Adaptive behavior and its ecological foundations 2025

21st February 2025 (Fri.)
Hyakunen-Kinenkan, Kobe University

Program

Session 1

10:05-10:15 *Opening remarks* Tetsushi Nonaka

10:15-10:45 *Keynote talk 1* **Thomas A. Stoffregen** (University of Minnesota)
"Perceptual information for the adaptive control of agent-environment behavior"

10:45-11:10 **Tom Froese** (Okinawa Institute of Science and Technology)
"Integrating ecological psychology with predictive processing via irruption theory"

11:10-11:35 **Kohei Nakajima** (University of Tokyo)
"Physical Reservoir Computing in Embodied Systems"

11:35-12:00 **Yuki Koyano** (Kobe University)
"Emergence of Goal-directed Behavior in Self-propelled System"

12:00-13:30 Lunch + Poster

Session 2

13:30-14:00 *Keynote talk 2* **Koh Hosoda** (Kyoto University)
"Soft Sensors and Adaptability"

14:25-14:50 **Dai Owaki** (Tohoku University)
"Motion Hacking: Understanding by Controlling Jellyfish Pulsatile Locomotion"

14:50-15:15 **Daiki Wakita** (University of Tokyo)
"Echinoderms show how to move when you have tens of arms"

15:15-16:45 Coffee Break + Poster

Session 3

16:45-17:15 *Keynote talk 3* **Hiraku Nishimori** (Meiji University)

"Non-Uniformity of Workload and Errors in Ant Colonies"

17:15-17:40 **Hitoshi Aonuma** (Kobe University)
"Understanding the mechanisms of adaptive behavior in insects: Insights from the trap-jaw ant"

17:40-18:10 *Keynote talk 4* **Fumiya Iida** (University of Cambridge)
"On the timescales of Embodied Intelligence for autonomous adaptive systems"

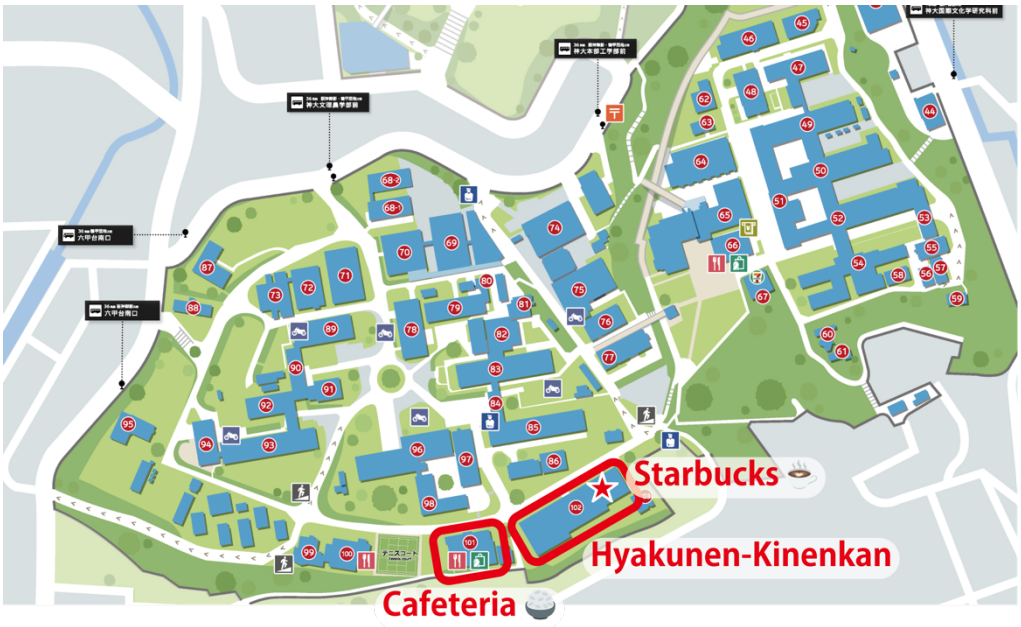
Group Photo / Closing remarks

Abstracts of oral/poster presentations

Abstract ↓

The abstracts are available on the website.
Please visit: https://www2.kobe-u.ac.jp/~koyano/abef2025/program.pdf

Campus map



Abstracts

Thomas A. Stoffregen (University of Minnesota)

"Perceptual information for the adaptive control of agent-environment behavior"

Adaptive behavior in agent-environment systems is optimized with accurate knowledge of states and transitions within such systems. Classically, it has been assumed that information sufficient for adaptive control does not exist outside the agent and, therefore, it must be created within the agent. Many inferential, computational models have been proposed for this role. However, it is possible to argue that information sufficient for adaptive control does exist outside the agent. James Gibson argued that ambient energy fields, such as optics, acoustics, and relations between them, are structured by events in agent-environment systems and that such structuring is lawful and determinate, such that patterns that exist in "ambient arrays" provide accurate information that can be detected, rather than being computed.

Tom Froese (Okinawa Institute of Science and Technology)

"Integrating ecological psychology with predictive processing via irruption theory"

I will compare two research programs in cognitive science: ecological psychology (EP) and predictive processing (PP). They are in tension regarding the basis of perception: PP claims it is in the brain and enabled by inner models of the world, whereas EP claims it is in the world and enabled by sensorimotor invariances. I propose a resolution, starting with an emphasis on complementary boundaries: PP starts inside the brain and ends at the inner surface of the body, e.g. neural activity interfacing with motor and receptor cells; the theory therefore has no role for the world. The EP, on the other hand, starts in the world and ends at the outer surface of the body, specifically as ambient information impacting on receptor cells; the theory therefore has no role for the brain. Next, I highlight that both accounts share the hard problem of consciousness: neither PP nor EP explain why perception is conscious rather than unconscious. I suggest that irruption theory, especially its novel concept of "absorption", could provide a framework that integrates these lines of research into a threefold theoretical synthesis: it is the precise cancellation of external worldly activity by means of internal neural activity that enables the absorption of that specific activity into conscious experience.

Kohei Nakajima (University of Tokyo)

"Physical Reservoir Computing in Embodied Systems"

Reservoir computing provides a powerful insight to understand how the system's intrinsic dynamics can contribute to its information processing. In this talk, we overview our recent results in reservoir computing

and discuss their relevance to embodied cognitive systems.

Yuki Koyano (Kobe University)

“Emergence of Goal-directed Behavior in Self-propelled System”

Self-propelled motion is realized in the non-equilibrium condition, and has attract interests of physicists. Self-propelled objects sometimes can perceive the surrounding environment and have a protocol to determine where to move next. A camphor particle, a sublimable solid substance, on a water surface is one of the simple examples of such a system. When a camphor particle is put on the water surface, it releases the camphor molecules on a water surface. Since the camphor molecules change the surface tension of the water surface, the camphor particle can move in a direction with higher surface tension. Since the time development of the camphor concentration field is affected by the water surface boundaries, the camphor particle "feels" the system boundaries through the camphor concentration field, and changes its direction of motion. Furthermore, a camphor particle can push or pull floating objects on the water surface.

Koh Hosoda (Kyoto University)

“Soft Sensors and Adaptability”

Soft sensors are crucial for realizing adaptability of bio-mimetic robots. However, it is normally very expensive to develop soft sensors since they require a lot of engineering. In the talk, I will present some soft sensors developed in our laboratory realizing adaptive behaviors of robots while they are relatively cheap. Taking the context how the robot achieve the task facilitates the outputs of sensors, and as a result, the robot can reduce computational cost for adaptive behaviors. Realizing intelligent behaviors by soft sensors, we can learn the role of proprioceptive sensors for generating adaptability.

Dai Owaki (Tohoku University)

“Motion Hacking: Understanding by Controlling Jellyfish Pulsatile Locomotion”

The jellyfish (Aurelia coerulea) exhibits an elegant buoyancy in aquatic environments. The manner in which this animal floats is not only aesthetically pleasing but also demonstrates flexibility and adaptability. Despite its enigmatic appearance, the jellyfish is capable of both drifting and active swimming throughout the day in pursuit of sustenance, possessing one of the highest energy efficiencies among aquatic animals. Although it has a relatively simple anatomical structure and nervous system, the jellyfish proficiently navigates its complex and dynamically varying fluid environment. In this talk, I will introduce a approach to investigating the control mechanisms underlying jellyfish pulsatile locomotion through a technique we

term "Motion Hacking." This technique entails the manipulation of movement via electrical stimulation of the muscles while maintaining the integrity of the animal's inherent sensory-motor functions. From the perspective of a jellyfish "cyborg," I will explore the control mechanisms of both biological and artificial systems, grounded in the concept of "embodiment."

Daiki Wakita (University of Tokyo)

“Echinoderms show how to move when you have tens of arms”

Why are animals able to coordinate individual movements while their bodies have evolved into complicated forms? Feather stars are echinoderms that extend "arms" in the radial directions. Several species "swim" with arms, whose number grows from ten to several dozen. The presenter studied the swimming patterns of feather stars to reveal a mechanism to coordinate an increasing number of arms. The major finding was that a stroke of one arm followed that of its neighboring arm with a delay depending on the basal branching structure of the arms. This coordinated pattern, a circular flow of information regardless of the number of arms, could be explained by extending a mathematical model that the presenter has built for a behavior of another echinoderm.

Hiraku Nishimori (Meiji University)

“Non-Uniformity of Workload and Errors in Ant Colonies”

Using a mathematical model, we have demonstrated that the group foraging of ants is optimized by the effective use of errors in following chemical cues in foraging walks[1], where type of the optimal error-strategy as a group is twofold: uniform or non-uniform. The relative advantage of each strategy depends on the location of feeding sites. Our finding extends the concept of error strategy proposed by Doneubourg [2]. In this study, we explore the interplay between the non-uniformity of the error strategy and the distance between tasks in "task-space." We also provide a concise overview of experiments conducted on the non-uniform behavior of ant colonies utilizing RFID tags (smaller than 0.5 mm × 0.5 mm) attached to the bodies of all ants in the colonies.

[1] J. L. Deneubourg, J. M. Pasteels, and J.C.Verhaeghe, J. Theo. Bio. Vol.3,259(1983).
[2] M.Shiraishi, R.Takeuchi, H.Nakagawa, S.I.Nishimura, A.Awazu, H.Nishimori, J. Theo. Bio., 465, 7(2019).

Hitoshi Aonuma (Kobe University)

“Understanding the mechanisms of adaptive behavior in insects: Insights from the trap-jaw ant”

Insects are among the most successful animals in terms of diversity on Earth and have evolved a variety of adaptive behaviors. Understanding the mechanisms underlying adaptive behavior is a common interest among biologists, robotics researchers, and other scientists. Insects provide valuable insights into the design and control principles of animals, which can contribute to the development of control laws and the design of artificial systems inspired by insects. Here, I introduce the adaptive behavior of a small insect, the trap-jaw ant. I will demonstrate the aminergic control of aggressive behavior and the aggression-related, extremely fast mandible movements observed during prey hunting and the bouncer jump used to evade threats.

Fumiya Iida (University of Cambridge)

"On the timescales of Embodied Intelligence for autonomous adaptive systems"

This talk explores the critical role of timescales in embodied intelligence for autonomous adaptive systems. By leveraging physical dynamics across multiple timescales—ranging from rapid material and mechanical dynamics, to slower reflexive responses and adaptive learning processes—these systems achieve enhanced performance, resilience, and adaptability. We will discuss how integrating mechanical properties, material behaviors, and control architectures allows embodied agents to fluidly adapt to dynamic environments. This multiscale approach enables systems to exploit immediate physical interactions while gradually refining long-term strategies. The presentation highlights design principles and examples demonstrating how embodied intelligence harnesses physical dynamics to optimize autonomous behavior across diverse tasks and contexts.

Poster List

#	Name	Affiliation	Poster title
1	Kazumi Azuma	University of Tokyo	The advantage of the in-phase bimanual movement over the unimanual movement for the non-dominant hand
2	Masashi Shiraishi	Meiji University	Statistical Study of Worker Activity Depending on Location in Ant Colonies
3	Rina Nishiyama	Kobe University	Can a human sing with an unseen partner? Coordination dynamics when singing with an unseen human or artificial partner
4	Yumi hughes	University of Tokyo	Where does improvisation emerge in a play?: An examination through online discrimination experiment using audiovisual conditions.
5	Takuto Kikuchi	Dept. of biology, Kobe University	Roles of an elastic protein resilin in the trap-jaw ant, O. kuroiwae
6	Balagopal Raveendranath	Texas Tech University	Do arm-support exoskeletons affect pointing movements and accuracy?
7	Yuta Azuma	Kindai-University, Faculty of Applied Sociology	Haptic information affects perception on the reachability of a hand-held rod even when optical information is available
8	Shinnosuke Yoneto	Dept. of biology, Kobe University	Neural responses to mandibular gland components in the Japanese honeybee brain
9	Akihisa Murata	Dept. of Biology, Kobe University	Effective Tactics for Winning in Cricket Fighting
10	Tatsuya Ueda	Dept. of biology, Kobe University	Unveiling the Physiological Mechanisms Underlying the Loser Effect in insects by Manipulating Aggressiveness with a Small Robot
11	Murakami Hitomi	Kobe University	How is the Temporal Structure of GAGAKU performance shared with others? ~ A Developmental Examination of the Transmission of Oral Mnemonics between Master and Pupil~
12	Hiroaki Furukawa	Graduate School of The University of Tokyo	Interpersonal synchronization among top marathon runners

13	Mingqian Guan	Graduate School of Economics, Kobe University	Denoised IPW-Lasso for Heterogeneous Treatment Effect Estimation in Randomized Experiments
14	Kei Hashizawa	Kobe University	Do Low Tones delay in Musical Ensemble?: A Brief Overview of Musicians' Awareness and Solutions.
15	Ikumi Aoi	Graduate School of Human Development and Environment, Kobe University	Infants’ manual contact with environmental objects and contingent experiences
16	Ryota P. Kitani	Graduate School of Human Development and Environment, Kobe University, Japan.	Environmental education using environmental DNA analysis increases high school students' interest in ecosystems
17	Uran Sumi	Kobe University	The Adaptive Significance of Color Variation and Pattern in Anurans: Focusing on Predator Avoidance Mechanisms Against Avian and Mammal Predators
18	Hyoma Akamatsu	Graduate School of Human Development and Environment, Kobe University	Synthesis and Physicochemical Properties of Room-Temperature Ionic Liquids with Asymmetrical Phosphonium Cation and Carboxylate Anions

Abstracts

Abstract ↓

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#1 Kazumi Azuma (University of Tokyo)
Co-authors: Kohei Miyata, and Kazutoshi Kudo
"The advantage of the in-phase bimanual movement over the unimanual movement for the non-dominant hand"

This study investigated bimanual deficit or facilitation in movement frequency during a maximal-speed cyclic bimanual coordination task. Seventy-three right-handed participants performed flexion-extension movements of their index fingers for 10 seconds at maximum speed under three conditions: anti-phase, in-phase, and unimanual modes. Movement frequencies were determined by cycle durations. In the dominant hand, the unimanual mode yielded the highest frequency among the three modes. Conversely, in the non-dominant hand, the in-phase mode demonstrated the highest frequency. The anti-phase mode exhibited the lowest frequencies for both hands. These findings revealed a distinct pattern where the bimanual facilitation occurred in the non-dominant hand, while the bimanual deficit was evident in the dominant hand.

#2 Masashi Shiraishi (Meiji University)
Co-author: Hiraku Nishimori
"Statistical Study of Worker Activity Depending on Location in Ant Colonies"

Ants exhibit a sophisticated distribution of labor, wherein worker ants act autonomously to forage and care for eggs and larvae, which are necessary for communal living in a swarm (colony). The self-organized division of roles is called division of labor, which further distributes the amount of labor within the same role to improve efficiency.
In this presentation, we recorded the workers' activities for a long duration and analyzed how the de facto standard model, the Fixed-response threshold model, explains the statistical data.

#3 Rina Nishiyama (Kobe University)
Co-author: Tetsushi Nonaka
"Can a human sing with an unseen partner? Coordination dynamics when singing with an unseen human or artificial partner"

This study investigated whether a singer's coordination patterns differ when singing with an unseen human partner versus an unseen artificial partner (VOCALOID 6 voice synthesis software). We used cross-correlation analysis to assess the similarity and synchronization of the amplitude envelope time series between the partner's and the participant's singing voices. We also conducted a Granger causality test, and calculated GC from the amplitude envelope time series of the partner to the amplitude envelope time series

of the performance of the participant and vice versa for each participant and each trial to reveal anticipatory dynamics. We found more pronounced characteristics of anticipatory synchronization and increased similarity in the unfolding dynamics of the amplitude envelopes in the human-partner condition compared to the artificial-partner condition, despite the tempo fluctuations in the human-partner condition. The results suggested that subtle qualities of the human singing voice, possibly stemming from intrinsic dynamics of the human body, may contain information that enables human agents to align their singing behavior dynamics with a human partner.

#4 Yumi hughes (University of Tokyo)
Co-authors: Kae Mukai, Jun Nitta, Katsumi Watanabe, Kazutoshi Kudo

"Where does improvisation emerge in a play?: An examination through online discrimination experiment using audiovisual conditions"

While improvisation is a crucial aspect of interpersonal communication, its perceptual characteristics remain unexplored. In this study, we conducted a discrimination experiment with 216 participants to distinguish between improvised and scripted performances. The results demonstrated above-chance discrimination across audiovisual, visual, and auditory conditions, with auditory information playing a particularly important role in the perception of improvisation.

#5 Takuto Kikuchi (Dept. of biology, Kobe University)
Co-author: Hitoshi Aonuma

"Roles of an elastic protein resilin in the trap-jaw ant, O. kuroiwae"

The trap-jaw ant, Odontomachus kuroiwae closes their long mandibles at an ultra-fast speed. To achieve such a rapid motion, insects have developed coil-recoil mechanisms of the musculoskeletal systems. Resilin is an elastic protein that contributes to deformation of the skeleton and protection from the damages caused by the quick movement. Resilin shows blue fluorescence against UV illumination. Utilizing this property, we examined the localization of the resilin in the trap-jaw ant. We will demonstrate that blue fluorescence is detected in certain regions of the head, mouthparts and so on. We then investigated the relationship between the distribution of the fluorescence, and the thickness of the cuticle. We made a thickness map of the head exoskeleton using X-ray microCT scan. The thickness map of the head cuticle reveals that resilin-like fluorescence is present in the region where the head exoskeleton is deformed during the loading phase when the ant strikes the mandibles.

#6 Balagopal Raveendranath (Texas Tech University)
Co-authors: Christopher Pagano and Divya Srinivasan
"Do arm-support exoskeletons affect pointing movements and accuracy?"

Exoskeletons are wearable devices that reduce the physical demands of repetitive tasks with arms elevated. However, concerns exist about their impact on movement and precision. This study examined how an arm-support exoskeleton affects accuracy and movement dynamics during a repetitive blind-pointing task. Participants performed this task in both exoskeleton and no-exoskeleton conditions, with trials alternating between vertical and horizontal target placements. Accuracy was lower with the exoskeleton, especially for horizontal targets and extension movements. Surprisingly, accuracy did not improve from the pre-test to the post-test, likely due to consistently high initial accuracy. Movement analysis showed decreased determinism (1% reduction) and stability (13.6% reduction) when wearing the exoskeleton, highlighting its design implications.

#7 Yuta Azuma (Kindai-University, Faculty of Applied Sociology)
Co-author: Nozomi Sato
"Haptic information affects perception on the reachability of a hand-held rod even when optical information is available"

We conducted two experiments addressing perception on the reachability of a hand-held rod under the condition in that both haptic and optical information are available. Participants were instructed to judge the reachability of three rods, which had the same entire length but different rotational inertia. The result showed that even when optical information is available, haptic information still affects perception on a hand-held object. We also examined the effect of experience. We found that the effect of rod types temporally decreased. We discussed the form of exploration (i.e., attention) might control the effect of haptic information.

#8 Shinnosuke Yoneto (Dept. of biology, Kobe University)
Co-authors: Mai Otani, Ryuichi Okada, Midori Sakura
"Neural responses to mandibular gland components in the Japanese honeybee brain"

In Japanese honeybees, a mandibular gland component (3-HOAA and 10-HDA) is known to have pheromonal effects such as inducing aggregation and enhancing learning. However, neural mechanisms underlying these behavioral responses to these odors remain largely unknown. In this study, we physiologically and morphologically characterized the olfactory projection neurons (PNs) that respond to these odors using intracellular recording/staining techniques. So far, we obtained five PNs that responded

to the 3-HOAA/10-HDA mixture. Two PNs responding to 3-HOAA predominantly tended to show a phasic onset excitation whereas one PN responding to 10-HDA predominantly showed a tonic excitation. The axon of the 10-HDA responsive neuron ran through the lateral antennal lobe tract. These results suggest that 3-HOAA and 10-HDA encode the timing and the duration of the pheromonal reception, respectively.

#9 Akihisa Murata (Dept. of Biology, Kobe University)
Co-authors: Kanako Takemoto, Hitoshi Aonuma

"Effective Tactics for Winning in Cricket Fighting"

Conspecific males fight over resources such as food, water, territory, and mating partners. Cricket fighting provides one of the best model systems for investigating aggressive behavior. A fight begins with mutual threatening displays when a male encounters another conspecific male. They then engage in antennal fencing, which may escalate into a violent confrontation if neither opponent retreats. Here, we investigate the key factors that determine an opponent's decision to retreat. To explore this, we conducted a kinematic analysis of cricket fights. In most cases, a cricket immediately retreated once it was knocked over by its opponent. The eventual winner, on the other hand, opened its mandibles to position them under the opponent's head and then executed a quick jump—without biting any body parts of the opponent. These results suggest that an effective tactic for winning a fight is successfully knocking over the opponent.

#10 Tatsuya Ueda (Dept. of biology, Kobe University)
Co-authors: Kanako Takemoto, Yasuhiro Sugimoto, Hitoshi Aonuma

"Unveiling the Physiological Mechanisms Underlying the Loser Effect in insects by Manipulating Aggressiveness with a Small Robot"

Virtually all animals exhibit aggressive interactions between conspecific individuals over resources such as food, territory, and mating partners. As a result of these fights, losers exhibit reduced aggressiveness for a certain period. This phenomenon is known as the "loser effect." We have been investigating the neurophysiological mechanisms underlying adaptive behavior in which animals modify their behaviors depending on the situation and have focused on the loser effect in aggressive behavior. Cricket aggressive behavior is one of the ideal experimental systems for this research due to its clear outcomes and the observable loser effect. We will demonstrate a cricket-robot interaction system to manipulate aggressiveness of crickets that are affected by the loser effect by the previous fight.

#11 Murakami Hitomi (Kobe University)
Co-authors: Sayumi Kamata & Tetsushi Nonaka
“Transmission of ‘shōga’ between master and pupil in Japanese Gagaku music”

In **gagaku**, one of Japan's traditional performing arts, the process of learning to play musical instruments begins with a one-on-one interaction between master and disciple, where the disciple sings the melody without using an instrument. Focusing on this unique learning process, this study aims to clarify how the disciple’s skills develop primarily through oral transmission. By regularly recording practice sessions and tracking movements such as the right-hand gestures used to keep time while singing the melody, the study analyzes how the disciple’s actions evolve through repeated practice. Through this analysis, it explores the communication that takes place between master and disciple and how it facilitates skill acquisition.

#12 Hiroaki Furukawa (Graduate School of The University of Tokyo)
Co-author: Kazutoshi Kudo
“Interpersonal synchronization among top marathon runners”

We tend to synchronize our movements with others (interpersonal synchronization). Interpersonal synchronization can occur not only in daily movements, but also in movements of skilled athletes, and may modify their performance. It has been suggested that synchronization may occur between top athletes in sprinting. In this study, we examined the possibility of synchronization between top long-distance runners. We analyzed the step timing of the five runners who formed the lead group in the Osaka Women's Marathon held in 2021. The relative phase of each pair was calculated based on their step timing, and synchronization was evaluated by the localization of the occurrence distribution of the relative phase. As a result, significant in-phase/anti-phase localization was observed in more than half of the pairs. It is unlikely that these are all intentional synchronizations, suggesting the possibility for unintentional synchronization among top marathon runners.

#13 Mingqian Guan (Graduate School of Economics, Kobe University)
Co-authors: Komei Fujita, Mingqian Guan, Ryosuke Hyodo, Naoya Sueishi, Shota Yasui
“Denoised IPW-Lasso for Heterogeneous Treatment Effect Estimation in Randomized Experiments”

Understanding how treatment effects vary across subgroups with different characteristics is crucial for decision-making. In this study, we propose a novel method to estimate conditional average treatment effects (CATE) in randomized controlled trials. The key idea of our approach lies in modifying the inverse probability weighting (IPW) pseudo-outcome regression by incorporating a denoising component obtained through machine learning. This enables variance reduction and improve the precision of CATE estimates. Furthermore, we employ Lasso regularization to select a sparse subset of covariates most related to

treatment effect heterogeneity. This provides interpretable insights into sources of heterogeneity. Theoretical results demonstrate desirable properties of our method, and simulation studies show that Denoised IPW-Lasso not only significantly improves the performance of non-denoised IPW-Lasso but also outperforms state-of-the-art methods.

#14 Kei Hashizawa (Kobe University)
Co-author: Masahiro Okano
“Do Low Tones delay in Musical Ensemble?: A Brief Overview of Musicians' Awareness and Solutions”

Sounds of a low-pitched instrument tend to be perceived as delayed in ensemble performance. Our study aimed to identify the underlying causes and potential solutions to the perceived delay of low tones as recognized by musicians. The results confirmed that musicians considered the delay was influenced by one or more factors, including physics, perception, movement, and music. However, no single consistent explanation emerged across participants. Furthermore, musicians employed performance strategies specific to ensemble playing, adjusting their timing in response to their fellow performers and the overall musical flow. These findings suggest that performers adopt performance strategies based on their individual experiences and contextual demands.

#15 Ikumi Aoi (Kobe University)
Co-author: Tetsushi Nonaka
“Infants’ manual contact with environmental objects and contingent experiences”

Videos recorded in a 0-year-old class at a childcare facility were analyzed to identify instances of infants touching objects in their environment. Through case analyses, this study examined the variations in events that are contingent upon these spontaneous actions. The findings suggest that infants’ interactions with objects not only engage them in direct physical contact but also foster a range of experiences, including social interactions with caregivers.

#16 Ryota P. Kitani (Graduate School of Human Development and Environment, Kobe University)
Co-authors: Tatsuya Saga, Minoru Kasada, Mieko Kiyono, Masayuki Sato, Atushi Ushimaru, Toshifumi Minamoto
“Environmental education using environmental DNA analysis increases high school students' interest in ecosystems”

Biodiversity surveys are a common method of environmental education, but they present challenges such

as difficulty in species identification and discomfort in handling organisms. Environmental DNA (eDNA) analysis, which identify inhabiting species from DNA in the environment, can potentially address these issues. It requires no specialized knowledge and only involves water sampling, making it accessible to amateurs. This study investigated the usefulness of eDNA analysis as an educational tool through a program conducted in three Japanese high schools. The program included ecological explanations, water sampling, and a workshop on eDNA results. Questionnaire results indicated increased student interest in biodiversity and ecosystem services. This study is the first to demonstrate the effectiveness of environmental education using eDNA in schools.

#17 Uran Sumi (Kobe University)
Co-author: Atsushi Ushimaru
"The Adaptive Significance of Color Variation and Pattern in Anurans: Focusing on Predator Avoidance Mechanisms Against Avian and Mammal Predators"

Animals employ various anti-predator strategies, including body coloration. While previous studies focused on Anurans in forests, research on those in open environments like rice paddies is limited. This study examined the defensive function of body coloration in Dryophytes japonicus and Pelophylax nigromaculatus. We assessed whether D. japonicus's color change and P. nigromaculatus's dorsal stripe reduce predation using clay model experiments. D. japonicus matched leaves or soil colors, with brown individuals less detected by birds and green by mammals, but color change did not significantly reduce attacks. Likewise, the dorsal stripe in P. nigromaculatus had no significant effect on predation. These findings suggest color change in D. japonicus mainly serves physiological functions like thermoregulation and water retention rather than predator avoidance.

#18 Hyoma Akamatsu (Graduate School of Human Development and Environment, Kobe University)
Co-authors: H. Akamatsu S. Kubo S. Kikuchi Y. Tsuchida K. Tsunashima H. Hotta A. Yokobiki Y. Funasako Y. Okuno A. Hamada H. Yamada and A. Tani
"Synthesis and Physicochemical Properties of Room-Temperature Ionic Liquids with Asymmetrical Phosphonium Cation and Carboxylate Anions"

Ionic liquids, i.e. organic molten salts composed of cations and anions with melting points below 100° C, have unique properties such as high ionic conductivity, high thermal stability, low vapor pressure, low flammability, and so on. Among the numerous ionic liquids, considerable ionic liquids based on carboxylate anions have been reported. On the other hand, several published papers reported ionic liquids based on quaternary phosphonium cations, demonstrating relatively high transport properties and thermal stability. Our research group has preliminarily attempted to design and synthesize several carboxylate-based ionic liquids based on quaternary phosphonium cations. This presentation discusses the dependence

of carboxylate anions on physicochemical properties of room-temperature ionic liquids based on tributyloctylphophonium (P4448) cation in combination with various carboxylate anions.