Brains and Bodies in Social Interaction, Learning and Wellbeing

Abstract Book

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

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PROGRAM

TUESDAY 11.6.		
9.00-9.10	Tiina Parviainen	Opening words
9.10-10.00	Wolfgang Tschacher	"The embodiment of social interaction: from spatial behavior to synchrony"
10.00-10.30		Coffee break
Interpersonal synchrony in clinical context **Chair: *Virpi-Liisa Kykyri***		
10.30-10.55	Iiro Jääskeläinen	"Inter-subject synchronization of brain activity during movie viewing in autism spectrum and mental health disorders"
10.00-11.15	Anu Tourunen	"Interplay of couple's physiological synchrony and alliance events in couple therapy"
11.15-11.35	Petra Nyman-Salonen	"The ecological (or clinical) validity of our movement synchrony measures"
11.35-12.00	Virpi-Liisa Kykyri	"Problems (and possibilities) in integrating analyses of social interaction with synchronies in short episodes"
12.00-13.30		Lunch
Social interaction across species **Chair: *Miiamaaria Kujala***		
13.30-13.55	Miiamaaria Kujala	"Interaction of humans and our best friends"
13.55-14.30	Sonja Koski	"Sharing and connecting in human-horse relationships"
14.30-16.00		Coffee & posters
16.00-17.00	Takefumi Kikusui	"Human-dog interaction and mutuality"
17.30-18.30		Lab demonstrations
19.00		Conference dinner

WEDNESDAY 12.6.		
9.00-10.00	Hyeonjeong Jeong	"The role of social interaction in language acquisition: insights from fMRI studies"
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Collaborative learning **Chair: *Paavo H.T. Leppänen***		
10.30-10.55	Faisal Channa	"Examining in-service teachers' sequential patterns of knowledge construction and regulation during collaborative learning partnership with Generative AI"
10.55-11.15	Paavo H.T. Leppänen*	"Associations between cognitive skills and

		collaborative problem solving"
11.15-11.35	Héctor Pijeira-Díaz	"Sympathetic arousal commonalities and arousal contagion during collaborative learning: How attuned are group members?"
11.35-13.15		Lunch
Body and brain in synchrony **Chair: *Miriam Nokia***		
13.15-13.40	Sanna Lensu	"Parasympathetic highway between the body and brain –vagus nerve"
13.40-14.00	Miriam Nokia	"Optimizing learning with the help of bodily signals"
14.00-14.30	Tiina Parviainen	"Attending visceral information: neural correlates, individual differences and significance for interaction"
14.30-16.00		Coffee and posters
16.00-18.00		Lab demonstrations
* the authors: Shupin Li, Johanna Pöysä-Tarhonen, Jarkko Hautala, Susannah Otieno-Leppänen, **Päivi Häkkinen & Paavo H.T. Leppänen (presenter Leppänen)**		

THURSDAY 13.4.		
8.30-9.30	Guillaume Dumas	"Bridging the social divide using multi-brain neuroscience: from social physiology to social neuro-AI"
9.30-10.00		Coffee break
Analysis of coupling between signals Chair: *Jan Kujala*		
10.00-11.00	Jan Kujala	"Synchrony and causality between neural signals"
11.00-12.00	Satu Palva	"Connectomics view on brain dynamics"
12.00-13.00		Lunch
13.00-14.00		Business presentations
Approaches to psychophysiological measurements Chair: *Jan Wikgren*		
14.00-14.30	Santtu Seipäjärvi & Jan Wikgren	"Inducing and measuring stress in healthy and 'at-risk' populations"
14.30-15.00	Zhaodong Sun	"Facial video-based non-contact physiological signal measurement and applications"
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FRIDAY 14.6.		
Advanced analysis of respiratory-brain coupling **Chair: Tiina Parviainen**		
9.10-10.00	Daniel Kluger	"Advanced analysis of respiratory-brain coupling"
10.00-11.00	Ivan Zubarev	"Computational approaches for decoding brain-body interactions
11.00-12.00		Lunch
Approaches to measuring, analyzing and quantifying interpersonal synchrony **Chair: *Jan Kujala***		
12.00-13.00	Lauri Parkkonen	"Possibilities, caveats and methods for hyperscanning"
13.00-14.00	Wolfgang Tschacher	"On the many divergent methods to compute synchrony"
14.00-14.15	Tiina Parviainen	Closing words

LABORATORY DEMONSTRATIONS

Tuesday

- 17.30-18:30 Campus dogs: Care and reading dogs at JyU

Wednesday

- 16.00-17:00 Research on music and movement
- 16.00→ and 17:00→ Investigating body-brain interaction using TMS
- 16.30-17:15 Investigating multimodal interaction in clinical setting
- 16.30→ and 17:00→ Investigating social perception in naturalistic situations
- 16.30→ and 17:15→ Investigating body-brain interaction using MEG

ABSTRACTS FOR SPEAKERS

Tuesday Program

1.Wolfgang Tschacher: "The embodiment of social interaction: from spatial behavior to synchrony"

University of Bern, Switzerland

Embodiment denotes the close and reciprocal relationship between mental and bodily states and processes, thus going beyond a neuronal or physicalist concept of the mind. There are several levels of embodiment: First, all mental processes are embedded in a physical environment, and as ecological psychology and architects know, the environment (and its design) influence the experiences and social interaction of people in it. Second, this is also generally true for the relation between the body and the mind. Often we see reciprocal impacts between mind and body: in the one direction, the mind expresses its states by 'body language', in the other the mind resonates to the body psychologically, to bodily posture, tension, and bodily well-being. Finally, social interaction is likewise embodied, as we observe several kinds of synchrony between people in interaction, synchrony of movement, prosody, and sympathetic or vagal activation. Synchrony is a ubiquitous phenomenon and is related to the quality of social interaction, be it everyday conversations or psychotherapeutic relationships.

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2. Takefumi Kikusui: "Human-dog interaction and mutuality"

School of Veterinary Medicine, Azabu University

Center for Human and Animal Symbiosis Science, Azabu University

The dog (Canis familiaris) was the first animal to be domesticated, with hundreds of different dog breeds recognized today. During the domestication process, dogs were subjected to a strong selection process according to their temperament, behavior, and cognitive abilities (Hare et al., 2005). Dogs are skilled at understanding human communicative gestures compared with wolves and chimpanzees (Hare and Tomasello, 2002). They even look back at humans when encountering unsolvable tasks, while wolves do not (Miklosi et al., 2003). These findings suggest that dogs acquired their unique cognitive abilities during domestication. These human-like unique abilities might also be related with interspecies' bonding, namely human-dog bonding. Dogs can distinguish between individual humans (Nagasawa et al., 2009) and show distinctly different behaviors to caregivers compared with hand-raised wolves (Topál et al., 2005). We revealed that dog showed oxytocin mediated positive-loop for forming bonds with humans, and wolves did not show this positive loop with humans, suggesting that dog have acquired biological bond mechanisms in the process of domestication (Nagasawa et al. 2015). Behaviors associated with oxytocin-mediated dog-owner bonding are observed when dogs reunite with the owners. During this reunion scene, the amount of tear fluid in the dog has been found to increase. In addition, oxytocin receptors are expressed in the lacrimal gland, and tear volume increased when dogs were exposed to oxytocin eye drops (Murata et al. 2020). This suggests that dogs release oxytocin with a positive emotional response when reunited with their owners, which may increase the volume of tear fluid.

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Nowadays, there are many epidemiologic reports on the benefits to humans of owning dogs that have lived with humans for so long. We also found that dog ownership improved the well-being of adolescents. These children were also more sociable and had fewer behavioral problems (Endo et al. 2020). At the same time, we examined the gastrointestinal microbiome known to affect the central nervous system and found that the effects of dog ownership differed between dog-owner and non-dog-owner children. When the bacterial flora collected from the children was administered to sterile mice, the mice became more prosocial. Thus, it was found that some of the benefits of dog-ownership may be due to changes in the bacterial flora. It is feasible that dogs and humans have established a mutually beneficial relationship while influencing each other.

3.Iiro Jääskeläinen: "Inter-subject synchronization of brain activity during movie viewing in autism spectrum and mental health disorders"

Brain and Mind Laboratory
Department of Neuroscience and Biomedical Engineering
Aalto University School of Science

Using movies as naturalistic stimuli in human neuroimaging studies has significantly advanced our understanding of how the brains of individuals can synchronize, and also de-synchronize, when immersed in the events of the film, in both health and disorders. Inter-subject correlation (ISC) of brain activity is a method that has been developed to quantify such synchronization. Across autistic individuals, reduced ISC of brain activity has been observed due to

more idiosyncratic processing of the movies. In high-functioning autism, this is manifested especially in areas supporting social cognition whereas there seems to be a more generalized reduction of ISC in other autistic individuals. In other studies, mental health patients have also exhibited altered ISC of brain activity during movie watching. The foci of ISC differences as well as the events in the movie during which ISC is altered can give important clues into how the processing of the movie has been altered, however, obtaining complementary behavioral information is vitally important. While this approach does not disclose synchrony during interaction, it can nonetheless yield insights into how the perception of the world is altered in autism spectrum and other mental health disorders, with the potential of adversely impacting mutual understanding in interpersonal situations.

4.Anu Tourunen: "Interplay of couple's physiological synchrony and alliance events in couple therapy"

Department of Psychology, University of Jyväskylä

Background: Capturing genuine, prolonged emotional disputes within close relationships is uncommon in scientific research. Additionally, psychotherapy studies rarely link embodied phenomena such as physiological synchrony with moment-to-moment alliance events.

Aims: This study aimed to investigate the synchrony in electrodermal activity (EDA) between participants in a couple therapy session characterized by ongoing conflict. The session involved two clients and two therapists.

Methods: Alliance events were coded from therapy videos using the Rupture

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Resolution Rating System (3RS v2022; Eubanks & Muran, 2023). This system identifies instances of withdrawal ruptures, confrontation ruptures, and repairs. A multivariate analysis of variance followed by subsequent post hoc analyses were conducted to examine the three types of alliance events and the mean dyadic synchrony in EDA.

Results: The therapy session included 26 confrontation ruptures, 23 withdrawal ruptures, and 34 repairs. Only the couple's EDA synchrony was linked to alliance events, showing statistically significant differences between confrontation ruptures and withdrawal ruptures ($p = .014$), and between confrontation ruptures and repairs ($p = .007$).

Discussion: Romantic partners displayed lower synchrony in arousal during confrontations compared to other alliance events. The findings are discussed in terms of confrontation being a pursuit of agency at the expense of communion, whereas withdrawal seeks communion at the expense of agency.

5. Petra Nyman-Salonen: "The ecological (or clinical) validity of our movement synchrony measures"

Introduction: Research on movement synchrony within clinical interventions has expanded over the past decade. Movement synchrony has been related to therapeutic alliance and the outcome of therapy, and it has been shown to be affected by different psychiatric disorders. I have studied movement synchrony in couple therapy using two different operationalizations of movement synchrony. I will review these two different operationalizations and explore their significance in a clinical setting.

Methods: Two operationalizations of movement synchrony will be discussed in relation to their ecological validity and clinical meaning.

Results: The understanding that the operationalization of synchrony defines what we research, and what findings we obtain, is an important and often forgotten when reporting research.

Discussion: A comprehensive discussion is required on the ecological validity of the various algorithms and operationalizations within movement synchrony. The concept of movement synchrony and its relevance in clinical practice will be discussed.

6. Virpi-Liisa Kykyri: "Problems (and possibilities) in integrating analyses of social interaction with synchronies in short episodes"

Department of Psychology, University of Jyväskylä, Finland

The aim is to illustrate problems and possibilities involved in studying interpersonal synchronies in segments of varying length in couple therapy sessions. Interpersonal synchrony in psychotherapy has mainly been studied in entire sessions. However, to detail the meanings of synchrony, there is a need to focus on how synchronies vary in moment-by-moment interactions of the session. An important task is to define the length of the segment for the analyses. In naturally occurring conversation, a lot happens during a one-minute segment. E.g. conversational topics and structure, emotional valence, and the level of consensus between the participants varies from one segment to other. I will present observations from three studies, in which synchronies in participants' physiology and movement were analyzed with the Surrogate Synchrony (SUSY) method in a) 30-second segments and b) in segments of

two minutes or longer. Problems and possibilities in integrating qualitative analyses with synchrony findings are discussed.

7. Miiamaaria V. Kujala: "Interaction of humans and our best friends"

Department of Psychology, Faculty of Education and Psychology, University of Jyväskylä, Finland
Faculty of Veterinary Medicine, University of Helsinki, Finland

With two viewpoints that rapidly affect one another, studying interaction is challenging: interaction between species even more so. Considering the interaction of humans and domestic dogs, we have the human point of view—how humans see the world; we have the dog point of view—how dogs understand the world from their ecological perspective and species-typical limitations; and we have the response cycle of interaction between the two—what actually happens. The brain formation of different species reflects their processing of the world and suggest some common grounds for interaction. Many species share processing of nonverbal social cues, such as faces, bodies, or biological motion. Behavioral synchronization is evolutionarily adaptive, and instances of behavioral, hormonal, and emotional synchrony between humans and non-human species exist, while less is known of the nervous system synchrony. Here, I will present some examples of interaction between humans and our best friends.

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8. Sonja Koski: "Sharing and connecting in human-horse relationships"

University of Turku
University of Helsinki

Many people feel a strong sense of connection and empathy with other species, particularly those that we interact with in our daily lives. Horses are a fascinating case in this regard, having been domesticated for thousands of years and occupying many different roles in today's world, yet still primarily being a socially living prey animal. In my presentation, I will examine the human-horse relationship, particularly focusing on emotional processes in both interaction partners. First, I will discuss the sense of intersubjectivity people report in equestrian activities. Intersubjectivity through embodiment is typically emphasised in interactions with horses. However, in a recent study I found that people reported feeling intersubjectivity also when they explicitly considered the horse's perspective and emotions. Thus, shared connectedness with horses can be experienced both in physical contact and in empathic reflection of their experience. Second, I will focus on the horse partner, outlining the current knowledge on how they experience and interact with people. Horses are highly skilled in reading human behaviour and emotions, and to some extend they synchronise their emotional state with humans during interaction. I will present preliminary data of an experimental paradigm investigating horses' emotional responses to human valenced facial expressions, and their subsequent social referencing towards a novel object. While the study is still ongoing, the results seem to support the role of early learning in the ability to respond to and interpret human emotional states.

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Wednesday program

1.Hyeonjeong Jeong: "The role of social interaction in language acquisition: insights from fMRI studies"

Tohoku University, Sendai, Japan

Research suggests that while there are observable differences in how children and adults acquire their first and second languages (L2), these differences may not stem from distinct brain mechanisms. Instead, they likely result from varied contexts, conditions, and learning methods associated with different age groups. This talk introduces the concept of "social learning of L2," proposing that acquiring a second language beyond the sensitive period can be enhanced through social interactions and real-life experiences, much like first-language learning. The presentation will cover the essential aspects of language learning across age groups and detail a series of fMRI studies that examine the impact of social learning on language processing in the brain. This includes studies comparing how learning L2 through social interaction differs from learning through translation, how different communication modes (such as face-to-face interaction versus recorded video) affect brain functions during L2 communication, and how using a second language in social contexts influences the brain's processing of emotional words and the speaker's intention from L2 prosody.

2. Faisal Channa: "Examining in-service teachers' sequential patterns of knowledge construction and regulation during collaborative learning partnership with Generative AI"

Department of Teacher Education, University of Jyväskylä

Research has shown that socially shared regulation of learning (SSRL) supports knowledge construction (KC) and helps learners attain their collaborative learning goals. What is still unclear is the sequential interplay of cognitive challenges, SSRL strategies, and KC during collaborative learning partnerships with generative AI (i.e., ChatGPT). To address this research gap, 24 in-service teachers, in groups of three, were video observed while collaborating with ChatGPT to develop a lesson plan on "Education for Sustainable Development" on a desktop computer in a face-to-face situation. In the analysis, video data were coded on a fine-grained level for cognitive challenges, KC phases, and SSRL strategies, namely planning, monitoring, and controlling. Process mining was applied to visualize the sequential patterns of the phenomena as process maps. Results revealed that the groups demonstrated stronger sequential patterns between cognitive challenges and planning and controlling than monitoring. In terms of sequential interplay between cognitive challenges and the phases of knowledge construction, phase 3 (i.e., negotiate/co-construct) had a higher frequency value than other phases. The study has practical implications for collaborative learning with generative AI, teacher education, and theoretical and methodological implications for research on regulated learning. Suggestions for developing collaborative pedagogy, tailoring support for collaborative tools, and developing pedagogical tools can be used to support KC and encourage learners to initiate regulation to encounter challenges.

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3. Paavo H.T. Leppänen: "Associations between cognitive skills and collaborative problem solving"

Department of Psychology, University of Jyväskylä

Background: Collaborative problem solving (CPS) is globally recognized as one of the 21st century skills that are important for learning and working. Yet, the predictors from cognitive and online reading tests to explain CPS skills have not yet been understood.

Objectives: This study explored sixth-graders' individuals' and dyads' joint CPS skills with predictors from cognitive and online reading tests.

Methods: Altogether 199 students (Meanage = 12.45, SDage = 0.32, female = 112, 56.30%) from Finland participated in this study. Students' CPS skills were assessed through a computer-based assessment environment where they worked in pairs. Participants' visual associative learning, visual sustained attention and visual executive functioning were extracted with exploratory factor analysis through five tasks in the Cambridge Neuropsychological Test Automated Battery (CANTAB), while their non-verbal cognitive capacity was evaluated with Raven's Matrices. Students' online reading skills were assessed with the online testing portal. Hierarchical regression analysis was utilized to predict students' CPS skills.

Results and Conclusions: Results showed that predictors from cognitive tests and online reading tests shared a significant though relatively small proportion of variability of students' CPS skills. It implied that major variance of students' CPS skills was not explained by their cognitive skills or online reading skills. Further, we found that variance of individual students' CPS skills (23% for cognitive CPS skills, and 18% for social CPS skills) were contributed by their

paired partners' CPS skills respectively. The findings suggest that teachers should take the relevance of paired students' CPS skills into account when assigning students to work in pairs for CPS tasks.

4. Hector Pijeira-Díaz: "Sympathetic arousal commonalities and arousal contagion during collaborative learning: how attuned are group members?"

Department of Education, University of Jyväskylä

Introduction. Collaborative learning is considered a coordinated, synchronous activity resulting from learner's continued attempt to construct and maintain a shared conception of a problem. Collaborative learning may lead to higher-order thinking and other cognitive and social benefits, but it could also be detrimental to the learners. Accordingly, it is important to further study collaboration processes by going beyond the traditional conversational analyses. In this scenario, interpersonal physiology can provide insights into the process from a different perspective with potential for real-time, objective measures.

Methods. Using Empatica E4 wristbands, electrodermal activity—to derive arousal—was measured in 24 high school students working in groups of three (i.e., triads) during two runs of an advanced physics course. The participants met three times a week over six weeks for lessons of 75 min each.

Results. Most of the time ($\approx$ 60–95% of the lesson) the triad members were at different arousal levels, and, when they were on the same level, it was mainly the low arousal (or deactivated) level. Less than 4% of the time were the triad

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members simultaneously in high arousal. Possible within-triad arousal contagion cases (71.3%) occurred mostly on a one-to-one basis and with a latency from within a few seconds up to ten min, but usually within one min.

Discussion. This study supports the view that only small parts of group work are collaborative, as far as the synchronicity and coordination which collaboration presupposes. Although exploratory, results also illustrate the affordances of physiological measures to characterize collaborative processes.

5. Piia Astikainen & Xueqiao Li: "Social foreign language learning: behavioral and electrophysiological studies"

Active Mind Laboratory, Department of Psychology, University of Jyväskylä

Learning foreign languages is increasingly important in a global world, which is why new and effective methods of language learning are needed. Our research investigates whether phonetic learning of a foreign language is more effective with a peer than alone. We also investigate whether phonetic learning is transferred to speech production and whether this is reflected in changes in EEG synchrony between tutor and learner. So far, 38 native speakers of Finnish have participated in the study. They were taught Mandarin Chinese tones based on digital material for one hour per day for four days. Before and after the lessons, the participants were individually tested with behavioral and EEG measures in discrimination and categorization tasks. A listen and repeat task was used to investigate pronunciation, and EEG synchrony between learner and tutor was measured. In our presentation, we describe the research protocol and preliminary results based on a partial sample.

6. **Sanna Lensu: "Parasympathetic highway between the body and brain – vagus nerve"**

Center for Interdisciplinary Brain Research, Department of Psychology, University of Jyväskylä

Learning and memory are the key determinants for the survival of an individual. Brain functions are supported by the bodily systems, and one of the pathways linking them is the tenth cranial nerve, vagus nerve. Vagus nerve is the longest nerve in the body and acts as a transmitter of bidirectional information between the body and brain, driving especially the parasympathetic tone. In this talk critical components of anatomical and functional properties of vagus nerve will be outlined. Vagus nerve has been also a target for manipulations to treat disorders like depression and treatment resistant epilepsy, and the stimulation is used to relieve stress and inflammation in various circumstances. Experimentally, it is shown to enhance e.g. selective attention and extinction of learned fear. In my talk I will shortly describe the pathways by which these stimulatory effects may be introduced and mediated. I will also present some knowledge of how gut and gut microbes are involved in this. Lastly, the vagal pathway between the brain and body in support of learning and memory will be discussed.

7. Miriam Nokia: "Optimizing learning with the help of bodily signals"

Department of Psychology, University of Jyväskylä

Breathing and heartbeat connect to brain activity and behavior. Our studies in animals and in humans indicate that rhythmic changes in bodily state can affect

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the acquisition and performance of learned behavior. Namely, during classical conditioning, presenting the conditioned stimulus at diastole during expiration consistently leads to more conditioned responses than presenting the conditioned stimulus at systole during inspiration. In this talk, I will present findings from our recent studies in young and elderly healthy human participants and discuss what could explain our results.

8. Tiina Parviainen: "Attending visceral information: neural correlates, individual differences and significance for interaction"

Department of Psychology, University of Jyväskylä

We are used to thinking of the brain and cerebral cortex as the ultimate control center for body movements and functions. However, information also flows in the opposite direction, with bodily functions influencing the brain functional state and structural properties. During my presentation, I will provide examples of the ways bodily systems influence brain and mind. Besides the sensory system, the brain receives afferent input from the visceral organs. Using MEG we clarified whether and how bodily biosignals, namely respiration and cardiac parameters, affect brain activity. We also studied how sensitivity to these visceral signals, known as interoception, relates to individual temperament traits. In addition to exploring 'whether' and 'how', I'll discuss potential explanations for 'why' bodily signals influence brain and mind states.

Thursday program

1.Guillaume Dumas: "Bridging the social divide using multi-brain neuroscience: from social physiology to social neuro-AI"

Faculty of Medicine, Université de Montréal

Abstract: The study of social cognition has traditionally been divided into two camps: one emphasizing mentalizing and the ability to understand others' minds, and the other focusing on imitation and the propensity for interpersonal coordination. This divide creates a "chicken-and-egg" paradox regarding the origins of social cognition. Moreover, these perspectives operate at different levels of explanation, employing distinct conceptual and mathematical frameworks. For example, Bayesian statistics effectively model social computations in economic games, while dynamical systems better capture sensorimotor coupling during social coordination. This presentation proposes a "social physiology" approach, conceptualizing human cognition as a multi-scale complex system interfacing biological and social processes. Building upon Claude Bernard's vision of physiology as a holistic study of biological functions, we extend this perspective to encompass social functions as well. We will explore this approach through experiments with both real and artificial agents. We will begin with multi-brain neuroscience, where inter-brain connectivity serves as a quantitative bridge between individual mechanisms and interpersonal dynamics. We will then move into neuro-inspired artificial intelligence, demonstrating how insights from social neuroscience can inform the design of virtual avatars and machine learning algorithms. Finally, we will discuss the implications for mental health and the need for a computational psychiatry that extends beyond the individual's mind.

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Biography: Guillaume Dumas is an Associate Professor of Computational Psychiatry at the University of Montreal's Faculty of Medicine and Director of the Precision Psychiatry and Social Physiology laboratory at the CHU Sainte-Justine research center. Holding the IVADO Chair in AI and Mental Health and the FRQS J1 fellowship in AI and Digital Health, he is also an esteemed member of Mila – Quebec Artificial Intelligence Institute. Dr. Dumas is internationally renowned for his research on the neural underpinnings of social interaction, utilizing cutting-edge techniques in multi-brain neuroscience. His commitment extends beyond academia, actively engaging in projects at the intersection of science and society. As co-founder of Alius Research (2007) and HackYourResearch (2012), he champions awareness surrounding altered states of consciousness and open science, respectively. He also advises governments on AI policy, serving as an expert for both French national strategic plans on AI, and advocates for cognitive liberty as an invited expert at the United Nations Human Rights Council.

2. Jan Kujala: "Synchrony and causality between neural signals"

Department of Psychology, University of Jyväskylä

In my talk I will focus on two intertwined aspects related to quantifying coupling between neural signals. First, I will discuss different metrics that can be applied to determine either synchrony or causality between the signals. These metrics range from ones that allow the quantification of neural interactions at the time-resolution of tens of milliseconds to ones that are more applicable to determining neural coupling associated with continuous tasks or states spanning several minutes. Secondly, I will demonstrate how different types of metrics can be applied to extract information on neural interactions

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based on non-invasively recorded neuroimaging data and discuss the possible pitfalls in these analyses. Overall, my talk aims to present the key considerations related to different measures and approaches for determining how cortical signals are coupled with peripheral signals and signals originating in other cortical regions.

4. Santtu Seipäjärvi & Jan Wikgren: "Measuring stress with wearables: HealthBeat –project 2018-2020"

Department of Psychology, University of Jyväskylä

Measuring psychological stress and recovery could be an important factor in maintaining one's well-being. However, in contrast to physical stress, psychological stress is more difficult to quantify and measure, especially because psychological stress also involves cognitive assessment and other mental processing. Biologically, stress involves increases in activity of the sympathetic nervous system, which can be measured, for example, as changes in heart rate (HR) and it's variability (HRV) and increases in salivary cortisol (CRT). In the Healthbeat project, we aimed to determine how a commercial HRV-based stress index, utilizd in wearable technology, is related to other commonly used stress variables, perceived stress (PS), and CRT responses during and around psychosocial (Trier Social Stress Test) and physical stress (treadmill running until exhaustion). Furthermore, our participants represented different age groups and health status in order to provide information whether and how this need to be taken into account in measuring stress. We found robust changes in all participant groups as responses to stressors, albeit there were some differences in level between groups. It seems that the stress index based on HRV together with some individual information provided most

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accurate measures of stress. Wearable technology can be utilized in quantifying psychological stress also. However, since stress reactions depend heavily on the context (physical vs. psychological, perceived vs. physiological, stress vs. recovery), understanding what we are measuring and it's limitations is important.

5. Zhaodong Sun: "Facial video-based non-contact physiological signal measurement and applications"

University of Oulu

Traditional physiological signal acquisition often necessitates contact-based or invasive approaches, which are not always practical or accessible. In contrast, remote photoplethysmography (rPPG) leverages facial videos to capture physiological signals through the subtle color variations in the face corresponding to blood volume changes. This presentation focuses on two aspects of rPPG: rPPG measurement methods and the applications of rPPG. For the measurement methods, we will introduce the background of rPPG measurement and present our innovative unsupervised and weakly supervised rPPG techniques to address label issues that are frequently encountered in rPPG datasets. For the rPPG applications, we will introduce non-contact atrial fibrillation detection by analyzing facial videos to enhance heart rate variability (HRV) measurement through the identification of systolic peaks. Additionally, we will show the potential of using rPPG-derived HRV features from facial videos during virtual meetings to estimate stress levels. In addition, some security and privacy applications of rPPG are also introduced.

Friday program

1. Daniel Kluger: "Respiration-brain coupling in health and disease"

University of Münster

An ever-increasing number of studies convincingly report systematic effects of physiological signalling - respiration, heartbeat, gastric rhythms - on brain function and behaviour. I will present findings from MEG-based line of research on respiration-brain coupling, the potential underlying functional and anatomical mechanisms, and clinical applications in the field of neuro-psychiatric disorders.

2. Ivan Zubarev: "Computational approaches for decoding brain-body interactions"

Aalto University

The development of complex multimodal measurement techniques offers a unique opportunity to study brain-body interactions across a variety of psychological and neurophysiological states. Neuroimaging techniques in combination with other physiological measurements allow us to estimate functional interactions between the central (CNS) and the autonomic nervous

systems (ANS). Analysis of such rich multivariate and multimodal data requires advanced computational approaches, capable of capturing complex, possibly non-linear interactions between these measurements and the variables of interest. Machine learning techniques and particularly deep neural networks, rely on extracting complex multivariate patterns directly from the data. In this talk, I will discuss several predictive inference-based techniques applicable to studying ANS-CNS interactions in the decoding framework

3. Lauri Parkkonen: "Possibilities, caveats and methods for hyperscanning"

Aalto University

Social interaction is an integral part of human behavior, and our brains are specifically tuned to support it. Studying brain basis of social interaction has proved to be challenging since every natural interaction session is unique and thus not readily amenable e.g. to conventional neuroimaging approaches. This challenge can be partially addressed by hyperscanning, which refers to simultaneous measurement of brain activity of two or more interacting people. In this talk, I will explain the rationale for hyperscanning, describe our MEG hyperscanning set-up and analysis approaches, present our results, and discuss the caveats of analysis approaches and data interpretation.

4. Wolfgang Tschacher: "On the many divergent methods to compute synchrony"

University of Bern, Switzerland

Synchrony is the phenomenon that people (and most other animals) in social interaction become systematically coupled. Empirical research of the past two decades has shown that the existence of synchrony is reliably observed on several levels, such as people's body movement, gesturing, language use and physiology. Findings have however been partially incongruous in that the degree of synchronizing is not always associated with prosocial variables and good relationship, as was commonly expected. One reason for such heterogeneity is likely to be found in the applied methods: There are several quite different methods and algorithms to compute and quantify synchrony, the results of which are not always consistent. I will present the major methodological approaches based on correlation, on regression statistics, on information theory and frequency-decomposition measures. Together with participants, the pros and cons of the various approaches will be reviewed, and we will discuss aspects of convenience and practicality of approaches for research use.

ABSTRACTS FOR POSTERS

1. Physiological linkage during doctor-patient interactions in oncology

Marta Vigier, Katherine Thorson, Andreas Schwerdtfeger

Theme 1: Interpersonal synchrony in clinical context

Introduction

Doctors and patients influence each other when interacting and can become similar to each other in affect and behavior. We investigated whether their physiological responses could also become similar. Precisely, we examined

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whether physiological linkage occurred and whether it varied by role (doctor vs. patient), by relationship length, and by interactions between role and length.

Methods

We focused on the autonomic nervous system activity (ANS) of oncologists and their patients during a follow-up consultation. To estimate physiological linkage between doctors and their patients, we investigated how much a doctor's (or patient's) physiological response predicts a patient's (or doctor's) response, at a following time point. We also adjusted for participants' own prior physiological responses. We obtained complete data from consultations between 102 unique doctor-patient dyads.

Results

We found that, physiological linkage between doctors and patients varied by an interaction between role and relationship length (in a non-linear, quadratic fashion): $b = -0.01$, $p = .005$, $R2 = .07$. Patients were significantly linked to their doctors if they had medium-length relationships: $ps < .05$. Patients were not linked to their doctors in shorter or longer relationships. Doctors were never significantly linked to their patients: $ps > .13$.

Discussion

Physiological responses of doctors predicted patients' responses differently depending on relationship length. Considering that interactions between oncologists and their patients are frequently stressful and emotional, this research might shed some light on the phenomenons of transfer or contagion of physiological responses associated with interpersonal emotional processes in medical settings.

2. Neural basis of embodied social cognition in developmental coordination disorder: an fMRI study

Timo Nurmi, Virve Vuontela, Synnöve Carlson, Aulikki Lano, Helena Mäenpää, Harri Piitulainen

Theme 1: Interpersonal synchrony in clinical context

Introduction

Developmental coordination disorder (DCD) is a relatively common (incidence 5–6%) motor disorder often accompanied with deficits in social interaction, therefore leading to significant difficulties in everyday life. Neural basis of DCD is poorly understood, especially in the domain of social cognition. We

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aimed to examine the neural basis of DCD with neuroimaging using a social interaction evaluation task with videos of two-person interaction.

Methods

Thirty-one adults with DCD and 26 controls underwent brain scanning using functional magnetic resonance imaging (fMRI) while they performed the social interaction evaluation task. They were shown videos of two human-like point-light figures in non-verbal social interaction and control stimuli of non-biological random motion. The participants were asked to judge whether the interaction was happy or angry by a button press. The proportion of correct answers, the locations of the group-level brain activations, and the strength and spatial extent of the brain activations in predefined regions-of-interest (ROIs) were analyzed.

Results

Participants' performance in the social interaction evaluation task did not differ between the groups. The group-level brain activations were in similar, neurophysiologically relevant regions in both groups. However, the ROI analysis showed that controls had stronger blood-oxygen-level dependent (BOLD)-responses and larger spatial extent of activation than the DCD participants.

Discussion

In conclusion, the social competence did not differ between the groups, but the neuronal processing was different in terms of intensity and extent. These results demonstrate differences in the neural basis of social cognition in DCD even in the absence of differences in social competence of the specific task.

3. Psychotherapists' Interoception and the Therapeutic Alliance
Satu Halonen, Aarno Laitila, Tiina Parviainen, Virpi-Liisa Kykyri

Theme 1: Interpersonal synchrony in clinical context

Introduction

In this pilot study, we approached the therapeutic alliance from a new perspective, exploring it through the Interpersonal Synchrony model of psychotherapy. Our goal was to better understand the role of interoceptive accuracy and awareness as intrapersonal qualities of psychotherapists in forming the therapeutic relationship.

Methods

In the first part of this study, we measured the interoceptive accuracy of forty Finnish psychotherapists, assessed the interoceptive awareness of these therapists and their sixty-seven clients, and they reported a therapy process of 10 sessions with questionnaires. The interoceptive accuracy of the therapists was measured using a heartbeat discrimination task.

Results

The results showed statistically significantly higher interoceptive awareness in the psychotherapists than their clients. However, the therapists' interoceptive accuracy did not differ from that of a reference sample of persons without therapy training. Therapists' interoceptive accuracy and awareness were positively correlated with their own experience of the alliance. However, therapists' interoceptive accuracy or awareness were not associated with clients' experience of alliance.

Discussion

The second part of the study incorporates four additional therapy processes, each of which is captured on video. Within these processes, two sessions are designated as measurement sessions, during which we also recorded participants' heart rate and electrodermal activity. In our upcoming analysis, we aim to delve deeper into the impact of the therapist's interoceptive qualities on their capacity to observe and interpret bodily sensations during significant moments of the therapy session.

4. Multiple Cultural Creativity Study by Magnetoencephalography
Xiangyu Rong, Jan Kujala, Tommi Kärkkäinen, Tiina Parviainen

Introduction

Creativity plays an essential role in our lives and work. To addressing its complexities, this study explores the significant influence of culture on creativity. We examined how individuals from different cultural backgrounds approach creative tasks using the Alternative Uses Tasks (AUT) and Remote Associative Tasks (RAT) to assess divergent and convergent thinking. Our findings indicate that Chinese participants tend to employ the same thinking mode for both divergent and convergent tasks, whereas Finnish participants

adopt distinct strategies for each task. This study underscores the impact of cultural background on creative problem-solving approaches based on Magnetoencephalography (MEG) data.

Methods

37 Chinese students and 35 Finnish students from the University of Jyvaskyla are invited to this study. The Alternative Uses Tasks (AUT) consists of 20 objects and each one presents for 20 seconds. Participants are encouraged to think about the uses of the objects on the screen as much as possible until the object disappears. The Remote Associative Tasks (RAT) also consist of 20 three-object sets and each set presents for 20 seconds. The participant is required to think of only one object that is associated with all the three objects on the screen until the three-object set disappears. The MEG is recorded both on AUT and RAT. On the source-level data analysis, beamforming is adopted for the source estimation and then a permutation t-test is performed on those source estimations between different conditions.

Discussion

Chinese participants seem to use the same strategy for AUT and RAT, while Finnish participants present different strategies for the two tasks. However, this is the rudimental result of the current study, and more methods should be applied to consolidate the result.

5. Association between early signs of autism and physiological synchrony in toddler-parent play

Terhi Helminen, Valo Saaristo, Anni Karjalainen, Sara Kauppinen, Tiia Parttimaa, Elina Husu, Anneli Kylliäinen

Theme 1: Interpersonal synchrony in clinical context

Introduction

Atypical social interaction and communication in autism can be identified early in life. Previous studies suggest a negative association between autistic traits and physiological synchrony (PS) during interactions (Wang et al., 2020; Baker et al., 2015). This study investigates the association between early signs of autism and PS during a parental play session.

Methods

Autistic traits were assessed using the ADOS-2 toddler module at 17 months, dividing participants into low and high trait groups. Electrodermal activity (EDA) was recorded Empatica E4 at 24 or 36 months from 38 child-parent dyads during a 12-minute free play session with a fixed set of toys. Data quality was inspected with EDA Explorer (Hemmelmann, 2018). Further analysis included 14 low-traits and 8 high-traits dyads, each with over 70% simultaneously valid data. Surrogate synchrony analysis of tonic EDA was conducted with SUSY, and statistical analyses were conducted with effect sizes (ES) of both absolute and non-absolute correlations (Tschacher & Haken, 2019).

Results

Across the entire sample, ESabs significantly differed from zero (M=0.26, sd=0.28; t(21)=4.44, p<.001), while ESnoabs did not (p=.223). No significant differences were found between the low and high trait groups in both ESabs (p=1.00) and ESnoabs (p=.785).

Discussion

Significant PS was observed between children and parents during free play, characterized by a mix of anti-phase and in-phase synchrony. However, no association was found between the level of early autistic traits and PS. Several factors might explain these findings, which will be discussed.

6. Co-modulation of heart rate variability and activity between pet dogs and their owners during short-term interaction

Aija Koskela, Heini Törnqvist, Sanni Somppi, Katriina Tiira, Virpi-Liisa Kykyri, Laura Hänninen, Jan Kujala, Miho Nagasawa, Takefumi Kikusui, Miiamaaria Kujala

Theme 2: Social interaction across species

Introduction

Emotional and behavioral synchrony facilitates closeness between humans, and it manifests in attachment relationships. Also dogs form attachment bonds with humans and may synchronize their behavior and hormonal levels with the owner. Here, we examined whether heart rate variability (HRV) and activity of dogs and owners are co-modulated during short-term interaction.

Methods

Electrocardiogram and 3D-acceleration data were recorded simultaneously from 29 co-operative breed dogs (6 ± 3 years) and their owners (41 ± 8 years) during baselines (resting condition) and interaction tasks (Stroking, Training, Scent Task, Playing). The association of dog and owner HRV quantified as the root mean square of successive differences between normal heartbeats (RMSSD) and activity were examined with Spearman's rank correlation; multivariate linear regression was applied to determine the factors affecting the RMSSD.

Results

The overall RMSSD and activity of dogs and their owners correlated across all tasks ($\rho = 0.53$, $p = 0.007$; $\rho = 0.40$, $p = 0.048$, respectively). Instead, task-specific analyzes revealed correlation of dog and owner RMSSD during Pre- and Post-Baselines only ($\rho = 0.46$, $p = 0.024$; $\rho = 0.68$, $p < 0.001$) and correlation of dog and owner activity during Stroking ($\rho = 0.50$, $p = 0.010$) and Playing ($\rho = 0.50$, $p = 0.011$). Linear regression results are discussed in the poster.

Discussion

The arousal and activity of co-operative breed dogs and their owners correlate during short-term interaction. Partly independent associations of activity and HRV in dog-owner dyads demonstrate physiological and emotional connection characteristics of attachment relationships.

7. The impact of social support prime on fear conditioning and fear generalization : an ERP study

Ying Mei, Tao Xie, Susannah Otieno-Leppänen, Li Hong, Paavo Leppänen, Yi Lei

Theme 2: Social interaction across species

Introduction

Social species, including humans and animals, can modulate their response to threats through social support systems, a phenomenon known as "social buffering". However, whether social support affects the cognitive processing of fear, and its associated neural temporal dynamics is unclear.

Methods

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Addressing this gap, the present study examined the effect of social support prime on anticipation and emotional attention to fear acquisition and fear generalization with electroencephalography. Unconditioned stimuli (US) expectancy ratings, response times (RTs), and event-related potentials were recorded.

Results

We found when primed with a social support figure, participants reported less US expectancy ratings to safety cues (CS−/GS−) and exhibited shorter response times to safety cues (CS−/GS−) compared to danger cues (CS+/GS+). Moreover, the contingent negative variation (CNV) amplitude was significantly larger for danger cues (CS+/GS+) than safety cues (CS−/GS−) under the prime of social support. The emotional buffering effect was further supported by reduced late positive potential (LPP) amplitudes in response to danger cues primed by a social support figure compared to standard CS+. In contrast, priming with a stranger's image seemed to diminish the discriminative ability between danger and safety cues.

Discussion

These findings suggest that social support figures not merely provide a buffer effect against threat emotional attention, but

also enhance the individual's ability to differentiate between danger and safety cues during fear conditioning and generalization processes. This research provides evidence for the role of social support in enhancing cognitive functioning in the context of threat

8. Empathy enhances decoding of human brain responses to emotional expressions of dogs and humans

Miiamaaria Kujala, Lauri Parkkonen, Jan Kujala

Theme 2: Social interaction across species

Introduction

Factors contributing to the classification accuracy of neurophysiological brain responses at the individual level, besides attention, are largely unknown. As empathy affects the subjective experience of socio–emotional stimuli, we examined the effect of subjects' empathy on the accuracy of machine-learning-based classification of the event-related brain responses to human and dog emotional facial expressions.

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Methods

15 healthy volunteers, aged 28 ± 4 years (mean ± SD; 8f/7m) observed photos of human and dog threatening, pleasant and neutral facial expressions (10 different images per category) during a 306-channel magnetoencephalography acquisition, with a duration of 500 ms per stimulus and interval of 500–1500 ms.

Results

Support vector machine -based discrimination of event-related brain responses at 0–500 ms was successful between all stimulus categories. The classification accuracy for threatening vs. pleasant/neutral dogs was 72/71%, and for threatening vs. pleasant/neutral humans 69/70 %. The correlation between empathy (emotional concern of Interpersonal Reactivity Index) and the classification accuracy between the threatening vs. pleasant or neutral dog/human faces was further examined with Spearman's rho using a bootstrapping procedure (1000 samples). Subjects' emotional concern correlated with the classification accuracy between threatening vs. pleasant or neutral dogs (rs = 0.76, p = 0.001, CI 0.39–0.92; rs = 0.56, p = 0.031, CI 0.05–0.84), but not with classification accuracies of threatening vs. pleasant or neutral humans (p > 0.05).

Discussion

Empathy enhances accuracy of decoding brain responses to threatening dog expressions, likely reflecting attentional engagement through involuntary emotional reactivity and the subcortical magnocellular pathway.

9. Brain oscillations in the mirror game: Insights from MEG hyperscanning

Juan Avendano, Riitta Hari, Lauri Parkkonen

Theme 2: Social interaction across species

Introduction

We investigated the neural and behavioral signatures underlying action observation, audience effects, leader–follower coordination and joint improvisation in interacting dyads.

Methods

We present data from 10 pairs of participants performing a 1D finger-

movement mirror game while magnetoencephalography (MEG) was simultaneously recorded from both subjects and the related finger kinematics was tracked using accelerometers. We compared the source-level mean power and pairwise intra-brain connectivity (assessed by weighted phase lag index) across experimental conditions (t-test, permutations), separately for six frequency bands: delta [1–3 Hz], theta [4–7 Hz], alpha [8–13 Hz], beta [14–25 Hz], lgamma [35–48 Hz], hgamma [55–90 Hz].

Results

We observed that alpha band source-level power in widespread brain regions were reduced in social (interaction or observed action) compared to individual (isolated) action. This reduction in alpha was restricted to occipital areas when contrasting interaction vs. observed action. We also obtained a widespread beta suppression in interaction compared to individual action (observed or in isolation), and a left TPJ suppression when comparing observed vs. isolated action. Across interactive conditions, we found that rolandic theta and superior parietal beta were stronger in followers than leaders, while occipital beta was stronger in leaders than in joint improvisers. Finally, when examining intra-brain functional connectivity, we observed a reduction in the alpha-band-mediated connectivity while interacting, compared to individual (isolated) action. This reduction involved occipital, temporal, parietal and frontal brain regions.

Discussion

Our results contribute to the understanding of the role of brain oscillations on interpersonal motor interactions.

10. Threatening stare from your own kind: Conspecific eyes attract attention in humans and dogs alike

Heini Törnqvist, Gray S. Atherton, Liam Cross, Sanni Somppi, Jarkko Hautala, Miiamaaria V. Kujala

Theme 2: Social interaction across species

Introduction

Emotional expressions play an important part in social communication of dogs and humans. However, we lack the knowledge how non-conspecific emotions are perceived and comparative studies between dogs and humans are rare. Here, we compared the gazing behavior of dogs and humans towards emotional

dog and human facial expressions.

Methods

The eye gaze of 31 dogs and 64 humans was recorded during the viewing of facial images of angry, happy, and neutral dogs and humans. The eye gaze of dogs and humans were analyzed with separate repeated-measures ANOVAs and post hoc tests with Bonferroni correction. A normalized fixation score was used in analyses taking account the variation of the areas of interest sizes between the images.

Results

Dogs gazed at angry dog eyes more than angry human eyes (0.06 vs. 0.02, $p<0.01$) and happy dog eyes more than happy human eyes (0.08 vs. 0.04, $p<0.01$). Humans gazed angry human eyes more than angry dog eyes (0.19 vs. 0.09, $p<0.001$) and happy human eyes more than happy dog eyes (0.27 vs. 0.21, $p<0.001$). There were no differences in gazing times of neutral dog and human eyes in dogs (0.06 vs. 0.04, $p=0.275$) or in humans (0.31 vs. 0.31, $p=0.708$).

Discussion

The gazing behavior of dogs and humans differed between conspecific and non-conspecific emotional expressions. Both dogs and humans demonstrated attentional bias towards angry and happy eyes of their own species, which highlights ecological salience of the species and the importance of eyes in reading conspecifics' emotional expressions.

11. Effects of Listener Engagement in Face-to-Face and Video-Mediated Interactions

Santeri Lepistö, Francesca Celio, Emmi Koskinen, Markus Söderman, Mariel Wuolio, Iida Jääskeläinen, Jan Lindström, Niklas Ravaja, Anssi Peräkylä, Ville Harjunen

Theme 2: Social interaction across species

Introduction

Communication technologies mediate a significant number of present-day social encounters and keep transforming the ways people connect with each other. Yet, research on the effects of listener engagement (listener's involvement in social interaction) has been scarce in a video-mediated setting. In this study, we investigated how the level of listener engagement affects the teller's physiological and emotional responses in video-mediated and face-to-

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face interactions.

Methods

32 dyads (n=64) participated in a face-to-face or video call interaction to complete a storytelling task. In the role of the teller, the subjects were requested to tell a story about their personal experience, whereas listeners were either assigned to listen to the story and respond normally (control condition) or to simultaneously complete a mental arithmetic task (distraction condition). The mental arithmetic task was expected to decrease listener's behavioral responses to the teller's story. Changes in autonomic nervous system activity were examined through skin conductance responses.

Results

In the face-to-face setting, tellers showed increased skin conductance responses during the listener's distraction task when compared to the control condition. In contrast, similar changes in physiological responses were not found in the video call setting. Detailed results will be presented at the conference.

Discussion

The study found that the tellers exhibit increased physiological responses to listener disengagement in face-to-face interactions, but not in video-mediated interactions. The results indicate that the level of listener engagement is less evident in a video call setting and that fewer cues of engagement are conveyed through video-mediated communication.

13. Dynamic trajectory of electrical Brain Activity during passive exposure to foreign speech sound changes

Qin Li, Xueqiao Li, Jarmo Hämäläinen, Piia Astikainen

Theme 5: methods in psychophysiological research

Background

Active learning and passive exposure to foreign speech sounds induces learning related plasticity in brain. This is commonly demonstrated in studies using measurements of brain activity before and after learning. However, brain activity changes during the learning process are mostly ignored in human neuroscience.

Method

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We investigated phonetic learning in adult humans by using electroencephalography recordings during passive exposure to foreign speech sounds in an oddball fashion.

Result

ERP analysis showed that the large changes in tone showed a significant increase in P3a amplitude on the third day. No changes were observed in the mismatch negativity. The enhancement of P3a for the large deviant did not suddenly appear on the third or fourth day, but a further multivariate pattern analysis indicated that neural activity pattern in P3a time window already differed between the first day and the second day. According to P3a amplitude growth curve, F3, C3, P3, F4 Cz, Fz showed nearly constant growth over the first three days, with fastest growth observed on the second day. In contrast, C4, Pz, P4 exhibited the greatest growth on the third day. All electrodes showed the least growth on the fourth day. Moreover, P3a amplitude was not unchanged across the 2-hour exposure but fluctuated constantly.

Discussion

These results suggest that after four hours of passive exposure to foreign speech sounds, brain responses reflecting preattentive shifts of attention towards changes are increased, and after 8 hours the learning effect is saturated.

14. Behavior-related changes in canine heart rate variability during short-term measurement

Päivi Berg, Aija Koskela, Jukka A. Lipponen, Heini Törnqvist, Mika Tarvainen, Miiamaaria V. Kujala

Theme 5: methods in psychophysiological research

Introduction

Physiological derivatives of dog behavior are increasingly studied, yet no standards exist for short-term heart rate variability in dogs. Here, we provide such reference values in dogs during different behaviors.

Methods

Electrocardiography (ECG, Bittium Faros 180) was obtained from 29 dogs by

securing the electrodes on the skin with self-adhesive bandage, while the dogs spent time with their owners. From ECG-synchronized videos, the following behaviors were verified (2-5 min/each): resting, playing, retrieving treats from a sniffing mat, and panting. Heart rate (HR) data was analyzed with Kubios HRV Scientific; the differences of HR, SDNN (standard deviation of the inter-beat intervals) and RMSSD (root mean square of successive inter-beat differences) between behaviors were calculated using Friedman's test and clarified with Dunn's pairwise comparisons.

Results

HR values were 61±7; 155±22; 101±14 and 90±14 bpm (mean±SD for resting, playing, sniffing mat and panting, respectively); SDNN 293±125; 52±14; 65±33; and 87±35ms; RMSSD 476±213; 32±16; 74±48 and 99±62ms. All HR variables indicated difference between behaviors (all $p<0.001$). HR, SDNN or RMSSD during sniffing mat did not differ from panting; SDNN did not differ in playing vs. panting; all other pairwise comparisons were significant ($p<0.05$).

Discussion

Playing had higher HR and lower RMSSD than other behaviors, while SDNN did not differ between panting and playing despite different motion levels. Activity of the parasympathetic nervous system was most effective in resting as evidenced by the highest RMSSD values. Interestingly, despite the different breathing and eating in panting and sniffing mat, their HR variables did not differ.

15. ASSOCIATIONS OF MISMATCH NEGATIVITY WITH PERSONALITY, DEPRESSIVENESS AND ANXIETY

Madli Kuus, Liisi Ausmees, Anna Dadatskaja, Nele Põldver, Kairi Kreegipuu

Theme 5: methods in psychophysiological research

Introduction

Mismatch negativity (MMN) serves as the brain's automatic response to environmental changes and is commonly measured with electroencephalography (EEG). Previous research on the relationship between personality, anxiety, depression, and MMN has yielded inconsistent results, leaving a significant gap in the literature. Nevertheless, MMN may be associated with stable traits (e.g., personality) and state changes

(depressiveness, anxiety). This study aims to examine how the personality dimensions (measured with Estonian Personality Item Pool NEO; Mõttus jt 2006) and anxiety and depressiveness (measured with Emotional State Questionnaire 2; Aluoja jt, 1999) relate to the amplitude and latency of auditory and visual MMN.

Method

The data were gathered from 123 healthy adults (64,23% female; age range 18-59) via an online questionnaire and laboratory experiments. For auditory MMN (aMMN) we used frequency stimuli (1000 and 1200 Hz), while for visual MMN (vMMN) we employed letters "T" and "B" in an oddball paradigm (80%, 20%). At the same time participants were doing an attention requiring visual 2-back task with letters, and EEG was measured with 64 active electrodes. Correlation, multiple regression, and regularized linear regression were employed for data analysis.

Results

No statistically significant correlations were found between MMN and neuroticism, extraversion, anxiety, or depressiveness scores. Exploratively, a significant difference was observed when looking at auditory and visual MMN amplitudes and gender, which significantly predicted MMN amplitudes in regression analyses, alongside conscientiousness. Notably, female gender and conscientiousness were identified as predictors of both auditory and visual MMN amplitudes.

16. The effects of whole-body vibrotactile stimulation to evoked EEG responses and stress-related physiological correlates — an ongoing pilot study
Leevi Saukkola

Theme 5: methods in psychophysiological research

Introduction

Positive effects of whole-body vibrotactile stimulation have been of special interest since the 1990s in music therapy and related fields. Commercially, tactile features of sound waves have been used in vibroacoustics, which focuses on using specific frequency bands, amplitudes, and changes in both of these to alleviate stress and promote health. While the underlying physiological factors

and mechanisms associated with whole-body vibration (WBV) have been established quite thoroughly, neural correlates of WBV are not well known.

Methods

The pilot study utilizes the Neurosonic vibration mattress, EEG, ECG, fNIRS, salivary cortisol samples and questionnaires. Additionally, accelerometers related to vibration are used. Of main interest is to examine neural entrainment of brain oscillations, possible changes happening in the fluid dynamics of CSF, heart rate variability, hormonal changes indicating stress levels and self-assessed experiences of relaxation and awareness. Properties of the mattress are adjusted through a repeated measures design containing a total of five blocks given to the participants in a random order over three consecutive days.

Results & Discussion

Preliminary results indicate that simultaneous stimulation and measuring are both accurate and reasonable for the participants. Fast Fourier transform revealed occipital theta and alpha oscillations. Additional peaks at approximately 15, 20 and 25Hz may be created by spurious activation. Results can only be considered precursory.

Conclusions

relating to the selection of measurement equipment, sample size and also epiphenomenological issues relating to correlation and causation need to be addressed so that a viable and valid research design and subsequent hypotheses can be proposed.

17. Feasibility of measuring electrodermal activity in children using a sock with textile electrodes

Anneli Kylliäinen, Terhi Helminen, Henna Mattila, Musfequr Rahman, Pasi Raumonen, Johanna Virkki

Theme 5: methods in psychophysiological research

Introduction

Measuring children's psychophysiological state, such as electrodermal activity (EDA), provides vital knowledge for understanding socio-emotional development. It is important to measure in a way that is tolerable for young children. We have recently developed a child-friendly measuring device, a sock

with textile electrodes. The aim of the study was to investigate the feasibility of the sock in children in varying ages.

Methods

In this ongoing study, 2 toddlers and 10 school-aged children have participated in the study. In school-aged children, the EDA was measured during socio-emotional video stimulation. In toddlers, EDA was measured simultaneously form an accompanying parent during social interaction with a researcher. Children were able to choose a preferred sock from a selection of children socks. EDA was measured using a commercial Shimmer3 GSR+ device that was attached to the electrodes of the sock.

Results

The feasibility findings indicated that the children accepted the use of sock well. None of the children refused to wear the sock and no measurement had to be stopped before the end. For young children, it seemed useful that the parent put the sock on first and then it was the toddlers' turn.

Discussion

The newly developed sock for measuring EDA from children was proven to be feasible. The feasible wireless and wearable measuring devices offer a potential approach to study children in real-life environments where they interact with others.

18. Measuring Auditory Evoked Responses in Domestic Cats with Non-Invasive OPM-MEG

Markus Henttonen, Mikael Grön, Olli Pikkarainen, Miiamaaria Kujala, Lauri Parkkonen

Theme 5: methods in psychophysiological research

Introduction

Auditory evoked responses are commonly used to study cognitive processes related to hearing in humans. Here, for the first time, we present a set-up for measuring these responses non-invasively in unanesthetized domestic cats (Felis catus) using optically pumped magnetometers (OPMs). Our aim is to

study the P260 response in cats corresponding to P300 in humans a ssociated with conscious processing and working-memory recall.

Methods

Cats are measured using an array of nine OPMs (QZFM gen-2, QuSpin Inc., Louisville, CO, USA) in a 3D-printed helmet that conforms to the shape of cat's head. For stimulation, a variation of the local–global paradigm is used. Each trial comprises a sequence of five 50-ms tones: the first four tones are always the same and the last one is either the same or different in frequency. Trials are presented in blocks of 80 where in 80% of the trials the 5th tone is different and in 20% the same as the preceding four tones. During the measurements, the cat is seated with its owner and is free to move its head, while the owner holds the sensor array on the cat's head.

Results

Pilot measurements have been carried out, and N100 responses have been detected. SNR needs to be further improved for the P260 and mismatch negativity responses.

Discussion

When successful, this study shows that neurophysiological experiments can be performed non-invasively and without restraining the animals using OPM-MEG. The field compensation methods used could be further employed in other experiments with moving human subjects.

19. Links between facial perception and symptoms of depression and anxiety

Anna Dadatskaja, Kairi Kreegipuu

Theme 5: methods in psychophysiological research

Introduction

Efficient recognition of facial expressions is crucial for social interaction, but psychological well-being, such as depression and anxiety, can modulate the processing of emotional stimuli, particularly faces. Our study investigates how depression and anxiety impact both pre-attentional and attentional processing of facial emotions.

Methods

Using correlative analyses, we'll examine the effects of depression and anxiety on facial perception among participants with higher and lower depression and anxiety scores. We'll explore differences in processing between real and schematic faces, using event-related potentials (ERP) while utilizing the oddball and equiprobable paradigms to distinguish pre-attentional versus attentional stages.

Results and Discussion

At the upcoming Brains and Bodies Workshop in Jyväskylä, we'll discuss the design of the study focusing on the pre-attentional processing of the emotional faces, schematic faces, and non-emotional auditory and visual stimuli and present results from pilot testing.

20. Sharing biosignals during social interaction modulates psychophysiological states and perceived interpersonal closeness.
Ksenia Egorova, Juan Camillo Avendano Diaz, Lauri Parkkonen
Theme 5: methods in psychophysiological research

Introduction

Measuring physiological bodily signals such as electrocardiography (ECG) and electrodermal activity (EDA) has become accessible and popular in the last decade. Recent research, primarily qualitative, has explored whether sharing these biosignals in social settings can impact social interactions. Here, we quantitatively investigated whether social biosignal sharing affects the psychophysiological states and the underlying psychological traits influencing these effects.

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Methods

We present data from 18 sex-matched pairs of strangers whose ECG and EDA were measured while they were interacting face-to-face. Participants shared their heart rate and skin conductance levels (displayed on a monitor) either unidirectionally, bidirectionally, or not at all. We examined the effect of biosignal sharing on various indices of autonomic nervous system activity (e.g., RMSSD, skin conductance level, number of ski conductance responses and their amplitude), alongside correlations with psychometric items evaluating empathic traits, social interaction anxiety, and perceived closeness with the experiment partner.

Results

Our findings revealed that bidirectional biosignal sharing significantly reduced the number of SCRs compared to face-to-face interactions without biosignal sharing. Additionally, a higher number of SCRs in the face-to-face condition positively correlated with the change in the perceived interpersonal closeness. In contrast, during bidirectional sharing (normalized to face-to-face), the number of SCRs negatively correlated with the change in closeness ratings, while perceiving a higher focus on one's biosignals by the task partner correlated positively with the number of SCRs.

Discussion

These results suggest that biosignal sharing can modulate psychophysiological responses and interpersonal perceptions, with potential applications in social psychology, human-computer interaction, therapeutic practices, and educational settings.

21. Effects of Native Language and Exposure to Foreign Language on Categorization and Discrimination of Speech Sounds

Kaijun Jiang, Xueqiao Li, Chaoxiong Ye, Peixin Nie, Jarmo Hämäläinen, Piia Astikainen

Theme 3: Collaborative learning

Introduction

Discriminating speech sounds in a foreign language can be more difficult than discriminating speech sounds in one's native language. However, it is unclear whether the native language advantage is observed similarly for different features of speech sounds, and whether linguistic exposure can improve

perception of duration feature.

Methods

We measured behavioral categorization and discrimination ability for Chinese tones and vowel durations in native Finnish, native Chinese living in China (having no training or exposure to quantitative languages), and native Chinese who have lived in Finland for more than six months.

Results

We found that the slope of the category boundary for the tones was steeper in Chinese than in the Finnish speakers, whereas no group difference was observed for the duration feature. Duration discrimination was better in Finnish than in Chinese speakers, reflecting the native language advantage in the Finnish group. For tones, Chinese speakers exhibited enhanced discrimination ability for stimulus pairs involving stimuli positioned at the category boundary. The immersion of the Chinese speakers in Finnish language changed the categorization of vowel duration and the associated reaction times, especially for the stimulus at the border of the category.

Discussion

The results suggest the native language advantage in perception of vowels does notmanifest uniformly across tonal and duration features. The exposure to foreign language in adulthood may result in perceptual responses that diverge from, rather than align with, those of native speakers.

22. Sympathetic arousal commonalities and arousal contagion during collaborative learning: How attuned are group members?
Héctor J. Pijeira-Díaz

Theme 3: Collaborative learning

Introduction

Collaborative learning is considered a coordinated, synchronous activity resulting from learner's continued attempt to construct and maintain a shared conception of a problem. Collaborative learning may lead to higher-order thinking and other cognitive and social benefits, but it could also be detrimental to the learners. Accordingly, it is important to further study collaboration processes by going beyond the traditional conversational analyses. In this

scenario, interpersonal physiology can provide insights into the process from a different perspective with potential for real-time, objective measures.

Methods

Using Empatica E4 wristbands, electrodermal activity—to derive arousal—was measured in 24 high school students working in groups of three (i.e., triads) during two runs of an advanced physics course. The participants met three times a week over six weeks for lessons of 75 min each.

Results

Most of the time (≈ 60⌐─95% of the lesson) the triad members were at different arousal levels, and, when they were on the same level, it was mainly the low arousal (or deactivated) level. Less than 4% of the time were the triad members simultaneously in high arousal. Possible within-triad arousal contagion cases (71.3%) occurred mostly on a one-to-one basis and with a latency from within a few seconds up to ten min, but usually within one min.

Discussion

This study supports the view that only small parts of group work are collaborative, as far as the synchronicity and coordination which collaboration presupposes. Although exploratory, results also illustrate the affordances of physiological measures to characterize collaborative processes.

23. PERIPHERAL SYNCHRONY IN INTERACTIONAL LEARNING SETTINGS – PRELIMINARY ANALYSIS PIPELINE

Pyry Heikkinen, Suvi Karjalainen, Minna Silvennoinen, Mikko Vesisenaho, Anita Malinen, Tiina Parviainen

Theme 3: Collaborative learning

Introduction

To understand Learning in interactional settings it is essential to study the elements of interaction, such as mutual engagement and behavioral regulation. Physiological synchrony (PS) has been proposed as a suitable measure for this; however, applying PS to meaningful learning components can be challenging, particularly in naturalistic settings. This study introduces a preliminary analysis pipeline designed to quantify collaborative learning in various naturalistic

settings.

Methods

ECG activity was recorded from dyads (n=7) consisting of a university lecturer and a university student. Each dyad watched a video of the student's teaching exercise with differing levels of engagement and a neutral video, followed by a discussion. PS was quantified using the windowed peak cross-correlation of R-R peaks, with surrogate data as statistical control.

Results

Statistically significant PS was observed between dyad members during tasks where participants fully attended to the teaching video or engaged in verbal communication. PS was not significant during tasks involving notetaking or while viewing the neutral video.

Discussion

The findings suggest that PS in the autonomic nervous system reflects engagement with meaningful stimuli and overt interaction. Caution is advised when interpreting PS due to potential artifacts from speech and movement. The future aim is to implement this analysis pipeline in naturalistic learning environments, incorporating finer-grained information about learning events and participants' experiential states. This project contributes to understanding collaborative learning dynamics and supports the use of multimodal measures in educational research.

24. Exploitation vs. exploration in partner dancing: whether switching partners enhances non-verbal communication

Martin Miguel, Jonathan Cannon, Laurel Trainor

Theme 3: Collaborative learning

Introduction

Improvised partner dancing affords meaningful connections with other people and provides enhanced physical fitness and coordination, memory and self-confidence. This activity requires learning nonverbal communication skills. To achieve this, two strategies could be employed: repeatedly dancing with the same partner or training with multiple partners. We hypothesize that exposure to multiple partners yields faster learning by allowing exploration of diverse

ways in which communication can occur.

Methods

In our ongoing study, we are comparing these strategies on non-dancers learning process. Unexperienced participants are paired with experienced confederate dancers who will nonverbally indicate the steps to the participants. In each trial, couples perform a new step sequence only known by the confederates. We will measure synchrony of movement of each couple using motion capture. Learning strategies will be compared in a between-subjects pre-post design. In the post trials, they will dance with their firstly assigned partner and new partners, to compare the effect of training strategies in specialization and generalization.

Results

We collected pilot data from one group per condition. Steps were easy enough to learn by non-dancers and repeated execution of the task lead to improved synchronization, with some individual differences. Pilot results show that partner switching improves synchronization both with a familiar partner as well as new partners.

Discussion

These results provide evidence in favor of a common practice in dance studios: "switch partners!". Moreover, the benefits with familiar partners may entice couples who seek private lessons to open to group lessons to improve their learning.

25. Exploring indicators of collaborative knowledge construction and regulation of learning in group settings through speech recognition methods

Kateryna Zabolotna, Daniel Spikol, Hanna Järvenoja

Theme 3: Collaborative learning

Introduction

Humans have an unconscious tendency to imitate one another in many social aspects, whether it is physical movements (gestures, posture, etc) or linguistic characteristics (e.g. syntactic structure). This is especially relevant in the context of collaborative learning (CL) interactions when students with various

skills and knowledge have to work together on a task. This work in progress explores acoustic-prosodic entrainment, i.e., a phenomenon when human conversational partners become more similar to each other in what they say and how they say it (Levitan et al., 2012), in the context of a collaborative learning STEM session with secondary school students. Theoretically, we focus on the two central phenomena of collaboration – collaborative knowledge construction (CKC) and group-level regulation of learning, - which together address the cognitive progress in students' joint

understanding and the underlying metacognitive mechanisms that allow them to control, monitor and adapt their learning behaviors (Miller & Hadwin, 2015).

Methods

Methodologically, we combine qualitative video coding with speech recognition methods based on machine learning. First, we identify in the video data meaningful episodes in students' interactions where group-level regulation interplays with CKC. Next, we analyze the prosodic features of students' speech in terms of proximity, i.e., how similar group members are to one another in their speech intensity, pitch, shimmer and speaking rate, and synchrony, i.e., when a speaker aligns their speech to that of their partner.

Results & Discussion

The results are demonstrated through visualizations that combine both video data and speech analyses for clear visual representations of how peers' voices align with the cognitive and socio-emotional processes and with others in the group. At the conference we will discuss our contributions and limitations and implications for future research.

26.   Laughing Together – do people synchronize and bond when they laugh together?
Verena Schaefer, Carolina Pletti, Stefanie Hoehl

Theme 4: Body and brain synchrony

Introduction

This study aims to investigate if laughing together supports interbrain synchrony which in turn supports positive social outcome between people. Interpersonal synchrony is the mutual, dynamic, and temporally related alignment of brain activity and behaviour between individuals. It is proposed that laughter, which is a rhythmical and social signal, promotes interpersonal

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synchrony. Synchrony could be the mechanism by which laughter enhances bonding between individuals.

Methods

In this study, we manipulate laughing in pairs of participants; afterwards, we measure interpersonal synchrony and bonding. For manipulating laughter, the participants watch funny animal videos and play a funny game. We assess neural synchrony using fNIRS hyperscanning in frontal (IFG) and temporal (TPJ) brain areas. Behavioral synchrony is measured via video data and processed using openpose. Subsequently, synchrony values are analyzed using the wavelet-transform-coherence technique. To test our hypotheses, we use a sequential Bayesian approach with a Bayes factor of 5 or 1/5.

Results

Preliminary Bayes ANOVA results (N=84) on the neural data suggest anecdotal and moderate evidence support for the null hypotheses (BF10 for ROIs rIFG: .384, lIFG: .292, rTPJ: .312, lTPJ: .587).

Discussion

The initial findings from our analyses indicate that neural synchrony is not increased while watching funny videos and engaging in a funny game compared to watching neutral videos and participating in a neutral game. However, the amount of individual laughter must be considered for the synchrony analyses. Additional variables, such as behavioural synchrony, laughter, and bonding, are presently under analysis, with data collection still in progress.

27. Heart-brain coupling and its relevance for individual trait characteristics

Suvi Karjalainen, Jan Kujala, Tuija Aro, Tiina Parviainen

Theme 4: Body and brain synchrony

Introduction

A bulk of recent neurophysiological research has focused on how bodily functions are intertwined with neural activity, but the dynamic heart-brain coupling and its relevance for individual trait characteristics remains largely unexamined. Thus, our aim was to investigate how ongoing oscillatory brain

activity is modulated by the natural fluctuations in heart rate variability (HRV). We further explored whether heart-brain coupling is associated with individual trait characteristics.

Methods

Magnetoencephalography (MEG) together with electrocardiography (ECG) were used to record neural activity and HRV during rest. Self-reported trait characteristics were examined using Behavioral Inhibition and Activation Systems Scale (BIS/BAS) and attunement to internal bodily sensations using Body Vigilance Scale (BVS).

Results

Statistically significant increases were observed for low HRV vs. high HRV state in alpha and beta power (p<0.05) indicating that oscillatory brain activity is modulated by fluctuations in HRV. Moreover, we demonstrated that heart-brain coupling was associated with self-reported behavioral approach and avoidance tendencies. The results of the moderator analysis further indicated that the relationship between heart-brain coupling and trait characteristics is at least partly moderated by the attunement to internal bodily sensations.

Discussion

Our findings bring insights to the intricate interplay between cardiac and neural signaling and its relationship with individual trait characteristics. These findings have significant implications for the understanding of how bodily functions govern oscillatory brain activity. Moreover, we demonstrate that not heart-brain coupling as such but its moderation by the attunement to bodily sensations contributes to the way an individual approaches and interacts with the external world.

28. Co-representation vs. attenuation: whether motor representation of a distractor makes it more distracting

Martin Miguel, Laurel Trainor, Jonathan Cannon

Theme 4: Body and brain synchrony

Introduction

Humans can focus their attention to ignore distracting information (selective attention task, cocktail party problem). Yet this ability is modulated by our internal representation of the task and the distractors (social Simon effect, involuntary interpersonal synchronization). We tested whether having a motor

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representation of a distractor sound makes it more distracting in a synchronization task. We hypothesized that a key element of involuntary synchronization is identifying a metronome sound with tapping movements, therefore participants' tapping would be more attracted to distractors associated with movement.

Methods

Participants synchronized taps to a target metronome while a lagged distractor metronome with a different timbre was also present. We manipulated the internal representation of the distractor sound (motor; non-motor representation) and distractor-to-metronome lag. Conditions were tested within participants. To induce a specific representation of the distractor sound, participants performed priming tasks: counting target metronome sounds (no representation condition) or tapping to produce the sound that would become the distractor (motor representation condition).

Results

We carried out two studies with priming tasks interleaved either as sub-blocks or before each synchronization trial. We inspected changes in mean asynchrony between conditions. We only found an effect of distractor lag, replicating previous work. Bayesian ANOVA analysis found moderate evidence of no effect of representation.

Discussion

Our results show that priming a motor representation of a sound does not make it more distracting. We propose asserting this null effect with a pre-registered replication study and by evaluating musicians distracted by their instrument in contrast to an unfamiliar instrument.

29. Skin conductance response and habituation to emotional facial expressions and words

Liina Juuse, Diina Tamm, Kaidi Lõo, Jüri Allik, Kairi Kreegipuu

Theme 4: Body and brain synchrony

Introduction

Skin conductance response (SCR) is a reliable indicator of sympathetic activation used to measure emotional arousal. We examined the extent to which emotional discrimination is influenced by the modality of presentation.

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Methods

102 participants (42 men, 18–49 years, M = 25.16; SD = 6.51 years) were presented with six basic emotions—anger, happy, disgust, fear, sad, and surprise—conveyed by facial expressions or emotion words. SCR amplitudes for recorded and analysed using Continuous Decomposition Analysis (CDA). An exponential decay function ($e^{\wedge}(-\lambda(t-\tau))+\alpha$) was employed to observe the habituation process to emotional and neutral stimuli over six consecutive presentations.

Results

The amplitude of SCR was accurately predictable from the subjective arousal ratings, while valence did not play a significant role. The habituation process to emotional and neutral stimuli was shown, illustrating the gradual decrease in SCR response relative to the preceding trial of the same stimulus. Each first presentation of emotion has a sizable answer, which was produced by the emotional content. The initial emotional response to happy ($t(6424) = 4.35$, $p < .001$), disgust ($t(6424) = 3.11$, $p = .002$), and sad faces ($t(6425) = 2.34$, $p = .04$) surpassed that evoked by words conveying similar meaning.

Discussion

Habituation of the SCR to emotional faces and words decays exponentially and shows distinct patterns by emotion category and is more similar by category than by modality. The results highlight that emotions can be quantified using a simple electrical instrument, emphasizing the potential of SCR to offer insights into emotional processing.

30. Organ-specificity in viscera-motor coupling: the phase of the heart, lungs, and stomach all drive motor cortex excitability, but independently.

Tahnée Engelen, Teresa Schuhmann, Alexander Sack, Catherine Tallon-Baudry

Theme 4: Body and brain synchrony

Introduction

The rhythms of the heart, lungs, and stomach interact with cognition, exteroception, and action, and are coupled to a widespread network of brain areas. While many similarities between these organs exist (shared afferent pathways, general function of keeping the organism alive), they also show

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many specificities (rhythms at distinct frequencies, dedicated pathways, and respective functions). Despite this, interoception is typically defined in a holistic manner, and the extent of organ specificity in brain-body interactions rarely empirically tested. We here aim to bridge this gap by assessing whether the cardiac, respiratory, and gastric rhythm are coupled to the excitability of primary motor cortex (M1), and whether this coupling occurs in an organ-specific or organ-general manner.

Methods

We combined continuous physiological recordings with single pulse Transcranial Magnetic Stimulation (TMS) to probe phase-amplitude coupling between the phase of the cardiac, respiratory, and gastric rhythm and the amplitude of Motor Evoked Potentials (MEP).

Results

The phase of all three visceral rhythms was coupled to MEP amplitude. Importantly, participants displaying high coupling between one organ and M1 did not necessarily display high coupling between the other organs and M1, suggestive of unique interoceptive profiles. Self-reported awareness of each of these organs was not related to the extent to which the organ was coupled to the motor cortex.

Discussion

These results demonstrate that the three visceral rhythms each can influence fluctuations in motor cortex excitability, but do so in an independent manner. This brings forward the importance of defining interoception in an organ-specific manner.

31. Exploring teacher-student physiological synchrony in online synchronous education

Muhterem Dindar, Anne Frenzel, Elizabeth Cloude

Theme 4: Body and brain synchrony

Introduction

Personal computers and the Internet have revolutionized the world and transformed how we teach and learn. Nowadays, many brick-and-mortar universities organize fully online lectures, courses, and even graduate degree programs. Therefore, facilitating engaging and enjoyable learning experiences

in online education, and particularly in in online synchronous education (OSE) has become a significant agenda for the scientific and teaching community. The current study contributes to this agenda by studying the relationship between physiological synchrony (PS) and lesson enjoyment in OSE.

Methods

Participants of the study were 16 teachers and 64 students from a university in Finland. Participants' heart rate and electrodermal activity were captured during live online lectures. After the lecture, participants were asked to fill a lesson enjoyment questionnaire. Diagonal recurrence quantification analysis was used to calculate dyadic PS between teachers their students in terms of electrodermal activity and heart rate. Correlational analyses was conducted to observe the relationship between PS and lesson enjoyment.

Results

Preliminary findings will be presented at the conference.

Discussion

The current study findings contribute to facilitate enjoyable experiences for both teachers and students and further enhance the quality of social interaction in OSE. The findings might have practical implications for developing learning analytics tools to provide teachers feedback about their teaching performance in OSE.

32. Distinguishing Brain Responses to Interoceptive and Exteroceptive Attention Focus: An MEG Study

Kristina Pultsina, Tiina Parviainen, Suvi Karjalainen

Theme 4: Body and brain synchrony

Introduction

Interoception refers to the perception of sensory information originating from within the body, while exteroceptors are receptors that detect signals from the external environment. It is hypothesized that directing focused attention towards a specific perceptual modality increases activity within the brain regions responsible for processing that modality.

Methods

In the study, 27 participants took part in a Heart Beat Attention task. During this task, they were exposed to sounds that either synchronized with their heartbeats or were deliberately asynchronous, while their brain activity was recorded using MEG. The experiment required participants to perform two distinct tasks: an interoceptive task, where they attempted to feel and concentrate on their heartbeat, and an exteroceptive task, where they focused their attention solely on the auditory stimuli. The evoked auditory responses for each task condition were meticulously analyzed. To assess the statistical significance of the observed effects, a spatio-temporal clustering test, which considers both spatial and temporal dimensions of the MEG data, was employed.

Results

A significantly greater N100 response was observed in the temporal cortex during the interoceptive task compared to the exteroceptive task. However, this response did not vary based on whether the sound was synchronous or asynchronous.

Discussion

The obtained results may indicate that the interoceptive task is more challenging for the participants, leading to an increased response and slower suppression of the response.

33. Exploring Adult Learning Experience: A Multimodal Approach in KoKemus Project

Mikko Vesisenaho, Minna Silvennoinen, Tiina Parviainen, Anita Malinen, Suvi Karjalainen, Mari Manu

Theme 4: Body and brain synchrony

Introduction

This poster introduces methods for using an individual-level multimodal approach for studying learning experience. Traditionally, adult learning research has predominantly relied on educational methods, often involving surveys or interviews with the subjects. However, today it is possible to obtain comprehensive and reliable information from learning experiences using multimodal methods, such as combinations of physiological and

neurophysiological measurements. There has been increasing interest in recording physiological signals also in pedagogical contexts, although the research literature on multimodal studies of adult learning experience is scarce. There is a lack of larger datasets and strong empirical evidence to enable a comprehensive understanding of a complex nature of learning experience.

Methods

In KoKemus project we have piloted multimodal learning experience measurements within simulation-based learning (SBL) situations. The modalities we applied are video recordings, stimulated recall interviews, questionnaires, electrocardiography (ECG), and electroencephalography (EEG).

Results

We introduce pipelines and detailed descriptions on how multimodal research design can be used to study learning experience, by combining measurements of the human nervous system with subjective and observational data. The successful approach has required interaction across disciplines, harmonizing of conceptual frameworks and goals, and bringing together complementary, discipline-specific expertise.

Discussion

Even though the self-reported learning experiences are crucial for learning, there is a need for theoretical development and a more comprehensive multimodal empirical approach that incorporates physiological and neurophysiological elements involved in learning experience. Opening the disciplinary boundaries both at theoretical and methodological domains enables increased discussion between researchers from different disciplines as well as new insights

34. Effects of Ambroxol in restoration of behavioral parameters and tyrosine hydroxylase in Parkinson's disease model
Akanksha Mishra

Theme 4: Body and brain synchrony

Introduction

Disease-modification is still a dream for the treatment of Parkinson's disease

(PD). Ambroxol, a glucocerebrosidase (GCase)-stimulator is under clinical trial to halt PD progression, but its effect on restoration parameters related to PD is not yet known.

Methods

Ambroxol was administered as 400 mg/kg orally twice a day from D-28 to D-70 after the unilateral intrastriatal injection of 6-hydroxydopamine (6-OHDA) in male rats. Behavioral parameters were observed every week, and at last, tyrosine hydroxylase (TH) levels were estimated.

Results

Behavioral functions were progressively recovered. Ambroxol restored TH on D-71 as the markers of dopaminergic cell, indicating the recovery of dopaminergic system. Factors involved in PD pathogenesis such as α-synuclein pathology was decreased by ambroxol.

Conclusion

The current study provides the preclinical evidence to support the neurorestorative potential of ambroxol in 6- OHDA-induced hemiparkinson's rat model and indicates its possible use as disease-modifying agent in PD.

35. Event-related potentials to faces modulated by emotional expression and context
Xinyang Liu

Theme 4: Body and brain synchrony

Introduction

Fast and automatic perception of others' facial expressions is vital for social interactions. Event-related potentials (ERPs) studies have investigated deviance detection in facial expressions, yet few studies tried to untangle the impacts of visual features, presentation rate, and context from facial expressions on ERPs. Previous studies reported altered ERPs in older adults and individuals with depressive symptoms, but the underlying mechanisms remain unclear.

Methods

36 participants (M = 46.19, SD = ±13.07) with varying depressive symptoms (M = 15.06, SD = ±12.43) participated in the study. In oddball conditions, sad, happy, and neutral facial expressions were standard and deviant stimuli. A control condition included seven facial expressions with equal presentation rate was applied to control for visual features and presentation rate. P1 and N170 amplitudes were analyzed. Beck's Depression Inventory II (BDI-II) scores and age served as covariates to examine their impacts on ERPs.

Results

P1 amplitudes showed no modulation by stimulus type or facial expression. N170 amplitudes differed significantly between facial expression and stimulus type in oddball condition. Emotional faces elicited larger response than neutral faces, but neutral deviants did not elicit larger responses than emotional standards. Additionally, deviant stimuli elicited larger amplitudes than control stimuli. In general, the responses to facial expressions were the larger the older the participant was. BDI scores did not correlate with P1 or N170 amplitudes.

Discussion

Null results for P1 suggest it's related solely to visual feature encoding, while N170 is sensitive to facial expressions and context.

36. Does motor imagery involve sensory prediction?

Mila Nurminen, Ivan Zubarev, Lauri Parkkonen

Theme 4: Body and brain synchrony

Introduction

Efficient motor control relies on an efference copy of the motor program, which helps predict the sensory outcome of the movement. The correspondence between the predicted and actual feedback is further used to determine the agency. To date, it has not been fully explained how the brain generates such sensory predictions and detects conflicts with the actual feedback. This study aims to unveil whether motor imagery induces an efference copy similar to an overt movement and to elucidate the processing of prediction errors in the brain.

Methods

We designed a task where the subjects are 1) moving their hand and watching a real-time video of their moving hand, 2) imagining hand movements and watching a pre-recorded video of their hand moving, and 3) watching a video of their hand moving without imagery. Occasional incongruent visual feedback is provided by freezing the screen. Brain responses to matching or mismatching feedback are recorded with magnetoencephalography. Strength of self-agency is evaluated with behavioural reports.

Results

We expect brain responses to congruent versus incongruent feedback to differ. However, we hypothesize that movement and imagery cause mismatch responses between the efference copy and actual outcome, in addition to general error monitoring. Due to the absence of active movement planning, we do not expect these responses in the observe condition.

Discussion

Understanding how motor planning affects self-agency may help elucidate brain mechanisms of motor learning and could thus have long-term impact in diagnostics and treatment of certain motor disorders.

37. Synchrony between multiple affect signals and game-based learning outcomes

Elizabeth Cloude, Muhterem Dindar, Kristian Kiili

Theme 4: Body and brain synchrony

Introduction

Game-based learning (GBL) environments are designed to foster emotions conducive to learning; however, there are mixed findings regarding GBL effectiveness. The unclear findings may stem from methodological and analytical challenges associated with studying emotions as multi-componental constructs. Traditional approaches often use one data channel and inferential statistics, which limit our understanding of the multiple components that underlie emotions during GBL. Non-linear dynamical systems (NLDS) methods offer a means to assess emotions as a multi-componental system

during GBL. In this study, we merged NLDS theory with the component process model of emotion to examine the degree of synchrony between two emotion components during GBL--specifically, facial expressions and heart rate variability (HRV)--to assess its relation to knowledge and learning.

Methods

Data were collected from 58 learners (n=58) during GBL, and the results showed a significant improvement in knowledge after GBL. A NLDS technique called cross-wavelet transformation showed there were varying degrees of synchrony between facial expressions and HRV.

Results

Neutral facial expressions showed the highest degree of synchrony with HRV, followed closely by happiness, anger, and HRV, while fearful expressions and HRV showed the lowest rate of synchrony. However, there were no relationships between synchrony of facial expressions and HRV with prior knowledge, post-test scores, and learning gain.

Discussion

This research contributes to the field by demonstrating how multiple emotion signals synchronize during GBL and its relation to learning and knowledge. Implications of this work offer opportunities to leverage NLDS tools to study emotions as a multi-componential phenomenon.

38. Neural Correlates of Concreteness and Attractiveness in Icon Processing Based on A MEG Study

Jiaqi Zheng, Weiyong Xu, Johanna Silvennoinen, Fengyu Cong, Tiina Parviainen, Tuomo Kujala

Theme 4: Body and brain synchrony

Introduction

Icons are pivotal in human-computer interaction (HCI) as a universal visual language, enhancing the accessibility, recognition, and memorability of actions, objects, and concepts compared to text. In cognitive neuroscience, icon processing involves stages of visual perception and interpretation, with the visual cortex decoding shapes, colors, and other visual features. However, to understand how concreteness and attractiveness affect brain responses in visual symbol processing are still largely unexplored and warrant further investigation.

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Method

Our study utilized Magnetoencephalography (MEG) to record brain responses to icons with varied characteristics. We initially conducted two types of surveys to evaluate 420 icons, namely a concreteness-rating survey, which was divided into two parts to avoid ineffective answers due to participant tiredness (N1=39, N2=36), After filtering the icons based on the results, we conducted an attractiveness-rating survey with a new group of 64 participants. Finally, MEG data were recorded from 35 participants who had participated in the attractiveness rating survey (Mean age = 26, SD = 7.1).

Results

Preliminary result from whole-brain analysis of MEG data revealed differences across various conditions. Concrete icons evoked stronger cortical activity in the lateral occipital, inferior parietal, superior temporal, and middle temporal regions compared to abstract icons. Attractive icons elicited heightened activation in the anterior cingulate cortex, pericalcarine, and specific postcentral regions compared to unattractive icons. Additionally, the activation associated with icon processing seems to be predominantly lateralized to the right hemisphere.

Discussion

These findings suggest that the concreteness and attractiveness of icons distinctly influence neural processing, highlighting the importance of visual characteristics in cognitive and perceptual mechanisms.

39. Differential brain processes of newly-learned and overlearned audiovisual associations

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Theme 4: Body and brain synchrony

Introduction

Learning the associations between letters and speech sounds is a crucial step in reading acquisition. Previous studies have found that the brain's process of linking letters and speech sounds is very dynamic during initial learning and takes years to become fully automatic. However, changes related to learning (e.g., newly-learned and overlearned) in audiovisual processing are not well-

characterized.

Methods

In this study, we first trained adult native Finnish speakers to associate novel foreign letters with familiar Finnish speech sounds. We then directly compared the audiovisual processing of the newly-learned (one day after learning the foreign letter-sound associations) and the overlearned Finnish letter-speech sound associations using MEG. We used both ERF and decoding analysis to examine visual and audiovisual effects at different levels of learning.

Results

We found different patterns of visual processing for the two types of letters, with larger responses for the newly-learned letters than for the overlearned letters. The audiovisual interaction (A+V-AV) could be detected in both overlearned and newly-learned conditions, but showed no significant difference between them. Most interestingly, the audiovisual congruency effect (audiovisual congruent vs. audiovisual incongruent) was found for responses to both newly-learned and overlearned stimuli in the left hemisphere. The congruency effect appeared to be processed faster for the overlearned stimuli than for the newly-learned audiovisual associations.

Discussion

The results indicate different brain processes for newly-learned compared to overlearned audiovisual associations, which are likely related to the varying levels of automaticity in audiovisual integration.

40. The association of voluntary running and sex with pattern separation in mice

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Theme 4: Body and brain synchrony

Introduction

The hippocampal dentate gyrus is central for pattern separation, a cognitive ability improved by physical exercise. In fear-related tasks, pattern completion (generalization) overrides pattern separation more often in females than in males, but the reason is unknown. We investigated how physical exercise impacts pattern separation in the brain and at the behavioral level in mice. We hypothesized better performance in runners compared to sedentary females.

Methods

Adult healthy mice (n = 6, female) were allowed to run voluntarily in the home cage for ~15 weeks, while others (n = 6/6, female/male) remained sedentary. All mice then performed a contextual fear discrimination task: Each mouse was exposed to two similar environments daily for 20 days. From day 11 onwards, a foot-shock was administered in one of the environments. Activity of hippocampal dentate gyrus granule cells during the training was recorded using calcium imaging and behavior of the animals was filmed.

Results

Males and sedentary females showed behavioral pattern separation while runner females indicated generalized fear. Surprisingly, we found no difference between the female groups in freezing, the measure of learned fear. Analysis of hippocampal activity is ongoing: We expect to see discrimination of the two contexts in the hippocampal neural activity. The neural and behavioral discrimination should correlate positively.

Discussion

Either the female mice truly could not tell the two contexts apart or the activity of the fear circuits for example in the amygdala override hippocampal signals in controlling behavioral output.

41. Acute Effects of Endurance Exercise on Brain Activity, Mood, and Well-Being: A MEG Study

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Theme 4: Body and brain synchrony

Introduction

Exercise is known to positively impact mood and well-being, benefiting both healthy individuals and those with mental health issues. Despite this, the brain mechanisms behind these effects are not well understood. This study aims to investigate the effects of endurance exercise on brain activity, mood and well-being.

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Methods

Twenty-one participants (31 ± 6 years) volunteered. In the first visit, their maximal oxygen uptake was measured using a bicycle ergometer test to exhaustion. During the second visit, they cycled for 30 minutes at a self-selected load. Subjects were divided into three groups (n=7) based on self-selected workload: light (60-70% of max heart rate), medium (70-80%), and heavy (80-90%). Brain activity was measured with MEG before, 10 min and 45 min after the exercise. Mood (Hardy's & Rejeski 1989) and well-being (Warr 1990) were measured at the same time points.

Results

Alpha power significantly increased in both post-measurements for the medium group and at post45 for the heavy group, with no significant changes in the light group. Pearson's correlation indicated that alpha power increased with exercise intensity ($R = 0.51$, $p < 0.05$). These changes in alpha power were accompanied by similar changes in mood and well-being.

Conclusion

The results show that alpha power, mood, and well-being respond similarly to a single session of endurance exercise. Alpha power could potentially measure the positive brain effects of exercise. These findings support the development of wearable devices for real-time brain activity monitoring and mental state feedback, and can inform targeted exercise programs.