offer lower generalisability to the situations apes face in the wild. Virtual Reality presents a novel solution to these problems, combining experimental specificity with proxies of realistic situations. In this study, chimpanzees and bonobos were presented with a lifelike 3-D virtual environment, through which they moved using a touchscreen. Subjects had to collect either a piece of static fruit or a moving rabbit. Some trials also featured an obstacle that had to be circumvented to reach the target. Trials also differed in their viewpoint (first-person or top-down). All subjects learned to chase and catch the rabbits, with varying success rates. Some subjects also exhibited high success rates in the presence of obstacles, even when these blocked their view of the target—indicating they remembered its location from previous trials. Success was much higher with the first-person viewpoint, suggesting that the immersive nature of this mode helped subjects to understand their location in the environment better than when they took a top-down view. This study validates the use of VR as an experimental paradigm for studying primate spatial and social cognition, demonstrating that ape subjects can understand the behaviour of moving virtual agents in situations of varying complexity, and paving the way for future work in multi-agent coordination tasks.

PS4-12 **Do expectations of co-efficiency inform action prediction?**

Vjeran Keric[1], Katrina McDonough[2], Natalie Sebanz[1], Patric Bach[2]
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Previous research shows that when people engage in a joint task, they tend to minimize the total required effort even when that minimization increases the amount of effort the individual would need to expend (Török et al., 2019). Another line of research shows that when we observe individual actions, expectations of efficiency bias our perceptual estimates towards least-effortful trajectories

(Hudson et al., 2018). Bringing together these two different lines of research, we investigated whether people have expectations of co-efficiency of a dyad and if those expectations inform action prediction when observing an interaction between two agents. In a first online experiment, participants were shown a recording of a virtual game played by two players. The game consisted of the bottom agent leading a ball half-way across the screen where the top agent would take over the ball and lead it to the end position on the top of the screen. The layout of obstacles on the screen was varied so that the bottom agent could choose individually or jointly efficient paths. In the majority of trials, the ball disappeared during transit, and participants had to click at the ball's last location. The dependent measure was the spatial difference between the actual and reported last seen location of the ball. Results showed a bias towards paths that are efficient for only one of the agents. In subsequent experiments we plan to modify the procedure so that the task requires attending to both the bottom and top agent's obstacles equally. Data collection is ongoing, expected to be completed in April 2023.

NOTES