World Premier International Research Center Initiative (WPI)
FY 2021 WPI Project Progress Report **(The center selected in and before FY2020)**

Host Institution	The University of Tokyo	Host Institution Head	Teruo Fujii
Research Center	International Research Center for Neurointelligence (IRCN)		
Center Director	Takao Hensch	Administrative Director	Nobukazu Toge

Common instructions:
* Unless otherwise specified, prepare this report based on the current (31 March 2022) situation of your WPI center.
* So as to execute this fiscal year's follow-up review on the "last" center project plan, prepare this report based on it.
* Use yen (¥) when writing monetary amounts in the report. If an exchange rate is used to calculate the yen amount, give the rate.
- Prepare this report within 10-20 pages (excluding the appendices, and including Summary of State of WPI Center Project Progress (within 2 pages)).

Summary of State of WPI Center Project Progress (write within **2 pages**)

Center Vision: The grandest challenge of science is to solve human intelligence for a healthy society. As technology races forward, how can human and artificial intelligence achieve a sustainable balance with each other and the planet? The solution seems embedded in the child's brain, the cradle of intelligence, and the reservoir of lifespan resilience and happiness. If we can understand the fundamental principles of brain development, that knowledge will be useful to navigate toward a more human wellness-centered artificial intelligence while, in their absence, the risk of mental imbalance and illness looms. While the race of current AI is exclusively the domain of fast-moving industrial labs, neuroscience remains in its infancy and is far from solving the brain's mysteries. The center has pursued a visionary course that requires threading a fine needle between the random-walk pace of basic neuroscience with the ultra-focused race of AI. The "eye of the needle" turns out to be computational neuroscience as the bridge between brain and machine. The experimental labs at IRCN are building computational models based on physiological data, while the computational labs are developing theories derived from dynamical systems and reservoir computing. After five years of development, IRCN is uniquely positioned to blend these top-down and bottom-up models across a range of themes in Team Science and to create novel human, clinical, and AI applications.

High-Level Research: In 2021, IRCN published world-leading research despite delays due to the global COVID-19 pandemic. Prof. Haruo Kasai discovered a new principle in brain circuit function (Ucar et al., Nature) based on an overlooked form of synaptic communication and memory. Another group led by Prof. Shoji Takeuchi built a cell-free detector for volatile organic compounds that can be used for biological odorant sensing or incorporation into intelligent devices (Yamada et al., Science Advances). Likewise, Dr. Takamitsu Watanabe devised a neurofeedback system to decode and control the dynamics of human brain activity (Watanabe, eLife) suggesting that understanding intelligence will require monitoring brain dynamics. In the clinical area, Prof. Kiyoto Kasai assessed the effect of birth order in multi-sibling families on adolescent social intelligence (Okada et al., Scientific Reports) and found prosocial birth order linked to the amygdala. Using a computational robotics approach, Dr. Yukie Nagai developed an active perception/inference method based on an energy minimization principle (Horii and Nagai, Frontiers in Robotics and AI) highlighting the potential of robots with emotional communication. In another computation study, a photonic artificial neural network was designed by Prof. Kazuyuki Aihara and collaborators (Inagaki et al., Nature Communications) with the potential to solve hard combinatorial optimization problems.

Interdisciplinarity: Interdisciplinary fusion research at IRCN seeks to bridge human and artificial intelligence, using principles of brain development and function to co-evolve novel computational models and algorithms. IRCN designed a Team Science "ecosystem" consisting of 12 teams organized into four interlocking human and machine intelligence scientific domains: Core Intelligence (Reinforcement, Prediction, Intrinsic Activity, and Sleep), Social Intelligence (Social Learning, Critical Period Mapping, Critical Period Timing, and Attention), Diverse Intelligence (Autism, Psychosis, Creativity, Multiscale Imaging), and Artificial Intelligence (Brain Dynamics, and Neuromorphic

Hardware). The IRCN Synergy Office curated team composition based on updated goals and the center has developed a strong environment of interdisciplinarity with neural computation as a common language. Team Science highlights include the Reinforcement Team modeling the dopamine D2 receptor signaling pathway for memory and disease (Urakubo et al., PLoS Computational Biology), and the Brain Dynamics Team solving a long-standing computational bottleneck in topology (Hirata et al., Chaos).

Internationalization: IRCN has become an international research center of excellence based on a network of 16 international partner institutions and an active program of on-site global symposia, workshops, an international computational course, and extensive researcher exchanges. The center's hiring exceeds the standard for an international workforce at all career levels including nineteen international IRCN Postdoctoral Fellows out of twenty-two (86%). In 2021, while the pandemic unfortunately limited travel and in-person events, the center promoted an international research environment through online events in English. IRCN held 46 International Science Salon seminars with twenty-four of forty-six speakers (52%) from international locations. IRCN also organized a New Horizons in Computation Workshop, PosterTown digital poster sessions, and co-organized the 6th Japan-US Science Forum and Tokyo Forum, all in English. Once the pandemic subsides, IRCN will resume an active slate of international symposia, workshops, annual retreats, courses, and team science meetings. and expand Team Science with a global brain circulation strategy that will support a dynamic international exchange of researchers, students, and faculty.

Organizational Reform: IRCN's high-level management of scientific activities and personnel hiring continues to be overseen by three 'Offices', each led by a Deputy Director, to intersect the Director's top-down leadership and PIs' bottom-up proposals. The Sustainability Office is led by Prof. Masanobu Kano to catalyze support, infrastructure and personnel, including fundraising, building renovations for an 'under-one-roof' ecosystem, strategic recruitment with an emphasis on diversity, WPI budget, evaluation, and related tasks. The Synergy Office, led by Prof. Kazuo Emoto, promotes research fusion and Team Science, and manages research-related events. The Community Office, led by University Prof. Kazuyuki Aihara, coordinates education and outreach activities, and support for international researchers. In April 2021, a new administrative director (AD), Dr. Nobukazu Toge, and a Special Advisor to the Director (SAD), Dr. Masamitsu Iino, were added to strengthen center management. IRCN also enlisted forty-seven Affiliated Faculty members and seventeen Associate Research Fellows to involve PIs from other UTokyo campuses and other institutes in Japan and worldwide. Finally, the five IRCN Core Facilities (ES-Mouse/Virus Core, Imaging Core, Data Science Core, Human fMRI core, and Science Writing Core) continue to provide professional, inexpensive, and rapid access to state-of-the-art research services and technologies by expert IRCN staff.

Sustainability: IRCN is proactively addressing mid- and long-term sustainability in its research and organizational planning. The center faces three main challenges, building its unique research fusion brand and societal values for global excellence and leadership, integrating successfully into the local university academic and research ecosystem and large data-driven global initiatives that exist or are emerging, and securing long-term financial support from non-government external sources. IRCN is committed to advancing Team Science as its main engine for research progress with the next stage involving a deeper integration of brain development principles with the center's goals of developing neuro-inspired AI/robotics and human/clinical research lines for novel applications to benefit society. For the funding aspect of sustainability, IRCN has initiated discussions with a wide range of candidate sponsors and partners, including the UTokyo Beyond AI Joint Project with Softbank, UTokyo-Daikin partnership, the Graduate School of Medicine, the Technology Licensing Office (TLO), and various domestic and international corporate and NPO organizations. To facilitate long-term sustainability, a joint IRCN-UTokyo executive working group is currently developing a road map for IRCN to integrate into The University of Tokyo's academic and research ecosystem. With the unique goal of neuro-inspired, human wellness-centered AI, IRCN will challenge the frontiers of science and engineering.

* Describe clearly and concisely the progress being made by the WPI center project from the viewpoints below.
- In addressing the below-listed 1-6 viewpoints, place emphasis on the following:
  (1) Whether research is being carried out at a top world-level (including whether research advances are being made by fusing disciplines).
  (2) Whether a proactive effort continues to be made to establish itself as a "truly" world premier international research center.
  (3) Whether a steadfast effort is being made to secure the center's future development over the mid- to long-term.

1. Advancing Research of the Highest Global Level

* Among the research results achieved by the center, concretely describe those that are at the world's highest level. In Appendix 1, list the center's research papers published in 2021.
* Regarding the criteria used when evaluating the world level of center, note any updated results using your previous evaluation criteria and methods or any improvements you have made to those criteria and methods.

IRCN published major new research in 2021 despite significant on-site research and journal editorial delays due to the global COVID-19 pandemic. Here, we concretely describe the research highlights in the three main areas of the center's scientific mission representing novel principles of brain development, novel human and clinical applications, and novel neural computation and artificial intelligence. Please refer to Appendix 1 for a complete list of 2021 IRCN research achievements.

1-1. Novel Principles of Brain Development

A new synaptic wiring principle in brain circuit function

Brain communication occurs at specialized cellular synaptic junctions comprising a presynaptic bouton and postsynaptic spine. The two known modes of synaptic transmission are via chemical and electrical signaling. Here, the laboratory of Haruo Kasai discovered a third major form of synaptic communication based on mechanical signaling. The research team used fluorescence imaging techniques to show that mechanical displacement of presynaptic boutons increased their transmitter release and the assembly of SNARE protein complexes required for membrane fusion for more than twenty minutes in neurons within cultured brain slices. They further showed that these mechanically-driven changes could also occur during the application of low hypertonic solutions and when postsynaptic spines were enlarged by two-photon induced glutamate uncaging, which caused spine growth in the direction of the adjacent bouton. These findings reveal a novel mechanism for synaptic communication that may regulate memory and other cognitive functions in the intact brain.

Ucar H, Watanabe S, Noguchi J, Morimoto Y, Iino Y, Yagishita S, Takahashi N, Kasai H (2021) Mechanical actions of dendritic-spine enlargement on presynaptic exocytosis. Nature 600(7890):686-689. doi: 10.1038/s41586-021-04125-7

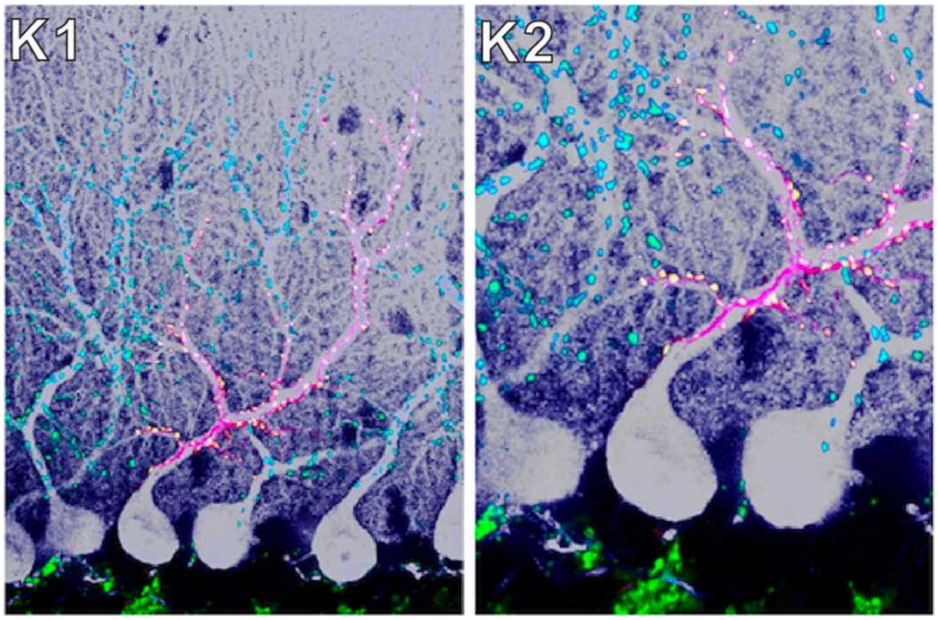
Adult neurogenesis determined by a pluripotent mechanism

The adult brain harbors a pool of quiescent neural stem cells that can provide a source of new neurons that are known to control cognitive behavior and intelligence. The molecular control mechanism that maintains this progenitor pool remained unknown. In the embryonic brain, a protein module called Notch and its effectors Hes1 and Hes5 regulate cell maintenance in a sinusoidal oscillatory expression pattern. In the present study, in contrast, the researchers found that Notch and another effector Hey1 form a non-oscillatory (tonic) high expression module that maintains cell pluripotency. Notch-Hey1 expression is upregulated by cell cycle arrest in slowly dividing neural progenitor cells (NPCs). This "division of labor" among Notch effectors suggests a neurodiversity of stem cell niche control in developmental versus adult neurogenesis. The results indicate the potential of adult NPCs to respond to alternate signals in a novel form of neural intelligence.

Harada Y, Yamada M, Imayoshi I, Kageyama R, Suzuki Y, Kuniya T, Furutachi S, Kawaguchi D, Gotoh Y. (2021) Cell cycle arrest determines adult neural stem cell ontogeny by an embryonic Notch-nonoscillatory Hey1 module. Nat Commun. 12(1):6562. doi: 10.1038/s41467-021-26605-0

Autism mutation disorders developmental synapse pruning

Autism spectrum disorder (ASD) is a common pediatric brain condition incurring a major impact on human intelligence. A molecular genetic feature of ASD is the prevalence of genes involved in synaptic wiring and communication, including the neurexin-neuroligin family of adhesion proteins. Here, the researchers examined the impact of a specific gene and mutation in genetically engineered mouse lines. Neuroligin 3 (NLGN3) is expressed in postsynaptic spines and the mutation R451C is thought to affect synaptic development and function. The team assessed key phenotypes of mutant mice with NLGN3 R451C, and found a marked impairment in normal developmental synaptic pruning in the cerebellar circuit comprising climbing fibers to Purkinje cells. These alterations were accompanied by defects in excitatory to inhibitory balance and calcium signaling. The findings point to a key role for NLGN3 in neural circuit development in the cerebellum and suggest that abnormal synapse pruning caused by the R451C mutation may be involved in the etiology of ASD.



Lai ESK, Nakayama H, Miyazaki T, Nakazawa T, Tabuchi K, Hashimoto K, Watanabe M, Kano M. (2021) An Autism-Associated Neuroligin-3 Mutation Affects Developmental Synapse Elimination in the Cerebellum. Front Neural Circuits. 15:676891. doi: 10.3389/fncir.2021.676891

Long-range connectivity and functional neural circuit architecture

The signaling of visual information in the brain is crucial for behavioral and cognitive intelligence. One of the key cellular elements in visual signaling is callosal projection neurons (CPNs) that comprise a major long-range pyramidal neuronal type in layer 2/3 of the mouse visual cortex. These neurons typically send their axons across brain hemispheres where they interact with local circuitry to coordinate visual response properties. Here, researchers used CPNs to map neuronal connectivity and visual response properties in the mouse brain. Using two-photon calcium imaging and tracing methods they observed long-range interhemispheric connections that showed a higher ipsilateral eye preference. CPNs tended to connect with each other suggesting their coordination of fine-scale target-dependent local subnetworks. These results provide a road map for the discovery of functional properties of visual signaling and the design of novel computational architectures.

Hagihara KM, Ishikawa AW, Yoshimura Y, Tagawa Y, Ohki K. (2021) Long-Range Interhemispheric Projection Neurons Show Biased Response Properties and Fine-Scale Local Subnetworks in Mouse

Visual Cortex. Cereb Cortex, 31(2):1307-1315, doi: 10.1093/cercor/bhaa297

Olfactory receptor arrays designed for intelligent odorant detection

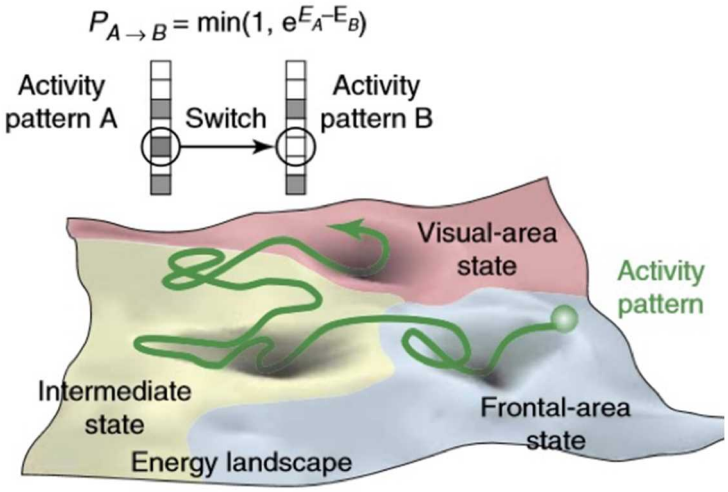
Artificial intelligent systems are not only computational in design but may be engineered as a biohybrid device or component. Here, researchers demonstrate proof-of-principle application of a cell-free detector for volatile organic compounds (VOCs) based on biological olfactory receptors (ORs). The ORs along with co-receptors forming ligand-gated ion channels were embedded in lipid bilayers in arrays and coupled to gas flow elements that included microchannels and hydrophobic microslits for rapid gas introduction and detection into the lipid droplet in a parallel bilayer device. The team could detect the VOC 1-octen-3-ol, a component of human breath, at 0.5 parts per billion (ppb) level. The system could be extended to similar applications for biological odorant sensing and further incorporated into intelligent devices for computational analysis with AI algorithms.

Yamada T, Sugiura H, Mimura H, Kamiya K, Osaki T, Takeuchi S (2021) Highly sensitive VOC detectors using insect olfactory receptors reconstituted into lipid bilayers. Science Advances, doi: 10.1126/sciadv.abd2013

1-2. Novel Human and Clinical Applications

Dynamic causality of prefrontal cortex in human consciousness

The continuous flux of brain activity called neural dynamics is a key to understanding intelligence but the identification of specific activity patterns associated with a property such as conscious awareness is elusive. In prior studies, activations of several prefrontal cortical areas were identified at the moment of switches in consciousness; but whether this activity was causal for visual consciousness remained controversial. To address this conundrum, the researcher devised a brain stimulation system that exposed human subjects to electroencephalography (EEG) driven transcranial magnetic stimulation (TMS) inhibition of their prefrontal cortex during bistable visual illusions. Three prefrontal areas were causally responsible for visual consciousness only when the whole-brain activity pattern was in a specific neural state. These findings suggest that understanding intelligence will require monitoring fluctuations in brain state dynamics. The EEG-triggered TMS-based neural stimulation system could control cognitive flexibility in other behaviors, and future clinical applications might allow the mitigation of cognitive deficits in psychiatric brain disorders.



Watanabe T (2021) Causal roles of prefrontal cortex during spontaneous perceptual switching are determined by brain state dynamics. eLife, doi:10.7554/eLife.69079

Resolving brain temporal and areal differences of an auditory biomarker
The auditory steady-state response, or ASSR, is a prominent physiological signature linked to the gamma range of neural oscillations. Clinically, impairment of the ASSR is linked to a number of neuropsychiatric disorders such as schizophrenia and autism. However, the general physiology of the ASSR is poorly understood. Here, researchers examined patients with refractory epilepsy enabling physiological measurements on their cortical surface by electrocorticography (ECoG) to examine the neural substrates of the ASSR. They found the ASSR is globally distributed but showed regional differences in temporal response and frequency tuning. Interestingly, the frequency tuning was different between the frontotemporal and parietal cortex, two parallel pathways for auditory processing. This study is important as a baseline for the further fine-scale differentiation of the ASSR by brain area or neuropsychiatric disorder in larger human populations.

Tada M, Kirihara K, Ishishita Y, Takasago M, Kunii N, Uka T, Shimada S, Ibayashi K, Kawai K, Saito N, Koshiyama D, Fujioka M, Araki T, Kasai K (2021) Global and Parallel Cortical Processing Based on Auditory Gamma Oscillatory Responses in Humans. Cereb Cortex, 31(10):4518-4532. doi: 10.1093/cercor/bhab103

Developmental sensitive period regulates native speech sound learning
During speech sound learning, infants show inverse trends of improved discrimination of native phonetic sounds and loss of non-native phoneme perception. The developmental mechanism of this switch in speech sound tuning appears to involve time-delimited changes in the statistics of speech sound distributions. The researchers explored whether early phoneme learning was limited to the content domain of phonetic categories via electroencephalography conducted over early age groups of 5-, 9-, and 12-month old English language infants. The subjects were familiarized to unimodal and bimodal distributions of /ra/ versus /la/ phonemes and tested for discrimination. The results showed that exposure to uni- versus bi-modal distributions altered neural responses at 5 and 9 but not 12 months, representing the first demonstration of a decline in sensitivity to the distributional statistics in the environment. The findings suggest a novel principle of statistical inference by the brain in critical period learning of speech as a model for human intelligence.

Reh RK, Hensch TK, Werker JF (2021) Distributional learning of speech sound categories is gated by sensitive periods. Cognition, 213:104653. doi: 10.1016/j.cognition.2021.104653

Prosocial brain development involves birth order and the amygdala
The adolescent stage of brain development is essential for the acquisition of social intelligence such as effective communication, relationship building, and prosocial orientation. Conversely, less common developmental trajectories can lead to antisocial orientations or psychiatric disorders. Here, as part of a large-scale analysis of adolescent brain development called the Tokyo Teen Cohort, researchers examined the effect of birth order in multi-sibling families on teen social development with environmental stress. They found a positive effect of later birth order on prosociality. MRI analysis of the amygdala, a key locus of prosocial development and adaptation to stress, revealed increases in volume and connectivity to the prefrontal cortex. These results provide a road map for future research on the neuronal mechanisms of birth order underlying social intelligence. The findings also indicate that the amygdala may play a central role in adaptive prosocial development.

Okada N, Yamamoto Y, Yahata N, Morita S, Koshiyama D, Morita K, Sawada K, Kanata S, Fujikawa S, Sugimoto N, Toriyama R, Masaoka M, Koike S, Araki T, Kano Y, Endo K, Yamasaki S, Ando S,

Nishida A, Hiraiwa-Hasegawa M, Yokoyama C, Kasai K. (2021) Birth order and prosociality in the early adolescent brain. Sci Rep, 11(1):21806. doi: 10.1038/s41598-021-01146-0

A computational modeling framework for social context in language learning

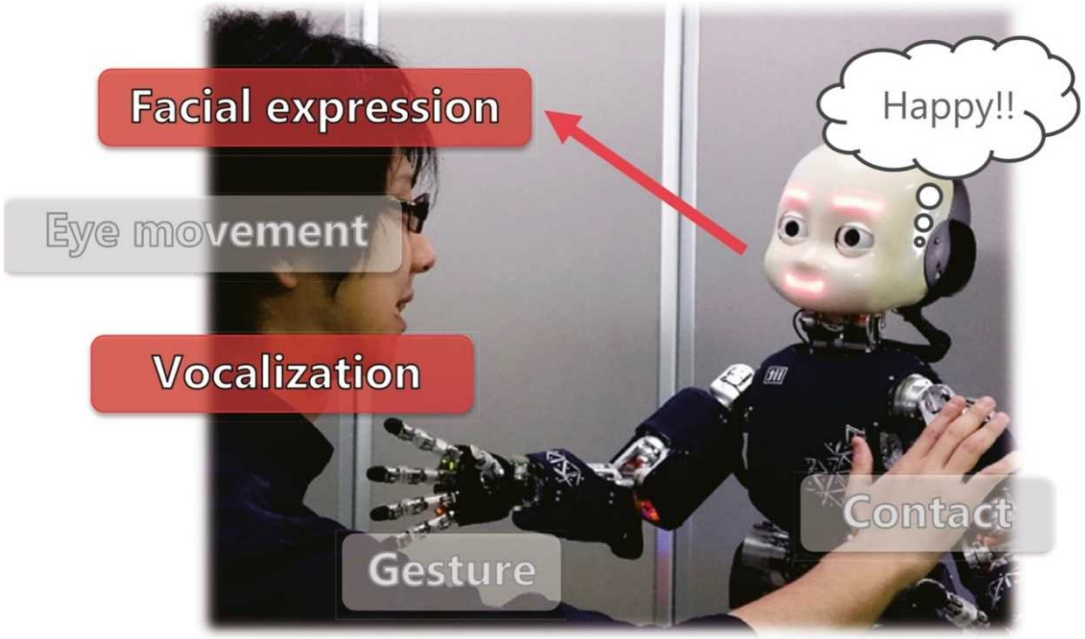
Human social intelligence is based on a diverse range of sensory and environmental signals gathered from the local context of the learning space. Recent technological advances allow the unprecedented collection of multi-modal large datasets to empirically assess such signals, however, better computational models are needed to integrate these various sources into a coherent framework, and to evaluate their respective relevance for human learning. Here, an international research collaboration proposed a framework for computational models of the early language learner called SCALa (Socio-Computational Architecture of Language Acquisition) that specifies the environmental signals and possible human processing mechanisms. SCALa integrates perspectives ranging from linguistics, social cognition, and artificial intelligence to enable precise recommendations required for large-scale empirical research on language acquisition. The model provides an entry point to the computational analysis of human learning and intelligence.

Tsuji S, Cristia A, Dupoux E. (2021) SCALa: A blueprint for computational models of language acquisition in social context. Cognition, 213, 104779 doi: 10.1016/j.cognition.2021.104779

1-3. Novel Artificial Intelligence

Multimodal affective human-robot interactions using energy minimization

Humans have the capability to read and express multiple emotional states and signals during communication. Robots, in contrast, have more limited means of analyzing and acting on both input and output signals from human communicators and the environment. Here, researchers developed an active perception/inference method to select the most effective modalities. The method of selection is based on energy minimization instantiated in a multimodal deep belief network that represents the interactions between emotional state and sensory signals. The approach was effective in contexts associated with affective human-robots interaction and represented an objective improvement over alternate candidate methods. The results demonstrate that tasks involving mutually-correlated multimodal information can be efficiently executed. These findings show potential for the computational design of next-generation robots with emotional I/O capabilities.



Horii T, Nagai Y (2021) Active Inference Through Energy Minimization in Multimodal Affective Human-Robot Interaction. Front Robot AI, 8:684401. doi: 10.3389/frobt.2021.684401

Recurrence plots and contact maps for 3D chromosome reconstruction

The accurate three-dimensional reconstruction of human chromosomes would have a transformative impact on biology and medicine, including a deeper understanding of the genetic and genomic underpinnings of the organization of human intelligence. However, a computational pathway to chromosome reconstruction was unknown. Here, a novel IRCN interdisciplinary collaboration discovered a computational method that may allow the topological analysis of chromosome structure. Using a form of neighbor contact mapping analysis called recurrence plots, prior work had extended the algorithm to chromosome analysis, however, the resolution was insufficient for detailed structural analysis. Here, the researchers devised an inverse operation for a recurrence plot that enabled iterative refinements of a coarse reconstruction. The method was applied to three-dimensional chromosome mapping from single cell Hi-C data. More generally, the novel method will allow the fast reconstruction of neighboring points in a sparse contact map into reliable 3D structures.

Hirata Y, Kitanishi Y, Sugishita H, Gotoh Y (2021) Fast reconstruction of an original continuous series from a recurrence plot. Chaos 12:121101. doi: 10.1063/5.0073899

Chaotic amplitude control in neuromorphic computing systems

In the classic Ising model, neural states representing stable memories may be organized into an energy landscape with local and global minima. However, this energy landscape is "rough" with local minima that impede transitions to lower energy states and overall computational power, as finding lower energy states is equivalent to hard combinatorial optimization problems that even supercomputers cannot easily or rapidly solve. An international research team led by IRCN showed that lower energy states can be reached much faster with non-relaxational dynamics involving the destabilization of nontrivial attractors in a recurrent neural network via a scheme called chaotic amplitude control. The team further developed a neuromorphic computing system using a field programmable array to solve combinatorial optimization problems with improved scaling. Such non-relaxational dynamics may facilitate the development of new Ising machines with greater speed and efficiency in problem solving. In the human brain, chaotic amplitude control could facilitate cognition in combinatorial tasks such as image segmentation or complex decision making.

Leleu T, Khoyratee F, Levi T, Hamerly R, Kohno T, Aihara K (2021) Scaling advantage of chaotic amplitude control for high-performance combinatorial optimization. Commun. Phys. 4, 266, doi: 10.1038/s42005-021-00768-0

Balanced Dopamine Signaling for Healthy Learning and Memory

In the mammalian brain, reward learning and memory depend on dopamine (DA) signaling. One type of signal, defined by a short absence of DA (0.5–2 s) called the "DA dip", triggers long-term memory formation. Here, researchers used a computational model of DA signaling to examine how DA dips are processed through a biochemical signaling network to generate long-term memory. Computer simulations and theoretical analyses showed that the DA dip signal depends on a balance in the levels of two key molecules, D2R and RGS. This balance is achieved during healthy development, whereas an imbalance between D2R and RGS levels is evident in patients with schizophrenia and dystonia, and could manifest in abnormal long-term memory. In the model, the D2R–RGS imbalance impaired DA dip detection, disturbed long-term memory formation, and resulted in symptoms of schizophrenia and dystonia. Thus, the balance between D2R and RGS may

be a key biochemical control point for learning, memory, and intelligence in the human brain.

Urakubo H, Yagishita S, Kasai H, Kubota Y, Ishii S (2021) The critical balance between dopamine D2 receptor and RGS for the sensitive detection of a transient decay in dopamine signal. PLoS Comput Biol, 17(9):e1009364. doi: 10.1371/journal.pcbi.1009364

Diverse and controllable dynamics in photonic spiking neural networks

Photonic artificial neurons are a promising avenue for the implementation of brain-inspired computation for neuromorphic hardware development. The nonlinear properties of such neurons allow, in principle, the incorporation of bio-realistic spiking instantiated into optical oscillators. Here researchers at IRCN in collaboration with NTT designed novel photonic spiking neural networks with paired optical parametric oscillators. They showed that control of the bio-pump amplitude of these photonic neurons can generate two modes of spiking activity. Upon coupling into a network, these neurons can change the pump amplitude depending on the order parameter for synchronization. These results suggest that both collective and synchronous dynamics can be implemented in photonic neurons, which in turn may enable spontaneous shifts in network activity. Future work will explore the implementation of these spiking neurons in solving hard combinatorial optimization problems.

Inagaki T, Inaba K, Leleu T, Honjo T, Ikuta T, Enbutsu K, Umeki T, Kasahara R, Aihara K, Takesue H (2021) Collective and synchronous dynamics of photonic spiking neurons. Nat. Commun 12, 2325, doi: 10.1038/s41467-021-22576-4

2. Generating Fused Disciplines

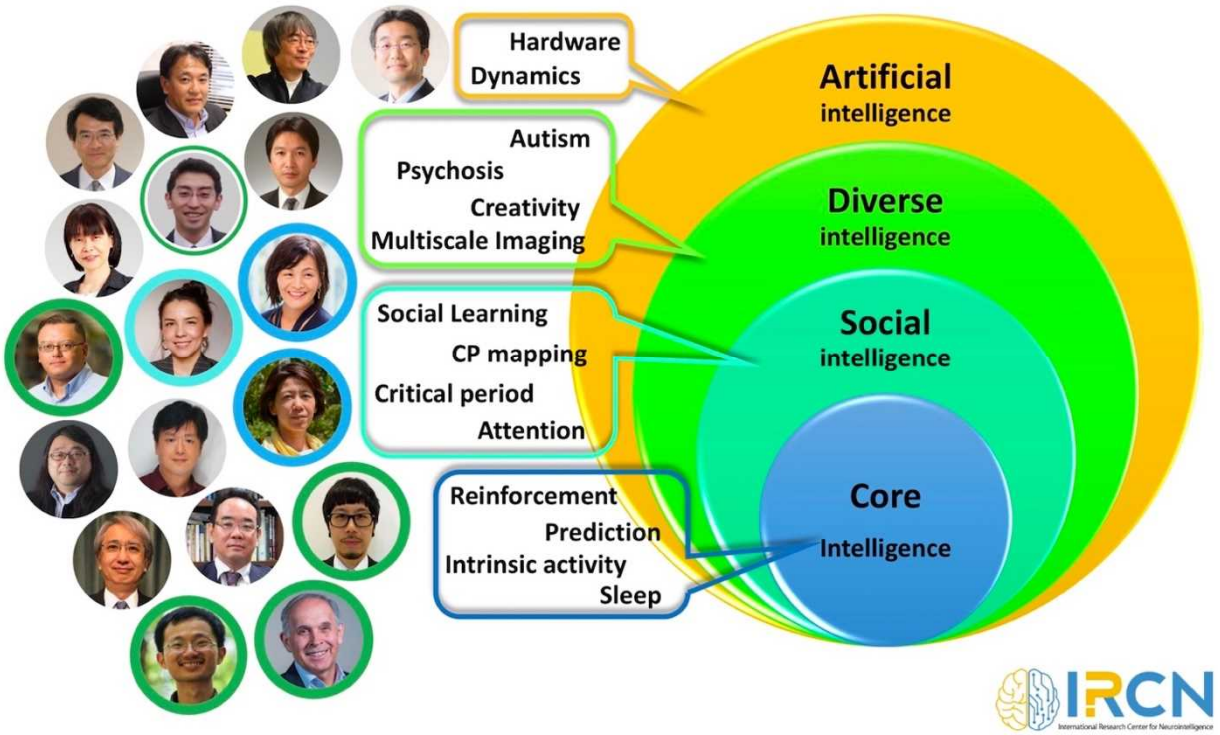
* Describe the content of measures taken by the center to advance research by fusing disciplines. For example, measures that facilitate doing joint research by researchers in differing fields. If any, describe the interdisciplinary research/fused discipline that have resulted from your efforts to generate fused disciplines. You may refer to the research results described concretely in "1. Advancing Research of the Highest Global Level."

Human intelligence and artificial intelligence are individually two of the most challenging areas of science and technology in modern society. Each area contains a multitude of diverse subfields whose interdisciplinary fusion is essential to solve the larger domain. Specifically, human intelligence draws upon neuroscience, psychology, and psychiatry, and many fields of the natural and social sciences, while artificial intelligence is built upon computer science, information and data science, engineering, and technology development. Interdisciplinary fusion at IRCN seeks to bridge human and artificial intelligence, using principles of brain development and function to co-evolve novel computational models and algorithms. This fusion process can take many forms and paths and therefore is far from linear. Moreover, the fusion requires merging vastly different epistemological cultures, which is arguably more difficult than natural partners such as physics or chemistry and mathematics. Thus, the IRCN mission to fuse biological and machine intelligence research is one of the most difficult and ambitious challenges within the WPI Program with outcomes that are incremental across years as empirical neuroscience typically requires timelines of 3-6 years from project start to publication.

Team Science is one of the most notable global trends in interdisciplinary biology-based research organization of the last several years. Adapted from the large-scale physics field, these systems are built on the collaboration between multiple investigators with common research goals but different disciplines and technologies. Leveraging its base of well-established faculty at UTokyo along with newly hired principal investigators in emerging areas of interest to the center's mission, IRCN designed a Team Science "ecosystem" initially consisting of 12 teams drawn from bottom-up PI collaborations centered on IRCN's mission. The initial lineup was organized into four interlocking

human and machine intelligence scientific domains consisting of various multi-investigator teams: Core Intelligence (Reinforcement, Prediction, Intrinsic Activity, and Sleep), Social Intelligence (Social Learning, Critical Period Mapping, Critical Period Timing, and Attention), Diverse Intelligence (Autism, Psychosis, Creativity, Multiscale Imaging), and Artificial Intelligence (Brain Dynamics and Neuromorphic Hardware). Team composition evolves over time based on deliverable productivity.

IRCN, with top-down management provided by the Synergy Office, initially supported the starting lineup of 12 teams in 2020 and in 2021 disbanded teams whose mission was achieved or merged based on convergent goals. Ultimately, only the most productive teams will survive this ongoing top-down selection process. Each team was provided with ample support for postdoctoral researchers, equipment, and other startup needs, and are expected to seek external funding with assistance from the Research Support Team of the Administrative Office. Programmatically, teams held periodic planning meetings to coordinate efforts and conducted intellectual discussions to improve interdisciplinarity, supported by the Program Committee and Salon seminars. Fusion of disciplines into new interface areas between fields has flourished at IRCN and the center is developing a natural culture of interdisciplinarity for interstitial and/or fused field creation. For example, computational modeling has become a common language in the center bridging the empirical fields. Due to the natural flow of research progress, many published results are pending, but the foundation of the center for neuro-inspired computation is well-established, with AI integration in the next stage.



Below, we highlight team science research progress in the four IRCN-designated intelligence areas.

2-1. Research Progress in Core Intelligence

Prediction Team

Predictive coding is a fundamental theory of brain function with significance for neuro-inspired computation and the design of next-generation AI. Dr. Zenas Chao and other PIs in the Prediction Team are seeking to identify the key neural signals underlying the theory, prediction and prediction error signals, respectively, in human and mouse brains. The first phase of this research is to define

the signals in the hierarchical neural network of auditory cortex during behavior. By fusing human, mouse, and computation studies the team has developed a model to characterize prediction coding.

Intrinsic Activity Team
Intrinsic activity is generated by neurons and brain networks in the form of spontaneous activity and noise and plays a key role in brain development, brain state, and circuit function. Prof. Ohki and other members of the Intrinsic Activity Team have characterized neural activity using two-photon imaging in visual cortex. In Hagihara et al. (2021) they recorded the activity of callosal projection neurons (CPNs) in visual cortex and their interhemispheric targets to map long range projections. The results indicate that neural activity in CPNs may coordinate information in local cortical subnetworks.

2-2. Research Progress in Social Intelligence

Critical Period Mapping Team
Critical periods coordinate brain development including social cognitive capabilities. However, the mechanisms are poorly understood for complex skills such as language acquisition. The bird song system has shown that neuromodulation plays a role in learning. Prof. Yazaki-Sugiyama and the Critical Period Mapping Team have identified a neuromodulatory circuit that helps to process social information in critical periods, a new principle in development. Moreover, a fusion collaboration with Prof. Okada using a novel microscope technology is mapping song learning circuits at 3D resolution.

Critical Period Timing Team
Developmental disorders and pediatric treatments are regulated by critical period timing. The Critical Period Timing Team, led by Prof. Hensch and conducted at the IRCN Satellite at Boston Children's Hospital with collaborators at Boston University, has generated computational models of the very first thalamocortical signatures of plasticity. Principles of dynamic E:I balance are being applied as biomarkers to clinical cohorts at-risk for autism or developmental acceleration by neonatal anesthesia (final revision). The research team merges biologists, clinicians, and computer scientists.

Social Learning Team
Infant learning of social intelligence typically involves dyadic interactions between a tutor and baby in a local environmental context. The complex sensory signals in this process are a challenge to identify and map. Drs. Tsuji and Nagai are fusing human developmental studies with computation, including in Tsuji et al. (2021). Currently, they are applying computational analyses to naturalistic mother-infant communication samples to uncover bottom-up and top-down principles of human language learning. In addition, Dr. Nagai brings a developmental robotics perspective to the team and is investigating human-robot developmental interactions in normal and ASD paradigms.

2-3. Research Progress in Diverse Intelligence

Psychosis Team
The laboratory of Prof. Kiyoto Kasai is helping to lead a national clinical project to understand teenage brain development and psychosis, as a part of the spectrum of diverse brain intelligence. A different clinical project led by University Prof. Aihara seeks computational methodologies for early disease prediction. The two groups have joined forces to create a novel fusion area of clinical and computer science based on the common goal of prediction modeling of psychosis disorders such as schizophrenia. The team is co-developing dynamical systems algorithms based on time-series analyses of network biomarkers, and similar work is conducted in Prof. Aihara's Moonshot Project.

Autism Team
Shank3 is a synaptic adhesion molecule whose gene is a causative mutation in autism spectrum disorder. Using a novel fast ultrasound brain imaging technology, the labs of Prof. Hensch (Boston Satellite) and Prof. Gotoh have been analyzing mutant mice for Shank3 or other genes involved in brain development. In a fusion collaboration with Dr. Watanabe and his human/clinical computation group, the data are being analyzed by energy landscape models as featured in Watanabe (2021). The results demonstrate that Shank3 brain state intermediate dynamics are more rigid than normal.

2-4. Research Progress in Artificial Intelligence

Reinforcement Team
Reinforcement learning (RL) based on dopamine signaling is widely considered the basis of reward and aversive signaling in mammalian brain, and a promising avenue to novel brain-inspired AI. The lab of Prof. Haruo Kasai in collaboration with Affiliated Faculty Shin Ishii and Sho Yagishita has made key advances in understanding the principles of reward learning as in Iino et al. (2020) Nature. Now they are developing computational models such as in Urakubo et al. (2021) that step toward AI frameworks, while Dr. Mingbo Cai is examining the developmental trajectory of RL in human and its relationship to mental disorders with behavioral experiments and computational modeling.

Brain Dynamics Team
Current conventional AI relies on deep learning with massive scale computational resources. Future AI will include energy-efficient and neuro-inspired solutions. One promising area is the application of dynamical systems approaches drawn from mathematics inspired by biology, including complex time series analyses. IRCN created a new fusion area applying recurrence plots to Hi-C chromatin data to generate 3D chromosomal maps as shown in Hirata et al. (2021) involving Prof. Gotoh and former Affiliated Faculty Prof. Hirata. The novel method may be broadly applicable in science and AI.

3. Realizing an International Research Environment

* Describe what's been accomplished in the efforts to raise the center's recognition as a genuine globally visible research institute, along with innovative efforts proactively being taken in accordance with the development stage of the center, including the following points, for example:
- Efforts being developed based on the analysis of number and state of world-leading, frontline researchers (in Appendix 2); exchanges with overseas entities (in Appendix 4); number and state of visiting researchers (in Appendix 5)
- Proactive efforts to raise the level of the center's international recognition
- Efforts to make the center into one that attracts excellent young researchers from around the world (such as efforts fostering young researchers and contributing to advancing their career paths)

In four years, IRCN has become an international research center of excellence. The global foundation was built on the construction of a formal research network of 16 international partner institutions that continued through 2021. Prior to the COVID-19 pandemic, these interactions enabled IRCN to organize several on-site global symposia and workshops each year, an international computation course, and extensive reciprocal researcher exchanges with partners and other visitors. Hiring of faculty investigators and postdoctoral researchers from abroad was also completed prior to 2020. Unfortunately, in 2021, the global coronavirus pandemic prevented all international travel and severely curtailed on-site activity, but here we describe the efforts and accomplishments conducted under these restrictive conditions.

The 2021 international composition of IRCN Principal Investigators (PI) was four out of eighteen (21%), with Takao Hensch (USA), Arthur Konnerth (DEU), Zenas Chao (TWN), and Mingbo Cai (CHN). Twelve out of forty-seven (25%) Affiliated Faculty (AF) were foreign. Associate Research Fellows (ARF) consisted of five international members out of seventeen (29%). IRCN employed three

Research Fellows out of thirteen (23%). Finally, nineteen Postdoctoral Fellows out of twenty-two (86%) were from abroad. An analysis of IRCN international faculty and researcher composition suggests that the center meets the standard for internationalization with anticipation of further post-pandemic gains.

In 2021, with the pandemic limiting travel and in-person events, the center made efforts to build and maintain an international research environment through online events in English including distinguished international speakers and participants. In calendar 2021, IRCN held 46 International Science Salons nearly weekly. These seminars with discussion were popular, typically drawing attendees in the 35-55 range. Twenty-four of the forty-six speakers (52%) were international or speaking from abroad. IRCN also organized a New Horizons in Computation Workshop, two PosterTown digital poster sessions, and co-organized the 6th Japan-US Science Forum and Tokyo Forum, respectively.

Once the pandemic phase of COVID-19 subsides and travel and society reopens, IRCN will resume an active slate of international symposia, workshops, annual retreats, and Team Science research meetings. The center plans to globalize Team Science with the recruitment of further international members and collaborators to the teams. In particular, Team Science is moving to the next phase of AI pilot studies, in an incubator program. The next computation course is also under consideration. These programs will be fueled by a global brain circulation strategy that will require WPI and UTokyo support for exchange of researchers, students/interns, and faculty-in-residence via Tokyo College.

4. Making Organizational Reforms

* Describe the system reforms made to the center's research operation and administrative organization, along with their background and results.
* If innovated system reforms generated by the center have had a ripple effect on other departments of the host institutions or on other research institutions, clearly describe in what ways.
* Describe the center's operation and the host institution's commitment to the system reforms.

IRCN's high-level management of scientific activities and personnel hiring continues to be overseen by a structure consisting of three complementary 'Offices': Sustainability Office, Synergy Office and Community Office. Each Office is led by a Deputy Director and designed to intersect the Director's

top-down leadership, PIs' bottom-up proposals, and support from the administration and UTokyo.

- Sustainability Office, led by Deputy Director Masanobu Kano, catalyzes support, infrastructure and personnel, including fundraising, building renovations for a 'under-one-roof' ecosystem, strategic recruitment with an emphasis on diversity, WPI budget, evaluation and related tasks.
- Synergy Office, led by Deputy Director Kazuo Emoto, promotes research fusion and Team Science. It manages workshops, seminars, and salons proposed by the IRCN Program Committee to foster Team Science, and recommends the 'IRCN Director's Collaboration Awards'.
- Community Office, led by Deputy Director Kazuyuki Aihara, coordinates education and outreach activities. It offers academic courses for trainees, outreach events and workshops, and various learning opportunities within IRCN, and ensures logistical support for international researchers.

In April 2021, a new Administrative Director (AD), Dr. Nobukazu Toge, and a new Special Advisor to the Director (SAD), Dr. Masamitsu Iino were enlisted in center management. Dr. Toge brings a wide range of management and executive experience attained as an Executive Director at KEK, the Japan High Energy Research Organization (2012-2015) on top-level management issues at a major research center. Likewise, Dr. Iino has extensive expertise from one of IRCN 's key infrastructure hosts, the UTokyo Graduate School of Medicine, having served as it's Vice Dean in the past. The AD cooperates with the Director and provide administrative services necessary for the execution of IRCN activities, while the SAD assists the Director in coordinating the work pursued by the three Offices and issues that require coordination with UTokyo and the various Schools that intersect with IRCN.

In addition to the global partner network explained in Internationalization, IRCN has also formed an extensive domestic research collaboration network, involving researchers in IRCN activities from outside the main laboratories located in the Faculty of Medicine Building No.1 and the adjacent Experimental Research Building. In 2021, IRCN enlisted 47 Affiliated Faculty members and 17 Associate Research Fellows to effectively involve both senior and early career researchers from other UTokyo campuses and across Japan in IRCN activities. During the current COVID-19 pandemic, IRCN used virtual events and communications to stimulate active collaborative relationships with these external domestic members, including Salon seminars and collaborative funding mechanisms.

The five IRCN Core Facilities (ES-Mouse/Virus Core, Imaging Core, Data Science Core, Human fMRI core, and Science Writing Core) continued to provide professional, inexpensive and rapid access to research services and technologies by expert IRCN staff. In 2021, a new animal fMRI facility was introduced into the Human fMRI core, to allow projects involving the comparison of human and animal brain mapping data. Also in 2021, steps were taken to assure the future of the Core Facilities via a planned expansion of their services to UTokyo researchers under the direction of newly appointed IRCN Core Director Prof. Haruo Kasai whose term will begin in April 2022. Efforts for Team Science and internationalization are also expected to benefit from further Core Facility integration.

IRCN continued to support graduate student teaching and education. Half of IRCN's PIs (9 out of 18) are based in regular faculties of UTokyo and carry the standard duties of supervising graduate students. In parallel, IRCN continued its membership in the MEXT WISE Graduate Program 'Forefront of Physics and Mathematics Program to Drive Transformation' based in the Graduate School of Science. Many non-tenured IRCN PIs organized and taught FoPM courses including "21st Century Biology for Mathematicians and Physicists", "Scientific Writing, Publishing, and Communication" and "Introductory Course for Neuroscience and Neural Computation". Through these programs, 14 PIs are eligible to give lecture courses in Graduate Schools of UTokyo. Similarly, 6 out of 17 non-PI academic scientists at or above the Lecturer or Associate Professor rank are actively providing lectures or supervising graduate students. In addition, IRCN hosted eleven student interns from Harvard University and institutions in Europe and Canada up to FY2019. The planned expansion of the international student exchange with Harvard and MIT since FY2020 has been suspended due to the pandemic situation and remains pending an update of their post-pandemic internship policies.

5. Efforts to Secure the Center's Future Development over the Mid- to Long-term

* Address the following items, which are essential to mid- to long-term center development:
- Future prospects with regard to the research plan, research organization and PI composition; prospects for fostering and securing of next-generation researchers

- Prospects for securing resources such as permanent positions and revenues; plan and/or implementation for defining the center's role and/or positioning the center within the host institution's institutional structure
- Measures to sustain the center as a world premier international research center after program funding ends
- Host institution’s organizational reforms carried out for the center’s autonomous administration simultaneously with the creation of the center.

IRCN is proactively addressing mid- and long-term sustainability into its research and organizational planning. Starting from a broad perspective, the center faces three main challenges, building its unique research fusion brand and societal values for global excellence and leadership, integrating successfully into the local university and large data-driven global scientific academic ecosystems that exist or are emerging, and securing long-term financial support from non-government external sources. These challenges are linked and addressing them will require identification of the center's foundational scientific identity and values from which fruitful discussion with counterparties will flow.

Prospective research planning over the next 5 to 10 years was a main objective of the Director's reorganization of IRCN management. The three-office structure and involvement of all PIs in organizational management and planning enable a division-of-labor for the center's future development. The Synergy Office will guide Team Science projects, suggesting changes, as needed, to team composition and mission. This plan will include more efforts to strengthen AI design and development capacities via recruitment or collaboration with AI researchers, and the further integration of Team Science projects with industrial partners like Daikin and Softbank/Beyond AI.

Long-term organizational planning in conjunction with UTokyo management is currently underway. The university is committed to embed IRCN in long range planning, and an executive working group was formed in 2021 to regularly meet and discuss the road map for IRCN to become an permanent center within the university academic and research ecosystem. Issues already under discussion include securing permanent positions for researchers and staff, a new building space, and inclusion in the internal budget system alongside other schools and institutes. Further items will include the integration of new faculty into UTokyo, graduate student training, and expansion of the Core Facilities.

Regarding mid to long-term financial planning, the Sustainability Office has initiated or is planning discussions with a wide range of candidate sponsors, partners, and stakeholders. Within UTokyo, IRCN will strengthen ongoing ties with existing partners, including the UTokyo AI ecosystem led by the Beyond AI Joint Project with Softbank, UTokyo-Daikin partnership, the Graduate School of Medicine, and the Technology Licensing Office (TLO) to design a startup engine based on anticipated IRCN intellectual properties and ventures. Regarding prospects with partners outside of UTokyo, IRCN is building long-term relationships with several promising corporate and NPO sponsors.

An essential component of sustainability planning is how to instantiate graduate student education of the center's unique constellation of values, research foci, interdisciplinary fusion ethos, and translational development for society. As a start, IRCN has successfully involved its non-school affiliated faculty in graduate teaching in various schools and programs, although, it is understood that this is a temporary measure. In fact, WPI guidelines exclude graduate education from its centers' missions, although it is acknowledged that an IRCN graduate program with its own students is preferable to placing it's teaching faculty in other schools. IRCN is open to working on graduate education with international and industrial appeal if WPI and UTokyo are willing to provide support.

6. Others

* Describe what was accomplished in the center’s outreach activities last year and how the activities have contributed to enhancing the center’s “globally visibility.” In Appendix 6, describe concretely the contents of these outreach activities. In Appendix 7, describe media reports or coverage, if any, of the activities.
* In addition to the above 1-5 viewpoints, if there is anything else that deserves mention regarding the center project’s progress, note it.

IRCN has held a major long-term public exhibition on neurointelligence at the Miraikan Museum through 2021, in cooperation with Nomura, an architectural space designer and constructor. The successful exhibition saw over 150,000 visitors in total, helping the general public raise their recognition of IRCN, neuroscience and AI. Exhibit visitors were also invited to participate in on-site synesthesia and children's language learning experiments on a voluntary basis, which helped IRCN to significantly build its cohort study population. The exhibit will move to other venues in 2022. In addition, IRCN continued holding events to provide lectures and lab tours for students from Super Science High Schools and other high schools, although in 2021 due to the COVID-19 pandemic they were held in a remote format. Some of these events were co-hosted with local civic governments.

7. Center’s Response to Results of Last Year’s Follow-up

* Transcribe the item from the “Actions required and recommendations” section in the site visit report and the Follow-up report, then note how the center has responded to them.
* If you have already provided this information, indicate where in the report.

Actions Required and Recommendations

IRCN should present concrete plans toward achieving its goals over the next 5 years. Especially, the center should articulate a clear vision as to how it will innovate next-generation AI based on principles of brain development. IRCN should strive to clarify how it will reveal the origin of HI. The Director will need to exert greater leadership over IRCN through his physical presence.

A system for training the next generation of researchers, especially through IRCN’s own graduate program, should be established.

The prospects for IRCN’s future after 2026 are very uncertain. IRCN must continue its efforts to establish a long-term commitment of support for IRCN and to secure permanent faculty positions for its senior researchers.

The University of Tokyo should clarify the content of the support it plans to provide IRCN, particularly the number of tenured PI positions to be secured for the center. Plans for the new IRCN building and long-term funding should be implemented.

7-1. Advancing the Establishment of the Center

Novel AI based on Principles of Brain Development

An essential aspect of the neural networks in the brain is that they are shaped by both genes and environment in a dynamic manner with critical timing windows. Current AI is based on a static multi-layered deep machine learning architecture but this standard is expected to be complemented or even surpassed by more powerful or flexible algorithms in the near future and under development at IRCN computational labs that draw upon novel top-down computational formats such as dynamical systems, reservoir computing, next-generation Ising machines, reward/punishment reinforcement learning, predictive coding, and various generative models. In parallel, IRCN experimental labs will build computational models incorporating bottom-up developmental and physiological neuro-inspired concepts including sequential critical period plasticity, neuronal dynamics, synapse proliferation and pruning, excitatory-inhibitory (E:I) neural circuit balance, neuromodulation, dopamine-dependent reinforcement learning, predictive coding, top-down feedback connections, intrinsic activity, attention and collective behavior. IRCN is now in a unique position to merge these top-down and bottom-up models to create novel neuro-inspired AI architectures. Such fusion within Team Science reflects areas of strength among the faculty and partner network. The goal is to build next-generation AI that mimics HI more accurately while conferring resilience to mental illness and overall well-being to the child's brain. By doing so, IRCN seeks to leverage the homeodynamic nature of HI with the explore (plasticity)/exploit (stability) tradeoff and emotion in the developing brain for a more flexible and generalizable neuromorphic AI.

Establishment of Center Goals for the Next 5 Years

IRCN planning over the next 5 years is described in Sections 1-4 above. In summary, IRCN is committed to advancing Team Science as its main engine for research progress, collaboration, interdisciplinary fusion, external partnerships, and concrete benefits to the scientific community and society. Team Science will operate in coordination with individual lab goals, projects and achievements, with the two research streams expected to bidirectionally converge around the most successful findings and avenues of labs or teams. The next stage of team science to be implemented in the next two years is deeper integration with AI-oriented algorithms and clinical projects for the center's goal of applying principles of brain development to novel human/clinical and AI products.

The most promising results generated by Team Science and individual labs will accrue further resources from the center related to internationalization, external funding grant application support, sustainability partnerships, and public domestic and international outreach. IRCN's global partner network will be an essential bridge between internal team science fusion and additional projects that require personnel or methods that exceed IRCN's capacity. Within 5 years, IRCN Team Science is expected to expand to international and industrial collaborations. Like the Teams, IRCN Core Facilities will undergo annual update to facilitate the center's most promising strategic research.

The initial group of published team science results expected in the next few years will help IRCN management to develop more concrete timelines for progress toward center sustainability. Considering the uncertain timing of published research results due to the COVID-19 pandemic, IRCN will carefully assess Team Science progress over the next year and adjust project trajectories. Likewise, current negotiations with prospective external sponsors are expected to resolve by 2023. At that time, an IRCN long-term road map and timeline will be provided to the Working Group.

To achieve these ambitious goals, the Director will lead IRCN through his physical presence in the Faculty of Medicine Building #1 on the Hongo Campus once the pandemic allows safe travel and living in Japan. While the global pandemic in 2021 has established remote work as an efficient new normal mode of work, and many virtual technologies and mechanisms will allow efficient communication and

community-building online, IRCN recognizes the critical value of direct human interactions in the scientific and physical center mission, as research on the development of human social intelligence has shown. Therefore, while also leading the Boston Satellite, the Director will alternate stays in Japan once restrictions are fully lifted.

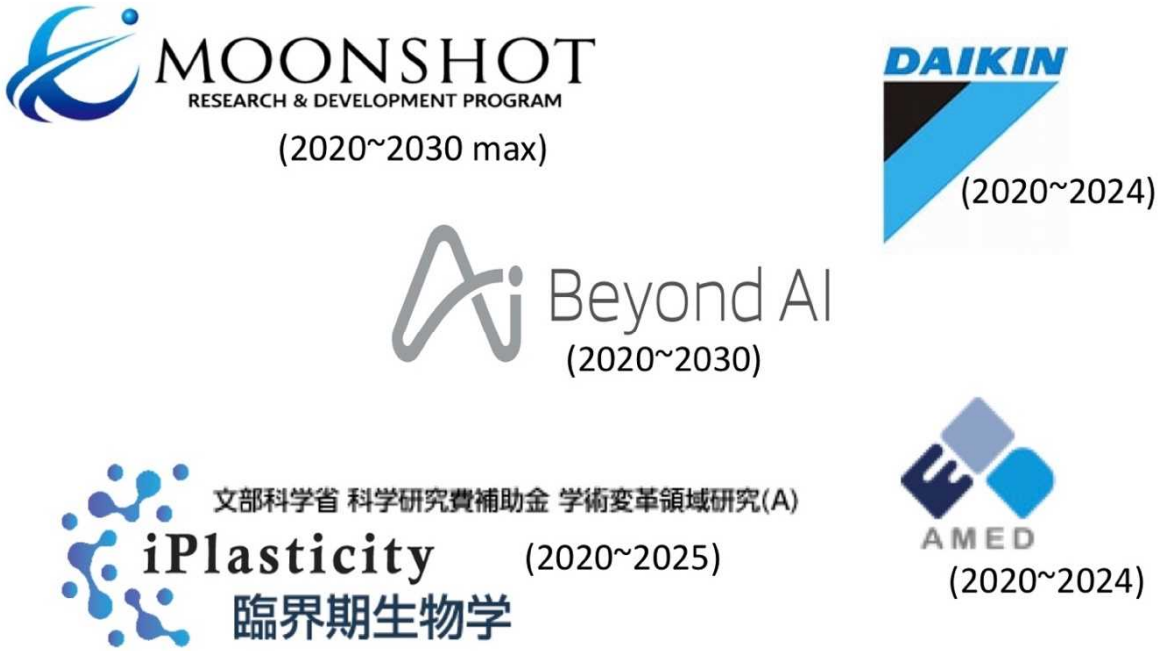
7-2. Host Institution's Concrete Action Plan

A New IRCN Building and Faculty Commitments

In 2021, UTokyo committed to working toward the goal of permanent installation of IRCN in the university's academic and research ecosystem. A statement in "UTokyo Compass," the manifesto document of university executive management indicates that UTokyo will "…facilitate the activities of research hubs such as IRCN" … " [and they] will be transformed into permanent institutions," including plans for a new building on the current site of the Faculty of Medicine Building #1. Permanent membership of IRCN in the university is also articulated in UTokyo's 4th Mid-Term Target Plan to be submitted to the Ministry of Education in 2022. In parallel, UTokyo has decided to support the salaries of two current PIs with the President's budget in 2022 and onward.

Working Group and Progress on Long-term Funding

In addition, the UTokyo has also set up an Executive Working Group, chaired by former Executive Vice President and Distinguished Prof. Kohei Miyazono, to develop long-range plans for integrating IRCN as part of UTokyo's ecosystem. IRCN has already successfully acquired large-scale government funding, leading Gakujyutu Henkaku A ("iPlasticity") and Moonshot ("disease prediction") projects under DDs Kano and Aihara, respectively. The "Sustainability Office" will continue to seek domestic and foreign funding, as well as Social Collaboration Partnerships with companies (e.g. Daikin, Softbank, Toyota Central R&D Labs, NTTRI) and venture capital entrepreneurs. Philanthropic funds will be sought to sustain further trainee globalization activities. These efforts led by the Executive Working Group will integrate with the development and execution of UTokyo's long-term strategy.



IRCN Graduate Program in Collaboration with UTokyo

An important component of center sustainability planning is how to instantiate graduate student education of the center's unique constellation of values, research foci,

interdisciplinary fusion ethos, and translational development for society. So far, IRCN has successfully involved its non-school-affiliated faculty in graduate teaching in various schools and programs.

For example, IRCN continued its membership in the MEXT WISE Graduate Program ‘Forefront of Physics and Mathematics Program to Drive Transformation’ based in the Graduate School of Science, and non-tenured IRCN PIs organized and taught FoPM courses including “21st Century Biology for Mathematicians and Physicists”, “Scientific Writing, Publishing, and Communication” and “Introductory Course for Neuroscience and Neural Computation”. Through these programs, 14 PIs are eligible to give lecture courses in Graduate Schools across UTokyo. Similarly, 6 of 17 non-PI academic scientists at or above the Lecturer or Associate Professor rank are providing lectures or supervising graduate students. Since IRCN is currently set up as a research institute supported by a fixed-term external budget (WPI fund), some of its PIs are not affiliated with any school and are not eligible for supervising thesis work by graduate students in doctoral courses in existing schools nor in a putative IRCN graduate program. This will be one of the subjects to be examined by the executive working group under the President of UTokyo as it develops a road map for IRCN to become a permanent center within the university's academic and research ecosystem.

Appendix 1 FY 2021 List of Center's Research Results and Main Awards

1. Refereed Papers

- List only the Center's papers published in 2021. (Note: The list should be for the calendar year, not the fiscal year.)

(1) Divide the papers into two categories, A and B.

A. WPI papers
List papers whose author(s) can be identified as affiliated with the WPI program (e.g., that state "WPI" and the name of the WPI center (WPI-center name)). (Not including papers in which the names of persons affiliated with the WPI program are contained only in acknowledgements.)

B. WPI-related papers
List papers related to the WPI program but whose authors are not noted in the institutional affiliations as WPI affiliated. (Including papers whose acknowledgements contain the names of researchers affiliated with the WPI program.)

Note: On 14 December 2011, the Basic Research Promotion Division in MEXT's Research Promotion Bureau circulated an instruction requiring paper authors to include the name or abbreviation of their WPI center among their institutional affiliations. From 2012, the authors' affiliations must be clearly noted.

(2) Method of listing paper
- List only refereed papers. Divide them into categories (e.g., original articles, reviews, proceedings).
- For each, write the author name(s); year of publication; journal name, volume, page(s), and article title. Any listing order may be used as long as format is consistent. (The names of the center researchers do not need to be underlined.)
- If a paper has many authors (say, more than 10), all of their names do not need to be listed.
- Assign a serial number to each paper to be used to identify it throughout the report.
- If the papers are written in languages other than English, underline their serial numbers.
- Order of Listing

A. WPI papers
1. Original articles
2. Review articles
3. Proceedings
4. Other English articles

B. WPI-related papers
1. Original articles
2. Review articles
3. Proceedings
4. Other English articles

(3) Submission of electronic data
- In addition to the above, provide a .csv file output from the Web of Science (e.g.) or other database giving the paper's raw data including Document ID. (Note: the Document ID is assigned by paper database.)
- These files do not need to be divided into paper categories.

(4) Use in assessments
- The lists of papers will be used in assessing the state of WPI project's progress.
- They will be used as reference in analyzing the trends and whole states of research in the said WPI center, not to evaluate individual researcher performance.
- The special characteristics of each research domain will be considered when conducting assessments.

(5) Additional documents
- After all documents, including these paper listings, showing the state of research progress have been submitted, additional documents may be requested.

*In the order of; author name(s), article title, journal name, volume, page(s), year of publication, DOI number, PMID etc(if any).

A. WPI papers

(1) Original articles

1. Hsiao YT, Wu CT, Tsai CF, Liu YH, Trinh TT, Lee CY., EEG-Based Classification Between Individuals with Mild Cognitive Impairment and Healthy Controls Using Conformal Kernel-Based Fuzzy Support Vector Machine, International Journal of Fuzzy Systems, 23, 2432-2448, 2021, 10.1007/s40815-021-01186-8
2. Yamashita H, Suzuki H, Aihara K., Accelerating numerical simulation of continuous-time Boolean satisfiability solver using discrete gradient, Commun. Nonlinear Sci. Numer. Simul., 102, 105908, 2021, 10.1016/j.cnsns.2021.105908
3. Koike S, Tanaka SC, Okada T, Aso T, Yamashita A, Yamashita O, Asano M, Maikusa N, Morita K, Okada N, Fukunaga M, Uematsu A, Togo H, Miyazaki A, Murata K, Urushibata Y, Autio J, Ose T, Yoshimoto J, Araki T, Glasser MF, van Essen DC, Maruyama M, Sadato N, Kawato M, Kasai K, Okamoto Y, Hanakawa T, Hayashi T., Brain/MINDS Beyond Human Brain MRI Group: Brain/MINDS Beyond Human Brain MRI Project: A protocol for multi-level harmonization across brain disorders throughout the lifespan., NeuroImage Clin, 30, 102600, 2021, 10.1016/j.nicl.2021.102600
4. Liu R, Zhong J, Hong R, Chen E, Aihara K, Chen P, Chen L., Predicting local COVID-19 outbreaks and infectious disease epidemics based on landscape network entropy, Sci.Bull., 66(22), 2265-2270, 2021, 10.1016/j.scib.2021.03.022
5. Okuno S, Ikeuchi K, Aihara K., Practical data-driven flood forecasting based on dynamical systems theory, Water Resour. Res., 57(3), e2020WR028427, 2021, 10.1029/2020WR028427
6. Sakemi Y, Morino K, Morie T, Aihara K., A supervised learning algorithm for multilayer spiking neural networks based on temporal coding toward energy-efficient VLSI processor design, IEEE Trans.Neural Networks Learn. Syst.,1-15, 2021, 10.1109/TNNLS.2021.3095068 (2021--7)

7. Kim KS, et al., A quantitative model used to compare within-host SARS-CoV-2, MERS-CoV and SARS-CoV dynamics provides insights into the pathogenesis and treatment of SARS-CoV-2, PLOS Biol., 19(3), e3001128, 2021, 10.1371/journal.pbio.3001128

8. ENIGMA Clinical High Risk for Psychosis Working Group, Jalbrzikowski M, Hayes RA, Wood SJ, Nordholm D, Zhou JH, Fusar-Poli P, Uhlhaas PJ, Takahashi T, Sugranyes G, Kwak YB, Mathalon DH, Katagiri N, Hooker CI, Smigielski L, Colibazzi T, Via E, Tang J, Koike S, Rasser PE, Michel C, Lebedeva I, Hegelstad WTV, de la Fuente-Sandoval C, Waltz JA, Mizrahi R, Corcoran CM, Resch F, Tamnes CK, Haas SS, Lemmers-Jansen ILJ, Agartz I, Allen P, Amminger GP, Andreassen OA, Atkinson K, Bachman P, Baeza I, Baldwin H, Bartholomeusz CF, Borgwardt S, Catalano S, Chee MWL, Chen X, Cho KIK, Cooper RE, Cropley VL, Dolz M, Ebdrup BH, Fortea A, Glenthøj LB, Glenthøj BY, de Haan L, Hamilton HK, Harris MA, Haut KM, He Y, Heekeren K, Heinz A, Hubl D, Hwang WJ, Kaess M, Kasai K, Kim M, Kindler J, Klaunig MJ, Koppel A, Kristensen TD, Kwon JS, Lawrie SM, Lee J, León-Ortiz P, Lin A, Loewy RL, Ma X, McGorry P, McGuire P, Mizuno M, Møller P, Moncada-Habib T, Muñoz-Samons D, Nelson B, Nemoto T, Nordentoft M, Omelchenko MA, Oppedal K, Ouyang L, Pantelis C, Pariente JC, Raghava JM, Reyes-Madrigal F, Roach BJ, Røssberg JI, Rössler W, Salisbury DF, Sasabayashi D, Schall U, Schiffman J, Schlagenhauf F, Schmidt A, Sørensen ME, Suzuki M, Theodoridou A, Tomyshev AS, Tor J, Værnes TG, Velakoulis D, Venegoni GD, Vinogradov S, Wenneberg C, Westlye LT, Yamasue H, Yuan L, Yung AR, van Amelsvoort TAMJ, Turner JA, van Erp TGM, Thompson PM, Hernaus D., Association of structural magnetic resonance imaging measures with psychosis onset in individuals at clinical high risk for developing psychosis: An ENIGMA Working Group mega-analysis, JAMA Psychiatry, 78, 753-766, 2021, 10.1001/jamapsychiatry.2021.0638. PMID: 33950164

9. Maikusa N, Zhu Y, Uematsu A, Yamashita A, Saotome K, Okada N, Kasai K, Okanoya K, Yamashita O, Tanaka SC, Koike S., Comparison of traveling-subject and ComBat harmonization methods for assessing structural brain characteristics, Hum. Brain Mapp., 42(16), 5278-5287, 2021, 10.1002/hbm.25615

10. Takahashi J, Miura K, Morita K, Fujimoto M, Miyata S, Okazaki K, Matsumoto J, Hasegawa N, Hirano Y, Yamamori H, Yasuda Y, Makinodan M, Kasai K, Ozaki N, Onitsuka T, Hashimoto R., Effects of age and sex on eye movement characteristics, Neuropsychopharmacol Rep., 41, 152-158, 2021, 10.1002/npr2.12163. PMID: 33615745

11. Yuizumi, N., Harada Y., Kuniya T., Sunabori T., Koike M., Wakabayashi M., Ishihama Y., Suzuki Y., Kawaguchi D.and Gotoh Y., Maintenance of neural stem - progenitor cells by the lysosomal biosynthesis regulators TFEB and TFE3 in the embryonic mouse telencephalon., Stem Cells, 39, 929-944, 2021, 10.1002/stem.3359

12. Morita M, Ando S, Kiyono T, Morishima R, Yagi T, Kanata S, Fujikawa S, Yamasaki S, Nishida A, Kasai K., Bidirectional relationship of problematic Internet use with hyperactivity/inattention and depressive symptoms in adolescents: a population-based cohort study, Eur. Child Adolesc. Psychiatry, Online, 2021, 10.1007/s00787-021-01808-4. Online ahead of print. PMID: 34021782

13. Morimoto C, Nakamura Y, Kuwabara H, Abe O, Kasai K, Yamasue H, Koike S., Unique Morphometric Features of the Cerebellum and Cerebellocerebral Structural Correlation Between Autism Spectrum Disorder and Schizophrenia, Biol. Psychiatry Global Open Science, 1(3), 219-228, 2021, 10.1016/j.bpsgos.2021.05.010

14. Kondo M., and Matsuzaki M, Neuronal representations of reward-predicting cues and outcome history with movement in the frontal cortex., Cell Reports, 34, 108704, 2021, 10.1016/j.celrep.2021.108704

15. Yoshihara C, Tokita K, Maruyama T, …, Touhara K, Miyamichi K, Kuroda KO, Calcitonin receptor signaling in the medial preoptic area enables risk-taking maternal care., Cell Rep, 35, 109204, 2021, 10.1016/j.celrep.2021.109204

16. Reh RK, Hensch TK, Werker JF., Distributional learning of speech sound categories is gated by sensitive periods., Cognition, 213, 104653, 2021, 10.1016/j.cognition.2021.104653. Epub 2021 Mar 19. PMID: 33752869

17. Gasparini L, Langus A, Tsuji S, Boll-Avetisyan N. , Quantifying the role of rhythm in infants' language discrimination abilities: A meta-analysis, Cognition, 213, 104757, 2021, 10.1016/j.cognition.2021.104757

18. Tsuji S, Cristia A, Dupoux E., SCALa: A blueprint for computational models of language acquisition in social context, Cognition, 213, 104779, 2021, 10.1016/j.cognition.2021.104779

19. Mano T., Murata K., Kon K., Shimizu C., Ono H., Shi S., Yamada R.G., Miyamichi K., Susaki E.A., Touhara K., Ueda H.R, CUBIC-Cloud provides an integrative computational framework toward community-driven whole-mouse-brain mapping., Cell Reports Methods, Methods 36, 100038, 2021, 10.1016/j.crmeth.2021.100038

20. Ejima K, et al. , Estimation of the incubation period of COVID-19 using viral load data, Epidemics, 35, 100454, 2021, 10.1016/j.epidem.2021.100454

21. Okano T, Daikoku T, Ugawa Y, Kanai K, Yumoto M., Perceptual Uncertainty Modulates Auditory Statistical Learning: A Magnetoencephalography Study, International Journal of Psychophysiology, 168, 65-71, 2021, 10.1016/j.ijpsycho.2021.08.002

22. Tsuji S, Fiévét A-C, Cristia A., Toddler word learning from contingent screens with and without human presence, Infant Behavior and Development, 63, 101553, 2021, 10.1016/j.infbeh.2021.101553

23. Ohashi H, et al., Potential anti-COVID-19 agents, cepharanthine and nelfinavir, and their usage for combination treatment, iScience, 24(4), 102367, 2021, 10.1016/j.isci.2021.102367

24. Takagi Y, Okada N, Ando S, Yahata N, Morita K, Koshiyama D, Kawakami S, Sawada K, Koike S, Endo K, Yamasaki S, Nishida A, Kasai K, Tanaka SC., Intergenerational transmission of the patterns of functional and structural brain networks, iScience, 24, 102708, 2021, 10.1016/j.isci.2021.102708

25. Matsumoto J, Fukunaga M, Miura K, Nemoto K, Koshiyama D, Okada N, Morita K, Yamamori H, Yasuda Y, Fujimoto M, Hasegawa N, Watanabe Y, Kasai K, Hashimoto R., Relationship between white matter microstructure and work hours, Neurosci. Lett., 740, 135428, 2021, 10.1016/j.neulet.2020.135428. Epub 2020 Oct 18. PMID: 33086092

26. Friston K, Moran R J, Nagai Y, Taniguchi T, Gomi H, Tenenbaum J., World model learning and inference, Neural Networks, 144, 573-590, 2021, 10.1016/j.neunet.2021.09.011

27. Bergoglio E, Suzuki IK, Tsuji M, Togashi K, Takeuchi S, Koizumi H, Emoto K. , Spatial and temporal diversity of DCLK1 isoforms in the developing mouse cortex, Neurosci. Res., 170, 154-165, 2021, 10.1016/j.neures.2020.12.004. Epub 2021 Jan 22.PMID: 33485913

28. Matsuda YT, Miyamoto H, Joho RH, Hensch TK., Kv3.1 channels regulate the rate of critical period plasticity, Neurosci. Res., 167, 3-10, 2021, 10.1016/j.neures.2021.04.003. Epub 2021 Apr 16. PMID:33872635

29. Kurokawa R, Kamiya K, Koike S, Nakaya M, Uematsu A, Tanaka SC, Kamagata K, Okada N, Morita K, Kasai K, Abe O., Cross-scanner reproducibility and harmonization of a diffusion MRI structural brain network: A traveling subject study of multi-b acquisition, Neuroimage, 245, 118675, 2021, 10.1016/j.neuroimage.2021.118675. Epub 2021 Oct 26. PMID: 34710585

30. Koike S, Tanaka SC, Okada T, Aso T, Yamashita A, Yamashita O, Asano M, Maikusa N, Morita K, Okada N, Fukunaga M, Uematsu A, Togo H, Miyazaki A, Murata K, Urushibata Y, Autio J, Ose T, Yoshimoto J, Araki T, Glasser MF, Van Essen DC, Maruyama M, Sadato N, Kawato M, Kasai K, Okamoto Y, Hanakawa T, Hayashi T., Brain/MINDS Beyond Human Brain MRI Group. Brain/MINDS beyond human brain MRI

project: A protocol for multi-level harmonization across brain disorders throughout the lifespan, Neuroimage Clin., 30, 102600, 2021, 10.1016/j.nicl.2021.102600. PMID: 33741307

31. Daikoku T, Fang Q, Hamada T, Handa Y, Nagai Y., Importance of environmental settings for the temporal dynamics of creativity, Thinking Skills and Creativity, 41, 100911, 2021, 10.1016/j.tsc.2021.100911

32. Benner S, Aoki Y, Watanabe T, Endo N, Abe O, Kuroda M, Kuwabara H, Kwakubo Y, Takao H, Kumimatsu A, Kasai K, Bito H, Kakeyama M, Yamasue H., Neurochemical evidence for differential effects of acute and repeated oxytocin administration, Molecular Psychiatry, 26(2), 710-720, 2021, 10.1038/s41380-018-0249-4

33. Bundo M, Ueda J, Nakachi Y, Kasai K, Kato T, Iwamoto K., Decreased DNA methylation at promoters and gene-specific neuronal hypermethylation in the prefrontal cortex of patients with bipolar disorder, Mol. Psychiatry, 26(7), 3407-3418, 2021, 10.1038/s41380-021-01079-0. Online ahead of print. PMID: 33875800

34. Ikegame T, Hidaka Y, Nakachi Y, Murata Y, Watanabe R, Sugawara H, Asai T, Kiyota E, Saito T, Ikeda M, Sasaki T, Hashimoto M, Ishikawa T, Takebayashi M, Iwata N, Kakiuchi C, Kato T, Kasai K, Bundo M, Iwamoto K., Identification and functional characterization of the extremely long allele of the serotonin transporter-linked polymorphic region, Transl. Psychiatry, 11, 119, 2021, 10.1038/s41398-021-01242-9. PMID: 33574244

35. Sasabayashi D, Takayanagi Y, Takahashi T, Nishiyama S, Mizukami Y, Katagiri N, Tsujino N, Nemoto T, Sakuma A, Katsura M, Ohmuro N, Okada N, Tada M, Suga M, Maikusa N, Koike S, Furuichi A, Kido M, Noguchi K, Yamasue H, Matsumoto K, Mizuno M, Kasai K, Suzuki M., Reduced cortical thickness of the paracentral lobule in at-risk mental state individuals with poor 1-year functional outcomes, Transl. Psychiatry, 11, 396, 2021, 10.1038/s41398-021-01516-2. PMID: 34282119

36. Inagaki T, Inaba K, Leleu T, Honjo T, Ikuta T, Enbutsu K, Umeki T, Kasahara R, Aihara K, Takesue H., Collective and synchronous dynamics of photonic spiking neurons, Nat.Commun., 12, 2325, 2021, 10.1038/s41467-021-22576-4

37. Harada, Y., Yamada, M., Imayoshi, I., Kageyama, R., Suzuki, Y., Kuniya, T., Furutachi, S., Kawaguchi, D. and Gotoh, Y., Cell cycle arrest determines adult neural stem cell ontogeny by an embryonic Notch-nonoscillatory Hey1 module, Nat. Comm., 12, 6562, 2021, 10.1038/s41467-021-26605-0

38. Koike S, Fujioka M, Satomura Y, Koshiyama D, Tada M, Sakakibara E, Okada N, Takano Y, Iwashiro N, Natsubori T, Zhu Y, Abe O, Kirihara K, Yamasue H, Kasai K., Surface area in the insula was associated with 28-month functional outcome in first-episode psychosis , NPJ Schizophr., 7(1), 56, 2021, 10.1038/s41537-021-00186-9. PMID: 34845247 PMCID: PMC8630202

39. Ucar, H., Morimoto, Y., Watanabe, S., Noguchi, J., Iino, Y., Yagishita, S., Takahashi, N. & Kasai, H., Mechanical actions of dendritic-spine enlargement on presynaptic exocytosis, Nature, 600, 686-689, 2021, 10.1038/s41586-021-04125-7

40. Tanaka SC, Yamashita A, Yahata N, Itahashi T, Lisi G, Yamada T, Ichikawa N, Takamura M, Yoshihara Y, Kunimatsu A, Okada N, Hashimoto R, Okada G, Sakai Y, Morimoto J, Narumoto J, Shimada Y, Mano H, Yoshida W, Seymour B, Shimizu T, Hosomi K, Saitoh Y, Kasai K, Kato N, Takahashi H, Okamoto Y, Yamashita O, Kawato M, Imamizu H., A multi-site, multi-disorder resting-state magnetic resonance image database, Sci. Data., 8(1), 227, 2021, 10.1038/s41597-021-01004-8. PMID: 34462444 PMCID: PMC8405782

41. Omiya, H., Yamaguchi, S., Watanabe, T., Kuniya, T., Harada, Y., Kawaguchi, D., and Gotoh, Y., BMP signaling suppresses Gemc1 expression and ependymal differentiation of mouse telencephalic progenitors, Sci. Rep., 11, 613, 2021, 10.1038/s41598-020-79610-6

42. Okada N, Yamamoto Y, Yahata N, Morita S, Koshiyama D, Morita K, Sawada K, Kanata S, Fujikawa S, Sugimoto N, Toriyama R, Masaoka M, Koike S, Araki T, Kano Y, Endo K, Yamasaki S, Ando S, Nishida A, Hiraiwa-Hasegawa M, Yokoyama C, Kasai K., Birth order and prosociality in the early adolescent brain, Sci. Rep., 11(1), 21806, 2021, 10.1038/s41598-021-01146-0. PMID: 34750406 PMCID: PMC8575884

43. Inoue D, Okada A, Matsumori T, Aihara K, Yoshida H. , Traffic signal optimization on a square lattice with quantum annealing, Sci. Rep., 11, 3303, 2021, 10.1038/s41598-021-82740-0

44. Leleu T, Khoyratee F, Levi T, Hamerly R, Kohno T, Aihara K. , Scaling advantage of chaotic amplitude control for high-performance combinatorial optimization, Commun Phys., 4, 266, 2021, 10.1038/s42005-021-00768-0

45. Hirata Y, Amigó JM, Horai S, Ogimoto K, Aihara K. , Forecasting wind power ramps with prediction coordinates, Chaos, 31(10), 103105, 2021, 10.1063/5.0061705

46. Hirata, Y., Kitanishi, Y., Sugishita, H. and Gotoh, Y., Fast reconstruction of an original continuous series from a recurrence plot, Chaos, 31, 121101, 2021, 10.1063/5.0073899

47. Yamasaki S, Nishida A, Ando S, Murayama K, Hiraiwa-Hasegawa M, Kasai K, Richards M., Interaction of adolescent aspirations and self-control on wellbeing in old age: Evidence from a six-decade longitudinal UK birth cohort, J. Posit. Psychol., 16, 779-788, 2021, 10.1080/17439760.2020.1818809

48. Hagihara KM, Ishikawa AW, Yoshimura Y, Tagawa Y, Ohki K., Long-Range Interhemispheric Projection Neurons Show Biased Response Properties and Fine-Scale Local Subnetworks in Mouse Visual Cortex, Cereb. Cortex, 31, 1307-1315, 2021, 10.1093/cercor/bhaa297

49. Tada M, Kirihara K, Ishishita Y, Takasago M, Kunii N, Uka T, Shimada S, Ibayashi K, Kawai K, Saito N, Koshiyama D, Fujioka M, Araki T, Kasai K., Global and parallel cortical processing based on auditory gamma oscillatory responses in humans, Cereb. Cortex, 31(10), 4518–4532, 2021, 10.1093/cercor/bhab103. Online ahead of print. PMID: 33907804

50. Nakamura Y, Ando S, Yamasaki S, Okada N, Nishida A, Kasai K, Tanaka S, Nakatani H, Koike S., Dietary restraint related to body weight maintenance and neural processing in value-coding areas in adolescents, J. Nutr., 151(7), 2059-2067, 2021, 10.1093/jn/nxab068. PMID: 33847349

51. Shi J, Aihara K, Chen L. , Dynamics-based data science in biology, Natl. Sci. Rev., 8(5), nwab029, 2021, 10.1093/nsr/nwab029

52. Koike S, Fujioka M, Takano Y, Iwashiro N, Satomura Y, Nagai T, Koshiyama D, Tada M, Natsubori T, Okada N, Abe O, Kirihara K, Yamasue H, Suga M, Kasai K., Neurocognitive Deficits Mediate the Relationship Between Structural Abnormalities and Clinical Outcomes in Individuals With Ultrahigh Risk for Psychosis: A Multimodal Neuroimaging and Longitudinal Neurocognitive Study, Schizophrenia Bulletin Open , 2(1), 2021, 10.1093/schizbullopen/sgab027

53. Ejima K, et al. , Time variation in the probability of failing to detect a case of polymerase chain reaction testing for SARS-CoV-2 as estimated from a viral dynamics model, J.R.Soc.Interface, 8(177), 20200947, 2021, 10.1098/rsif.2020.0947

54. Kurasawa K, Hashimoto K, Li A, Sato K, Inaba K, Takesue H, Aihara K, Hasegawa M., A high-speed channel assignment algorithm for dense IEEE 802.11 systems via coherent Ising machine, IEEE Wireless Commun. Lett. , 10(8), 1682-1686, 2021, 10.1109/LWC.2021.3077311

55. Bugur S, Oztop E, Nagai Y, Ugur E., Effect regulated projection of robot's action space for production and prediction of manipulation

primitives through learning progress and predictability-based exploration, IEEE Transactions on Cognitive and Developmental Systems, 13(2), 286-297, 2021, 10.1109/TCDS.2019.2933900

56. Komaki F, Shrinkage Priors for Nonparametric Bayesian Prediction of Nonhomogeneous Poisson Processes., IEEE Transactions on Information Theory, 67, 5305-5317, 2021, 10.1109/TIT.2021.3084062

57. Shimomura K, Kato A, Morita K, Rigid reduced successor representation as a potential mechanism for addiction., Eur. J. Neurosc, 53, 3768, 2021, 10.1111/ejn.15227

58. Ezaki T, Himeno Y, Watanabe T, Masuda N., Modelling state-transition dynamics in resting-state brain signals by the hidden Markov and Gaussian mixture models, The European Journal of Neuroscience, 54, 5404-5416, 2021, 10.1111/ejn.15386

59. Carbajal M J, Peperkamp S, Tsuji S., A meta-analysis of infants' word-form recognition, Infancy, 26(3), 369-387, 2021, 10.1111/infa.12391

60. Morimoto C, Uematsu A, Nakatani H, Takano Y, Iwashiro N, Abe O, Yamasue H, Kasai K, Koike S., Volumetric differences in gray and white matter of cerebellar Crus I/II across the different clinical stages of schizophrenia, Psychiatry Clin. Neurosci., 75, 256-264, 2021, 10.1111/pcn.13277. Epub 2021 Jul 1. PMID: 34081816

61. Ueda J, Bundo M, Nakachi Y, Kasai K, Kato T, Iwamoto K., Cell type-specific DNA methylation analysis of the prefrontal cortex of patients with schizophrenia, Psychiatry Clin. Neurosci., 75(9), 297-299, 2021, 10.1111/pcn.13282. Online ahead of print. PMID: 34164871

62. Kaji N, Ando S, Nishida A, Yamasaki S, Kuwabara H, Kanehara A, Satomura Y, Jinde S, Kano Y, Hiraiwa-Hasegawa M, Igarashi T, Kasai K., Children with special health care needs and mothers' anxiety/depression: findings from the Tokyo Teen Cohort study, Psychiatry Clin. Neurosci., 75(12), 394-400, 2021, 10.1111/pcn.13301. Online ahead of print. PMID: 34549856

63. Okumura Y, Yamasaki S, Ando S, Usami M, Endo K, Hiraiwa-Hasegawa M, Kasai K, Nishida A., Psychosocial burden of undiagnosed persistent ADHD symptoms in 12-year-old children: a population-based birth cohort study, J. Atten. Disord., 25, 636-645, 2021, 10.1177/1087054719837746. [Epub ahead of print] PMID: 30924712

64. Matsumoto J, Miura K, Fukunaga M, Nemoto K, Koshiyama D, Okada N, Morita K, Yamamori H, Yasuda Y, Fujimoto M, Ito S, Hasegawa N, Watanabe Y, Kasai K, Hashimoto R., Association Study Between White Matter Microstructure and Intelligence Decline in Schizophrenia, Clin. EEG Neurosci., Online, 15500594211063314, 2021, 10.1177/15500594211063314. PMID: 34889128

65. Urakubo, H., Yagishita, S., Kasai, H., Kubota, Y. & Ishii, S., The critical balance between dopamine D2 receptor and RGS for the sensitive detection of a transient decay in dopamine signal, PLoS Computational Biology, 17, e1009364, 2021, 10.1371/journal.pcbi.1009364

66. Tsuyoshi S. Nakamura,Yasuyuki Suda,Kenji Muneshige,Yuji Fujieda,Yuuya Okumura,Ichiro Inoue,Takayuki Tanaka,Tetsuo Takahashi,Hideki Nakanishi,Xiao-Dong Gao,Yasushi Okada,Aaron M. Neiman,Hiroyuki Tachikawa. , Suppression of Vps13 adaptor protein mutants reveals a central role for PI4P in regulating prospore membrane extension, PLoS Genet., 17(8), e1009727, 2021, 10.1371/journal.pgen.1009727

67. Iwanami S, et al. , Detection of significant antiviral drug effects on COVID-19 with reasonable sample sizes in randomized controlled trials: a modeling study, PLOS Med., 18(7), e1003660, 2021, 10.1371/journal.pmed.1003660

68. Kanamaru S, Shimada Y, Fujiwara K, Ikeguchi T., Performance evaluation of chaotic random numbers generated from responses of integer logistic maps, Nonlinear Theory and Its Applications, IEICE, 12(3) , 489-499, 2021, 10.1587/nolta.12.489

69. Kasahara K, Shimada Y, Fujiwara K, Ikeguchi T., Analysis on the mechanism of enhancing insulin secretion by TRPM2 channel in a pancreatic β-cell, Nonlinear Theory and Its Applications, IEICE, 12(3) , 500-511, 2021, 10.1587/nolta.12.500

70. Koyama K, Ando H, Fujiwara K., Multiple transition of synchronization by interaction of external and internal forces in bursting oscillator networks, Nonlinear Theory and Its Applications, IEICE, 12(3) , 545-553, 2021, 10.1587/nolta.12.545

71. Hasegawa M, Ito H, Takesue H, Aihara K (Invited Paper). , Optimization by neural networks in the coherent Ising machine and its application to wireless communication systems, IEICE Trans. Commun., E104-B(3), 210-216, 2021, 10.1587/transcom.2020NVI0002

72. Ide S, Nakanishi M, Yamasaki S, Ikeda K, Ando S, Hiraiwa-Hasegawa M, Kasai K, Nishida A. , Adolescent problem gaming and loot box purchasing in video games: cross-sectional observational study using population-based cohort data, JMIR Serious Games, 9, e23886, 2021, 10.2196/23886 PMID: 33560241 PMCID: PMC7902198 DOI: 10.2196/23886

73. Iino K, Toriumi K, Agarie R, Miyashita M, Suzuki K, Horiuchi Y, Niizato K, Oshima K, Imai A, Nagase Y, Kushima I, Koike S, Ikegame T, Jinde S, Nagata E, Washizuka S, Miyata T, Takizawa S, Hashimoto R, Kasai K, Ozaki N, Itokawa M, Arai M., AKR1A1 Variant Associated With Schizophrenia Causes Exon Skipping, Leading to Loss of Enzymatic Activity, Front. Genet., 12, 762999, 2021, 10.3389/fgene.2021.762999. eCollection 2021. PMID: 34938315 PMCID: PMC8685500

74. Trinh TT, Tsai CF, Hsiao YT, Lee CY, Wu CT, Liu YH., Identifying Individuals With Mild Cognitive Impairment Using Working Memory-Induced Intra-Subject Variability of Resting-State EEGs, Frontiers in Computational Neuroscience, 15, 700467, 2021, 10.3389/fncom.2021.700467

75. Daikoku T, Wiggins G A, Nagai Y., Statistical Properties of Musical Creativity: Roles of Hierarchy and Uncertainty in Statistical Learning, Frontiers in Neuroscience, 15, 640412, 2021, 10.3389/fnins.2021.640412

76. Feng Z, Nagase AM, Morita K, A Reinforcement Learning Approach to Understanding Procrastination: Does Inaccurate Value Approximation Cause Irrational Postponing of a Task?, Front. Neurosci, 15, 660595, 2021, 10.3389/fnins.2021.660595

77. Du J, Nakachi Y, Kiyono T, Fujii S, Kasai K, Bundo M, Iwamoto K., Comprehensive DNA Methylation Analysis of Human Neuroblastoma Cells Treated With Haloperidol and Risperidone, Front. Mol. Neurosci., 14, 792874, 2021, 10.3389/fnmol.2021.792874. eCollection 2021. PMID: 34938161 PMCID: PMC8687450

78. Nakamura Y, Koike S, Association of disinhibited eating and trait of impulsivity with insula and amygdala responses to palatable liquid consumption., Front System Neurosci, 15, 647143, 2021, 10.3389/fnsys.2021.647143

79. Dos Santos Kawata KH, Ueno Y, Hashimoto R, Yoshino S, Ohta K, Nishida A, Ando S, Nakatani H, Kasai K, Koike S., Development of Metacognition in Adolescence: The Congruency-Based Metacognition Scale, Front. Psychol., 11, 565231, 2021, 10.3389/fpsyg.2020.565231.PMID: 33488443

80. Sullivan S, Yamasaki S, Ando S, Endo K, Kasai K, Culpin I, Dardani C, Zammit S, Nishida A., The association between locus of control and psychopathology: A cross-cohort comparison between a UK (Avon Longitudinal Study of Parents and Children) and a Japanese (Tokyo Teen Cohort) cohort, Front. Psychol., 12, 600941, 2021, 10.3389/fpsyg.2021.600941. PMID: 33967883

81. Sakakibara E, Satomura Y, Matsuoka J, Koike S, Okada N, Sakurada H, Yamagishi M, Kawakami N, Kasai K., Abnormality of Resting-State Functional Connectivity in Major Depressive Disorder: A Study With Whole-Head Near-Infrared Spectroscopy, Front. Psychiatry, 12, 664859, 2021, 10.3389/fpsyt.2021.664859. PMID: 33995150

82. Yamashita A, Sakai Y, Yamada T, Yahata N, Kunimatsu A, Okada N, Itahashi T, Hashimoto R, Mizuta H, Ichikawa N, Takamura M, Okada G, Yamagata H, Harada K, Matsuo K, Tanaka SC, Kawato M, Kasai K, Kato N, Takahashi H, Okamoto Y, Yamashita O, Imamizu H., Common brain networks between major depressive-disorder diagnosis and symptoms of depression that are validated for independent cohorts, Front. Psychiatry, 12, 667881, 2021, 10.3389/fpsyt.2021.667881. eCollection 2021. PMID: 34177657

83. Takahashi J, Hirano Y, Miura K, Morita K, Fujimoto M, Yamamori H, Yasuda Y, Kudo N, Shishido E, Okazaki K, Shiino T, Nakao T, Kasai K, Hashimoto R, Onitsuka T., Eye Movement Abnormalities in Major Depressive Disorder, Front. Psychiatry., 12, 673443, 2021, 10.3389/fpsyt.2021.673443. eCollection 2021. PMID: 34447321 PMCID: PMC8382962

84. Yagi T, Ando S, Usami S, Yamasaki S, Morita M, Kiyono T, Hayashi N, Endo K, Iijima Y, Morimoto Y, Kanata S, Fujikawa S, Koike S, Kano Y, Hiraiwa-Hasegawa M, Nishida A, Kasai K., Longitudinal Bidirectional Relationships Between Maternal Depressive/Anxious Symptoms and Children's Tic Frequency in Early Adolescence, Front. Psychiatry, 12, 767571, 2021, 10.3389/fpsyt.2021.767571. eCollection 2021. PMID: 34899427 PMCID: PMC8652242

85. Horii T, Nagai Y., Active Inference Through Energy Minimization in Multimodal Affective Human–Robot Interaction, Frontiers in Robotics and AI, 8, 684401, 2021, 10.3389/frobt.2021.684401

86. Hsiao YT, Tsai CF, Wu CT, Trinh TT, Lee CY, Liu YH., MCI Detection Using Kernel Eigen-Relative-Power Features of EEG Signals, Actuators, 10(7), 152, 2021, 10.3390/act100701521

87. Wu CT, Huang HC, Huang S, Chen IM, Liao SC, Chen CK, Lin C, Lee SH, Chen MH, Tsai CF, Weng CH, Ko LW, Jung TP, Liu YH., Resting-State EEG Signal for Major Depressive Disorder Detection: A Systematic Validation on a Large and Diverse Dataset, Biosensors, 11(12), 499, 2021, 10.3390/bios11120499

88. S Aoyama-Ishiwatari, T Okazaki, S Iemura, T Natsume, Y Okada, Y Gotoh., NUDT21 links mitochondrial IPS-1 to RLR-containing stress granules and activates host antiviral defense, The Journal of Immunology , 206 (1), 154-163, 2021, 10.4049/jimmunol.2000306

89. Watanabe T., Causal roles of prefrontal cortex during spontaneous perceptual switching are determined by brain state dynamics, eLife, 10, e69079, 2021, 10.7554/eLife.69079

90. Jeong YD, et al. , Revisiting the guidelines for ending isolation for COVID-19 patients, eLife, 10, e69340, 2021, 10.7554/eLife.69340

(2) Review articles

91. Nagai Y., Predictive Coding for Cognitive Development, Encyclopedia of Robotics. Ang M H, Khatib O, Siciliano B (Eds.). Springer, 2021, 10.1007/978-3-642-41610-1_202-1

92. Shimizu, G., Yoshida, K., Kasai, H. & Toyoizumi, T., Computational Roles of Intrinsic Synaptic Dynamics, Current Opinions in Neurosci.ence, 70, 34-42, 2021, 10.1016/j.conb.2021.06.002

93. Furusawa K, Emoto K., Spatiotemporal control of developmental neurite pruning: Molecular and cellular insights from Drosophila models, Neurosci. Res., 167, 54-63, 2021, 10.1016/j.neures.2020.11.010. Epub 2020 Dec 10.PMID: 33309868

94. Emoto K, Hensch TK, Yuzaki M., Scrap & build functional circuits: Molecular and cellular basis of neural remodeling, Neurosci. Res., 167, 1-2, 2021, 10.1016/j.neures.2021.04.005. Epub 2021 Apr 18. PMID: 33878393

95. Kasai, H. & Ucar, H., Forceful synapses reveal mechanical interactions in the brain, Nature, Online, 2021, 10.1038/d41586-021-03516-0

96. Matsuzaki M., and Ebina T, Optical deep-cortex exploration in behaving rhesus macaques, Nature Communications, 12, 4656, 2021, 10.1038/s41467-021-24988-8

97. Kasai, H., Ziv, N. E., Okazaki, H., Yagishita, S. & Toyoizumi, T., Spine dynamics in the brain, mental disorders and artificial neural networks, Nature Reviews Neurosci.ence , 22, 407-422, 2021, 10.1038/s41583-021-00467-3

98. Han C, Rundo L, Murao K, Noguchi T, Simahara Y, Ádám M Z, Koshino S, Sala E, Nakayama H, Satoh S, MADGAN: unsupervised Medical Anomaly Detection GAN using multiple adjacent brain MRI slice reconstruction, BMC Bioinformatic, 22, 31, 2021, 10.1186/s12859-020-03936-1

99. Furusawa K, Emoto K., Scrap and build for functional neural circuits: Spatiotemporal regulation of dendrite degeneration and regeneration in development and disease., Front. Cell Neurosci., 14, 613320, 2021, 10.3389/fncel.2020.613320. eCollection 2020.PMID: 33505249

100. Zaadnoordijk L, Buckler H, Cusack R, Tsuji S, Bergmann C., A Global Perspective on Testing Infants Online: Introducing ManyBabies-AtHome, Frontiers in Psychology, 12, 3811, 2021, 10.3389/fpsyg.2021.703234

(3) Proceedings

101. Sviridova N, Artoni P, Fagiolini M, Hensch TK, Aihara K., Dynamical Characteristics of Wild-Type Mouse Spontaneous Pupillary Fluctuations, Annu. Int. Conf. IEEE Eng. Med. Biol. Soc., 2021, 853-856, 2021, 10.1109/EMBC46164.2021.9630747. PMID: 34891424

102. Otsuka T, Kurasawa K, Duan Z, Li A, Sato K, Takesue H, Aihara K, Inaba K, Hasegawa M., Coherent Ising machine based optimal channel allocation and user pairing in NOMA networks, Proc. 2021 ICAIIC, 401-406, 2021, 10.1109/ICAIIC51459.2021.9415221

103. Uenohara S, Aihara K. , CMOS mixed-signal spiking neural network circuit using a time-domain digital-to-analog converter, Proc. 2021 IEEE ISCAS, 1-5, 2021, 10.1109/ISCAS51556.2021.9401230

104. Song, M., Niv, Y., Cai, M.B., Using recurrent neural networks to understand human reward learning, the Annual Meeting of the Cognitive Science Society, Vol.43, No.43, 2021, N/A

105. Yoshida N, Daikoku T, Nagai Y, Kuniyoshi Y., Embodiment Perspective of Reward Definition for Behavioral Homeostasis, in Proc. of the NeurIPS 2021 Workshop on Deep Reinforcement Learning , 2021, N/A

(4) Other English articles

106. Arora, T., Li, L.E., Cai, M.B., Learning to perceive objects by prediction, SVRHM 2021 Workshop of the conference of Neural Information Processing Systems, 2021, N/A

B. WPI-related papers

(1) Original articles

107. Yijian Zhang, Chunman Zuo, Liguo Liu, Yunping Hu, Bo Yang, Shimei Qiu, Yang Li, Dongyan Cao, Zheng Ju, Jing Ge, Qiu Wang, Ting Wang, Lu Bai, Yang Yang, Guoqiang Li, Ziyu Shao, Yuan Gao, Yongsheng Li, Rui Bian, Huijie Miao, Lin Li, Xuechuan Li, Chengkai Jiang, Siyuan Yan, Ziyi Wang, Zeyu Wang, Xuya Cui, Wen Huang, Dongxi Xiang, Congjun Wang, Qiyun Li, Xiangsong Wu, Wei Gong, Yun Liu, Rong Shao, Fatao Liu, Maolan Li, Luonan Chen, Yingbin Liu, Single-cell RNA-sequencing atlas reveals an MDK-dependent immunosuppressive environment in ErbB pathway-mutated gallbladder cancer., Journal of Hepatology, 2021, 0.1016/j.jhep.2021.06.023

108. Jo B, Morimoto Y, Takeuchi S, Skeletal muscle-adipose cocultured tissue fabricated using cell-laden microfibers and a hydrogel sheet, Biotechnology and Bioengineering, 119(2), 636-643, 2021, 10.1002/bit.27989

109. Yabin Chen, Zhaoyuan Fang, Ying Tang, Yujuan Jin, Chenchen Guo, Liang Hu, Yang Xu, Xidong Ma, Jie Gao, Mei Xie, Xuelei Zang, Sanhong Liu, Haiquan Chen, Roman K Thomas, Xinying Xue, Hongbin Ji, Luonan Chen, Integrative analysis of multi-omics data reveals the heterogeneity and signatures of immune therapy for small cell lung cancer., Clinical and Translational Medicine, 2021, 10.1002/ctm2.620

110. Mori K, Shiramatsu TI, Ishizu K, Takahashi H, Simultaneous Mapping of Neural Activities in Auditory and Visual Cortex of Rat., Electronics and Communications in Japan, 104, 3, e12322, 2021, 10.1002/ecj.12322

111. Yagi Y, Takahashi Y, Ogata Y, Yamana H, Kumakura K, Ichihashi K, Kasai K, Kondo S., Oral corticosteroid dosage and clinical presentation of psychiatric conditions after steroid use: A consultation-liaison psychiatry service's experience, Neuropsychopharmacol Rep., 41(4) , 471-475, 2021, 10.1002/npr2.12204. Epub 2021 Aug 31. PMID: 34467675 PMCID: PMC8698699

112. Aoki A, Togoobaatar G, Tseveenjav A, Nyam N, Zuunnast K, Lkhagvasuren G, Shagdar B, Mori R, Kikuchi A, Soya H, Kasai K, Takehara K., Socioeconomic and lifestyle factors associated with mental health problems among Mongolian elementary school children, Social Psychiatry and Psychiatric Epidemiology, 57(4), 791-803, 2021, 10.1007/s00127-021-02178-7. PMID: 34595562 PMCID: PMC8483169

113. Kurata S, Kuroda R, Komaki F, Statistical modeling for temporal dominance of sensations data incorporating individual characteristics of panelists: an application to data of milk chocolate., J Food Sci Technol, 2021, 10.1007/s13197-021-05260-9

114. Johnson RM, Zhang X, Piper SJ, Nettleton TJ, Vandekolk TH, Langmead CJ, Danev R, Sexton PM, Wootten D, ryo-EM structure of the dual incretin receptor agonist, peptide-19, in complex with the glucagon-like peptide-1 receptor., Biophys. Res, Commun. 578, 84, 2021, 10.1016/j.bbrc.2021.09.016

115. Zhang X, Belousoff MJ, Liang YL, Danev R, Sexton PM, Wootten D, Structure and dynamics of semaglutide- and taspoglutide-bound GLP-1R-Gs complexes., Cell Rep, 36, 109374, 2021, 10.1016/j.celrep.2021.109374

116. Kawai M, Imaizumi K, Ishikawa M, Shibata S, Shinozaki M, Shibata T, Hashimoto S, Kitagawa T, Ago K, Kajikawa K, Shibata R, Kamata Y, Ushiba J et al, Long-term selective stimulation of transplanted neural stem/progenitor cells for spinal cord injury improves locomotor function., Cell Rep, 37(8), 110019, 2021, 10.1016/j.celrep.2021.110019

117. Yamane N, Sato Y, Shimura Y, Mazuka R, Developmental differences in the hemodynamic response to changes in lyrics and melodies by 4- and 12-month-old infants., Cognition, 2021, 10.1016/j.cognition.2021.104711

118. Spool J. A., Macedo-Lima M., Scarpa G., Morohashi Y., Yazaki-Sugiyama Y. and Remage-Healey L., Genetically-identified neurons in avian auditory pallium mirror core principles of their mammalian counterparts, Curr. Biol., 31, 2831-2843.e6, 2021, 10.1016/j.cub.2021.04.039

119. Kazuyuki Aihara, Rui Liu, Keiichi Koizumi, Xiaoping Liu, and Luonan Chen, Dynamical Network Biomarkers: Theory and Applications., GENE, 145997, 2021, 10.1016/j.gene

120. Yidi Sun, Chen Li, Shichao Pang, Qianlan Yao, Luonan Chen, Yixue Li, Rong Zeng, Kinase-substrate Edge Biomarkers Provide A More Accurate Prognostic Prediction in ER-negative Breast Cancer., Genomics, Proteomics & Bioinformatics, 2021, 10.1016/j.gpb.2019.11.012

121. Luonan Chen, Rong Fan, Ruchou Tang, Advanced single-cell omics technologies and informatics tools for genomics, proteomics and bioinformatics analysis., Genomics, Proteomics and Bioinformatics, 2021, 10.1016/j.gpb.2021.12.001

122. Yamaguchi H.Q., Ode K.L., Ueda H.R, A design principle for posttranslational chaotic oscillators., iScience, 1, 101946, 2021, 10.1016/j.isci.2020.101946

123. Mimura, K., Sakamaki, J.I., Morishita, H., Kawazu, M., Mano, H., *Mizushima, N, Genome-wide CRISPR screening reveals nucleotide synthesis negatively regulates autophagy, J. Biol. Chem, 296, 100780, 2021, 10.1016/j.jbc.2021.100780

124. Tsuchimoto S, Shibusawa S, Iwama S< Hayashi M, Okuyama K, Mizuguchi N, Kato K, Ushiba J, Use of common average reference and large-Laplacian spatial-filters enhances EEG signal-to-noise ratios in intrinsic sensorimotor activity., J Neurosci Methods, 353, 109089, 2021, 10.1016/j.jneumeth.2021.109089

125. Zemin Hou, Tao Yang, Zejie Mei, Si Zhang, Yuanyuan Gao, Xi Chen, Qilong Tan, Xuyou Zhu, Chengdang Xu, Jianpo Lian, Cuidong Bian, Ying Liu, Wei Le, Nazarov Hydyr, Denglong Wu, Luonan Chen, Shengsong Huang, Zhenfei Li, Tracing steroidogenesis in prostate biopsy samples to unveil prostate tissue androgen metabolism characteristics and potential clinical application., The Journal of Steroid Biochemistry and Molecular Biology, 210, 105859, 2021, 10.1016/j.jsbmb.2021.105859

126. Jinwang Feng, Shao-Wu Zhang, Luonan Chen, Jie Xia, Alzheimer's disease classification using features extracted from nonsubsampled contourlet subband-based individual networks., Neurocomputing, 421, 260–272, 2021, 10.1016/j.neucom.2020.09.012

127. Sato Y, Kondo T, Shibata R, Nakamura M, Okano H, Ushiba J, unctional reorganization of locomotor kinematic synergies reflects the neuropathology in a mouse model of spinal cord injury., Neurosci.Res., S0168-0102(2211)00248-0, 2021, 10.1016/j.neures.2021.12.002

128. Françoise Diaz-Rojas, F., Matsunaga, M., Tanaka, Y., Kikusui, T., Mogi, K., Nagasawa, M., Asano, K., Abe, N., & Myowa, M, Development of the paternal brain in expectant fathers during early pregnancy, NeuroImage, 225, 117527, 2021, 10.1016/j.neuroimage.2020

129. Rui Liu, Kazuyuki Aihara, Luonan Chen, Collective fluctuation implies imminent state transition., Physics of Life Reviews, 37, 103-107, 2021, 10.1016/j.plrev.2021.04.002

130. Eriguchi Y, Aoki N, Kano Y, Kasai K., Rotational plane-wise analysis of angular movement of neck motor tics in Tourette's syndrome, Prog. Neuropsychopharmacol Biol. Psychiatry, 108, 110092, 2021, 10.1016/j.pnpbp.2020.110092. Online ahead of print. PMID: 32890695

131. Rui Liu, Jiayuan Zhong, Renhao Hong, Ely Chen, Kazuyuki Aihara, Pei Chen, Luonan Chen, Predicting local COVID-19 outbreaks and infectious disease epidemics based on landscape network entropy. Science Bulletin., Science Bulletin, 2021, 10.1016/j.scib.2021.03.022

132. Okudo M, Komaki F, Shrinkage priors for single-spiked covariance models., Statistics & Probability Letters, 176, 2021, 10.1016/j.spl.2021.109127

133. Zhang X, Johnson RM, Drulyte I, Yu L, Kotecha A, Danev R, Wootten D, Sexton PM, Belousoff MJ, Evolving cryo-EM structural approaches

for GPCR drug discovery., Structure, 29, 963, 2021, 10.1016/j.str.2021.04.008

134. Benner S, Aoki Y, Watanabe T, Endo N, Abe O, Kuroda M, Kuwabara H, Kawakubo Y, Takao H, Kunimatsu A, Kasai K, Bito H, Kakeyama M, Yamasue H., Neurochemical evidence for differential effects of acute and repeated oxytocin administration, Mol. Psychiatry, 26, 710-720, 2021, 10.1038/s41380-018-0249-4. PMID: 30262887

135. Benham RS, Choi C, Hodgson NW, Hewage NB, Kastli R, Donahue RJ, Muschamp JW, Engin E, Carlezon WA Jr, Hensch TK, Rudolph U., α2-containing γ-aminobutyric acid type A receptors promote stress resiliency in male mice, Neuropsychopharmacology, 46(12), 2197-2206, 2021, 10.1038/s41386-021-01144-w. Epub 2021 Aug 18. PMID: 34408277; PMCID: PMC8505491

136. Zhu Y, Wang MJ, Crawford KM, Ramírez-Tapia JC, Lussier AA, Davis KA, de Leeuw C, Takesian AE; Major Depressive Disorder Working Group of the Psychiatric Genomics Consortium, Hensch TK, Smoller JW, Dunn EC., Sensitive period-regulating genetic pathways and exposure to adversity shape risk for depression, Neuropsychopharmacology, 47(2), 497-506, 2022, 10.1038/s41386-021-01172-6. Epub 2021 Oct 23. PMID: 34689167; PMCID: PMC8674315

137. Caicun Zhou, Tao Jiang, pingyang wang, Jie Zhang, Yanqiu Zhao, Jianying Zhou, Yun Fan, Yongqian Shu, Xiaoqing Liu, Helong Zhang, Jianxing He, Guanghui Gao, Xiaoqian Mu, Zhang Bao, Yanjun Xu, Renhua Guo, Hong Wang, Lin Deng, Ningqiang Ma, Yalei Zhang, Chunxia Su, Sheng Yao, Jiarui Wu, Luonan Chen, and Shengxiang Ren, Toripalimab plus chemotherapy as second-line treatment in previously EGFR-TKIs treated patients with EGFR-mutant advanced NSCLC: a multi-center phase II trial., Signal Transduction and Targeted Therapy, 2021, 10.1038/s41392-021-00751-9

138. Jingsong Zhang, Yang Zhang, Junyan Kang, Shuiye Chen, Yongqun He, Benhao Han, Mofang Liu, Lina Lu, Li Li, Zhigang Yi, and Luonan Chen, Potential transmission chains of variant B.1.1.7 and co-mutations of SARS-CoV-2., Cell Discovery, 2021, 10.1038/s41421-021-00282-1

139. Yoshida T, Yamagata A, Imai A, Kim J, Izumi H, Nakashima S, Shiroshima T, Maeda A, Iwasawa-Okamoto S, Azechi K, Osaka F, Saitoh T , Maenaka K, Shimada T, Fukata Y, Fukata M, Matsumoto J, Nishijo H, Takao K, Tanaka S, Okabe S, Tabuchi K, Uemura T, Mishina M, Mori H, Fukai S, Canonical versus non-canonical transsynaptic signaling of neuroligin 3 tunes development of sociality, Nature Communications, 12, 1848, 2021, 10.1038/s41467-021-22059-6

140. Chatterjee S, Ohki K, Reid RC., Chromatic micromaps in primary visual cortex, Nat. Commun., 2, 10763888888889, 2021, 10.1038/s41467-021-22488-3

141. Yamamoto, Y., Chino, H., Tsukamoto, S., Ode, KL, Ueda H.R., *Mizushima, N, NEK9 regulates primary cilia formation by acting as a selective autophagy adaptor for MYH9/myosin IIA., Nat. Commun, 12, 3292, 2021, 10.1038/s41467-021-23599-7

142. Tamada K, Fukumoto K, Toya T, Nakai N, Awasthi JR, Tanaka S, Okabe S, Spitz F, Saitow F, Suzuki H, Takumi T, Genetic dissection identifies Necdin as a driver gene in a mouse model of paternal 15q duplications, Nature Communications, 12, 4056, 2021, 10.1038/s41467-021-24359-3

143. Danev R, Belousoff M, Liang Y-L, Zhang X, Eisenstein F, Wootten D, Sexton PM, Routine sub-2.5 Å cryo-EM structure determination of GPCRs., Nat, Commun. 12, 4333, 2021, 10.1038/s41467-021-24650-3

144. Miyashita M, Yamasaki S, Ando S, Suzuki K, Toriumi K, Horiuchi Y, Yoshikawa A, Imai A, Nagase Y, Miyano Y, Inoue T, Endo K, Morimoto Y, Morita M, Kiyono T, Usami S, Okazaki Y, Furukawa TA, Hiraiwa-Hasegawa M, Itokawa M, Kasai K, Nishida A, Arai M, Fingertip advanced glycation end products and psychotic symptoms among adolescents, NPJ Schizophr., 7, 37, 2021, 10.1038/s41537-021-00167-y. PMID: 34385440

145. Agudo-Canalejo, J., Schultz, S.W., Chino, H., Migliano, S., Saito, C., Koyama-Honda, I., Stenmark, H., Brech, A., May, A.I., Mizushima, N., *Knorr, R. L, Wetting regulates autophagy of phase-separated compartments and the cytosol., Nature, 591, 142-146, 2021, 10.1038/s41586-020-2992-3

146. *Morishita, H., Eguchi, T., Tsukamoto, S., Sakamaki, Y., Takahashi, S., Saito, C., Koyama-Honda, I., *Mizushima, N, Organelle degradation in the lens by PLAAT phospholipases., Nature, 592, 634-638, 2021, 10.1038/s41586-021-03439-w

147. Draper-Joyce CJ, Bhola R, Wang J, Bhattarai A, Nguyen ATN, Cowie-Kent I, O'Sullivan K, Chia LY, Venugopal H, Valant C, Thal DM, Wootten D, Panel N, Carlsson J, Christie MJ, White PJ, Scammells P, May LT, Sexton PM, Danev R, Miao Y, Glukhova A, Imlach WL, Christopoulos A, Positive allosteric mechanisms of adenosine A1 receptor-mediated analgesia., Nature, 597, 571, 2021, 10.1038/s41586-021-03897-2

148. Umejima K, Flynn S, Sakai KL, Enhanced activations in syntax-related regions for multilinguals while acquiring a new language., Sci. Rep. 11, 7296, 2021, 10.1038/s41598-021-86710-4

149. Wake N, Ishizu K, Abe T, Takahashi H, Prepulse inhibition predicts subjective hearing in rats., Scientific Reports, 11, 18902, 2021, 10.1038/s41598-021-98167-6

150. Ishizu K, Shiramatsu TI, Hitsuyu R, Oizumi M, Tsuchiya N, Takahashi H, Information flow in the rat thalamo-cortical system: spontaneous vs. stimulus-evoked activities., Scientific Reports, 11, 19252, 2021, 10.1038/s41598-021-98660-y

151. Tanaka, Y., Kanakogi, Y. & Myowa, M, Social touch in mother–infant interaction affects infants' subsequent social engagement and object exploration., Humanities and Social Sciences Communications, 8, Article number: 32, 2021, 10.1057/s41599-020-00642-4

152. Yada Y, Yasuda S, Takahashi H, Physical reservoir computing with FORCE learning in a living neuronal culture., Applied Physics Letters, 119, 16, 173701, 2021, 10.1063/5.0064771

153. Miura S, Morimoto Y, Furihata T, Takeuchi, S., Functional analysis of human brain endothelium using a microfluidic device integrating a cell culture insert, APL Bioenginneering, 6(1), 016103, 2022, 10.1063/5.0085564

154. Weijun Jiang, Jiajia Shi, Jingjie Zhao, Qiu Wang, Dan Cong, Fenghua Chen, Yu Zhang, Yuhan Liu, Junzheng Zhao, Qian Chen, Linhao Gu, Wenjia Zhou, Chenhang Wang, Zhaoyuan Fang, Shuhui Geng, Wei Xie, Luo-Nan Chen, Yang Yang,Yun Bai, Haodong Lin, Xiajun Li, ZFP57 dictates allelic expression switch of target imprinted genes., PNAS, 118 (5), e2005377118, 2021, 10.1073/pnas.2005377118

155. Kusumaatmaja, H., May, A.I., Feeney, M., McKenna, J.F., Mizushima, N., Frigerio, L., *Knorr, R.L, Wetting of phase-separated droplets on plant vacuole membranes leads to a competition between tonoplast budding and nanotube formation., Proc. Natl. Acad. Sci. USA, 118, e2024109118 , 2021, 10.1073/pnas.2024109118

156. Hashimoto Y, Kakui T, Ushiba J, Liu M, Kamada K, Ota T, Portable rehabilitation system with brain-computer interface for inpatients with acute and subacute stroke: A feasibility study., Assist Technol, 1-9, 2021, 10.1080/10400435.2020.1836067

157. Chunman Zuo, Hao Dai, Luonan Chen, Deep cross-omics cycle attention model for joint analysis of single-cell multi-omics data, Bioinformatics, 2021, 10.1093/bioinformatics/btab403

158. Tia B, Takemi M, Kosugi A, Castagnola E, Ricci D, Ushiba J, Fadiga L, Iriki A, Spectral Power in Marmoset Frontal Motor Cortex during

Natural Locomotor Behavior., Cereb Cortex, 31(2), 1077-1089, 2021, 10.1093/cercor/bhaa275

159. Sakai KL, Oshiba Y, Horisawa R, Miyamae T, Hayano R, Music-experience-related and musical-error-dependent activations in the brain. Cereb. Cortex., Cereb. Cortex., Bhab478, 2021, 10.1093/cercor/bhab478

160. Cara L Green, Sharon E Mitchell, Davina Derous, Libia A García-Flores, Yingchun Wang, Luonan Chen, Jing-Dong J Han, Daniel E L Promislow, David Lusseau, Alex Douglas, John R Speakman, The Effects of Graded Levels of Calorie Restriction: XVI. Metabolomic Changes in the Cerebellum Indicate Activation of Hypothalamocerebellar Connections Driven by Hunger Responses, J Gerontol A Biol Sci Med Sci, 76(4), 601-610, 2021, 10.1093/gerona/glaa261

161. Chengming Zhang, Hong Zhang, Jing Ge, Tingyan Mi, Xiao Cui, Fengjuan Tu, Xuelan Gu, Tao Zeng and Luonan Chen, Landscape dynamic network biomarker analysis reveals the tipping point of transcriptome reprogramming to prevent skin photodamage., Journal of Molecular Cell Biology, 2021, 10.1093/jmcb/mjab060

162. Lin Li, Hui Tang, Rui Xia, Hao Dai, Rui Liu and Luonan Chen, Intrinsic entropy model for feature selection of scRNA-seq data, Journal of Molecular Cell Biology, 2021, 10.1093/jmcb/mjac008

163. Danev R, Yanagisawa H, Kikkawa M, Cryo-EM Performance Testing of Hardware and Data Acquisition Strategies., Microscopy , 70, 487, 2021, 10.1093/jmicro/dfab016

164. Takahasi M, Okanoya K, Mazuka R, How vocal temporal parameters develop: a comparative study between humans and songbirds, two distantly related vocal learners., Journal of Language Evolution, 6(1), 2021, 10.1093/jole/lzaa008

165. Wei-Feng Guo, Shao-Wu Zhang, Yue-Hua Feng, Jing Liang, Tao Zeng and Luonan Chen, Network controllability-based algorithm to target personalized driver genes for discovering combinatorial drugs of individual patients., Nucleic Acids Research, 2021, 10.1093/nar/gkaa1272

166. Xue Wang, Yuetong Wang, Zhaoyuan Fang, Hua Wang, Jian Zhang, Longfu Zhang, Hsinyi Huang, Zhonglin Jiang, Yujuan Jin, Xiangkun Han, Shenda Hou, Bin Zhou, Feilong Meng, Luonan Chen, Kwok-Kin Wong, Jinfeng Liu, Zhiqi Zhang, Xin Zhang, Haiquan Chen, Yihua Sun, Liang Hu, Hongbin Ji, Targeting HSPA1A in ARID2-deficient lung adenocarcinoma., National Science Review, 2021, 10.1093/nsr/nwab014

167. Jifan Shi, Kazuyuki Aihara and Luonan Chen, Dynamics-based data science in biology., National Science Review, 2021, 10.1093/nsr/nwab029

168. Kubota T, Takahashi H, Nakajima K, Polynomial Chaos Expansion for Temporal Information Processing: Extending the Reservoir Computing Paradigm., Phyisical Review Research, 3, 43135, 2021, 10.1103/PhysRevResearch.3.043135

169. S. Oshino, R. Nishihama, K. Wakamatsu, K. Inoue, D. Matsui, M. Okui, K. Nakajima, Y. Kuniyoshi, T. Nakamura, Generalization Capability of Mixture Estimation Model for Peristaltic Continuous Mixing Conveyor, IEEE Access, 9, 138866-138875, 2021, 10.1109/ACCESS.2021.3112614

170. Heecheol Kim, Yoshiyuki Ohmura, Yasuo Kuniyoshi, Gaze-based dual resolution deep imitation learning for high-precision dexterous robot manipulation, IEEE Robotics and Automation Letters, Vol.6, Issue 2, 1630-1637, 2021, 10.1109/LRA.2021.3059619

171. Kazutoshi Tanaka, Satoshi Nishikawa, Ryuma Niiyama, Yasuo Kuniyosh, Immediate generation of jump-and-hit motions by a pneumatic humanoid robot using a lookup table of learned dynamics, IEEE Robotics and Automation Letters, Vol.6, No.3, 5557–5564, 2021, 10.1109/LRA.2021.3076959

172. Lai Chen,Takuya Sasatani,Keung Or,Satoshi Nishikawa, Yoshihiro Kawahara, Ryuma Niiyama, and Yasuo Kuniyoshi, Wireless powered dielectric elastomer actuator, IEEE Robotics and Automation Letter, IEEE Robotics and Automation Letters, Vol. 6, No.4, 7278-7284, 2021, 10.1109/LRA.2021.3097271

173. Ryo Terajima, Katsuma Inoue, Shogo Yonekura, Kohei Nakajima, and Yasuo Kuniyoshi, Behavioral Diversity Generated From Body–Environment Interactions in a Simulated Tensegrity Robot, IEEE Robotics and Automation Letters, Vol. 7, No. 2, 1597–1604, 2021, 10.1109/LRA.2021.3139083

174. Jinwang Feng, Shao-Wu Zhang, Luonan Chen, Extracting ROI-Based Contourlet Subband Energy Feature from the sMRI Image for Alzheimer's Disease Classification., IEEE/ACM Transactions on Computational Biology and Bioinformatics, 2021, 10.1109/TCBB.2021.3051177

175. Okudo M, Komaki F, Bayes Extended Estimators for Curved Exponential Families., IEEE Transactions on Information Theory, 67, 1088–1098, 2021, 10.1109/TIT.2020.3035027

176. Oda H, Komaki F, Shrinkage Priors on Complex-Valued Circular- Symmetric Autoregressive Processes., IEEE Transactions on Information Theory, 67, 5318– 5333, 2021, 10.1109/TIT.2021.3079512

177. Ludusan B, Mazuka R, Dupoux E, Does Infant-Directed Speech help phonetic learning? A machine learning investigation., Cognitive Science, 45(5), e12946, 2021, 10.1111/cogs.12946

178. Ezaki T, Himeno Y, Watanabe T, Masuda N., Modelling state-transition dynamics in resting-state brain signals by the hidden Markov and Gaussian mixture models, The European Journal of Neuroscience, 54, 5404-5416, 2021, 10.1111/ejn.15386

179. Yu, L., & Myowa, M, The early development of tempo adjustment and synchronization during joint drumming: A study of 18- to 42-month-old children, Infancy, 2021, 10.1111/infa.12403

180. Imafuku, M, Kawai, M., Niwa, F., Shinya, Y., & Myowa, M, Longitudinal assessment of social attention in preterm and term infants: its relation to social communication and language outcome., Infancy, 2021, 10.1111/infa.12402

181. Echizen K, Sakakibara E, Suga M, Kasai K., Improvements in obsessive-compulsive disorder and schizophrenia after left putaminal hemorrhage, Psychiatry Clin. Neurosci., 75(11), 354-355, 2021, 10.1111/pcn.13296. Epub 2021 Sep 6. PMID: 34387923

182. Shutao He,Hongxia Wang,Xiaomeng Hao,Yinliang Wu,Xiaofeng Bian,Minhao Yin,Yandi Zhang,Weijuan Fan,Hao Dai,Ling Yuan,Peng Zhang, Luonan Chen, Dynamic network biomarker analysis discovers IbNAC083 in the initiation and regulation of sweet potato root tuberization., The Plant Journal, 2021, 10.1111/tpj.15478

183. Yamada T, Sugiura H, Mimura H, Kamiya K, Osaki T, Takeuchi S., Highly Sensitive VOC Detectors Using Insect Olfactory Receptors Reconstituted into Lipid Bilayers, Science Advances, 7(3), eabd2013, 2021, 10.1126/sciadv.abd2013

184. Okamoto K., Ebina T., Fuji N., Konishi K., Sato Y., Kashima T., Nakano R., Hioki H., Takeuchi H., Yumoto J., Matsuzaki M., and Ikegaya Y, Tb3+-doped fluorescent glass pipettes for biology., Science Advances, 7, eabd2529, 2021, 10.1126/sciadv.abd2529

185. Josephs TM, Belousoff MJ, Liang YL, Piper SJ, Cao J, Garama DJ, Leach K, Gregory KJ, Christopoulos A, Hay DL, Danev R, Wootten D, Sexton PM. Structure and dynamics of the CGRP receptor in apo and peptide-bound forms., Science, 372, 2021, 10.1126/science.abf7258

186. Lu Wang,Yi-Ning Xu,Chung-Ching Chu,Zehua Jing,Yabin Chen,Jinsong Zhang,Mingming Pu, Tingyan Mi, Yaping Du, Zongqi Liang, Chandraprabha Doraiswamy, Tao Zeng, Jiarui Wu,Luonan Chen, Facial skin microbiota mediated host response to pollution stress revealed by microbiome networks of individual., mSystems, 6(4), e0031921, 2021, 10.1128/mSystems.00319-21

187. Xu W, Niu G, Hyvärinen A, Sugiyama M. , Direction matters: On influence-preserving graph summarization and max-cut principle for directed graphs, Neural Computation, vol.33, no.8, 2128-2162, 2021, 10.1162/neco_a_01402

188. Xie Z, He F, Fu S, Sato I, Tao D, Sugiyama M., Artificial neural variability for deep learning: On overfitting, noise memorization, and catastrophic forgetting, Neural Computation, vol.33, no.8, 2163-2192, 2021, 10.1162/neco_a_01403

189. Han C, Rundo L, Murao K, Noguchi T, Simahara Y, Ádám M Z, Koshino S, Sala E, Nakayama H, Satoh S, MADGAN: unsupervised Medical Anomaly Detection GAN using multiple adjacent brain MRI slice reconstruction., BMC Bioinformatics, volume 22, number 31, 2021, 10.1186/s12859-020-03936-1

190. Aoki A, Ganchimeg T, Naranbaatar N, Khishigsuren Z, Gundegmaa L, Bat-Erdene S, Munkhbaatar B, Mori R, Kikuchi A, Soya H, Kasai K, Takehara K., Validation of the parent version of the Strengths and Difficulties Questionnaire (SDQ) to screen mental health problems among school-age children in Mongolia, BMC Psychiatry, 21, 218, 2021, 10.1186/s12888-021-03218-x. PMID: 33926396

191. Kato Y, Kuwabara H, Okada T, Munesue T, Benner S, Kuroda M, Kojima M, Yassin W, Eriguchi Y, Kameno Y, Murayama C, Nishimura T, Tsuchiya K, Kasai K, Ozaki N, Kosaka H, Yamasue H., Oxytocin-induced increase in N,N-dimethylglycine and time course of changes in oxytocin efficacy for autism social core symptoms, Mol. Autism, 12, 15, 2021, 10.1186/s13229-021-00423-z. PMID: 33622389350

192. Okawa, F., Hama, Y., Zhang, S., Morishita, H., Yamamoto, H., Levine, T.P., *Mizushima, N, Evolution and insights into the structure and function of the DedA superfamily containing TMEM41B and VMP1., J. Cell Sci, 134, jcs255877 , 2021, 10.1242/jcs.255877

193. Mobbs JI, Belousoff MJ, Harikumar KG, Piper SJ, Xu X, Furness SGB, Venugopal H, Christopoulos A, Danev R, Wootten D, Thal DM, Miller LJ, Sexton PM, tructures of the human cholecystokinin 1 (CCK1) receptor bound to Gs and Gq mimetic proteins provide insight into mechanisms of G protein selectivity., PLoS Biol., 2021, 10.1371/journal.pbio.3001295

194. Mori K, Shiramatsu TI, Ishizu K, Takahashi H, Simultaneous mapping of neural activities in auditory and visual cortex of rat. IEEJ Transactions on Electronics, IEEJ Transactions on Electronics, Information and Systems 141, 5, 614-619, 2021, 10.1002/ecj.12322

195. Shiramatsu TI, Abe T, Ishizu K, Takahashi H, Experimental system to evaluate auditory perception induced by microstimulation of auditory thalamus of rats., IEEJ Transactions on Electronics, Information and Systems 141, 5, 627-633, 2021, 10.1541/ieejeiss.141.627

196. Ikeda N, Takahashi H, Learning in dissociated neuronal cultures by low-frequency stimulation., IEEJ Transactions on Electronics, Information and Systems 141, 5, 654-660, 2021, 10.1541/ieejeiss.141.654

197. Kubota T, Sakurayama K, Shiramatsu TI, Takahashi H, Deviance detection property in dissociated cultures of neurons., Transactions on Electronics, Information and Systems 141, 5, 661-667, 2021, 10.1541/ieejeiss.141.661

198. Yano K, Kaneko R, Komaki F, Minimax predictive density for sparse count data., Bernoulli, 27, 1212-1238, 2021, 10.3150/20-BEJ1271

199. Sakai KL, Kuwamoto T, Yagi S, Matsuya K, Modality-dependent brain activation changes induced by acquiring a second language abroad, Front. Behav. Neurosci. 15, 631957, 1-10, 2021, 10.3389/fnbeh.2021.631957

200. Umejima K, Ibaraki T, Yamazaki T, Sakai KL, Paper notebooks vs. mobile devices: Brain activation differences during memory retrieval.., Front. Behav. Neurosci. 15, 634158, 1-11, 2021, 10.3389/fnbeh.2021.634158

201. Shiramatsu TI, Mori K, Ishizu K, Takahashi H, Auditory, visual, and cross-modal mismatch negativities in the auditory and visual cortex of rat., Frontiers in Human Neuroscience, 15, 721476, 2021, 10.3389/fnhum.2021.721476

202. Yamaguchi H, Hashimoto Y, Sugihara G, Miyata J, Murai T, Takahashi H, Honda M, Hishimoto A, Yamashita Y* , Three-dimensional convolutional autoencoder extracts features of structural brain images with a diagnostic label-free approach: Application to schizophrenia datasets. , Front. Neurosci, 15, 652987, 2021, 10.3389/fnins.2021.652987

203. Jinling Yan, Peiluan Li, Rong Gao, Ying Li, Luonan Chen, Identifying critical states of complex diseases by single-sample Jensen-Shannon divergence., Frontiers in Oncology, 11, 1824, 2021, 10.3389/fonc.2021.684781

204. Izumi R, Hino M, Wada A, Nagaoka A, Kawamura T, Mori T, Sainouchi M, Kakita A, Kasai K, Kunii Y, Yabe H., Detailed postmortem profiling of inflammatory mediators expression revealed post-inflammatory alternation in the superior temporal gyrus of schizophrenia, Front Psychiatry, 12, 653821, 2021, 10.3389/fpsyt.2021.653821. PMID: 33815179

205. Ryuma Niiyama, Young Ah Seong, Yoshihiro Kawahara, Yasuo Kuniyoshi, Blower-powered Soft Inflatable Joints for Physical Human Robot Interaction, Frontiers in Robotics and AI, 8, 1–12 (720683), 2021, 10.3389/frobt.2021.720683

206. Satoshi Nakagawa, Minlie Huang, Yasuo Kuniyoshi, Construction and Evaluation of QOL Specialized Dictionary SqolDic Utilizing Vocabulary Meaning and QOL Scale, Electronics, Vol.10, No.4, 2021, 10.3390/electronics10040417

207. Katsuma Inoue, Yasuo Kuniyoshi, Katsushi Kagaya, Kohei Nakajima, Skeletonizing the Dynamics of Soft Continuum Body from Video, Soft Robotics, 11pages, 2021, 10.1089/soro.2020.0110

208. Jie Xia, Lequn Wang, Guijun Zhang, Chunman Zuo and Luonan Chen, RDAClone: Deciphering Tumor Heterozygosity through Single-Cell Genomics Data Analysis with Robust Deep Autoencoder., Genes, 12(12), 2021, 10.3390/genes12121847

209. Nie M, Shima A, Fukushima K, Morimoto Y, Takeuchi S., A cylindrical molding method for the biofabrication of plane-shaped skeletal muscle tissue, Micromachines, 12(11), 1411, 2021, 10.3390/mi12111411

210. Huanfei Ma, Siyang Leng, Luonan Chen, Detecting High-Dimensional Causal Networks Using Randomly Conditioned Granger Causality., CSIAM Trans, 2, 680-696, 2021, 10.4208/csiam-am.2020-0184

211. 金井 嵩幸, 大村 吉幸, 長久保 晶彦, 國吉 康夫, メカニカルグローブによるロボットハンドデザインの第三者評価, 日本ロボット学会誌, Vol. 39 No. 6, 2021, 10.7210/jrsj.39.557

212. Watanabe T., Causal roles of prefrontal cortex during spontaneous perceptual switching are determined by brain state dynamics, eLife, 10, e69079, 2021, 10.7554/eLife.69079

213. Zerbi V, Pagani M, Markicevic M, Matteoli M, Pozzi D, Fagiolini M, Bozzi Y, Galbusera A, Scattoni ML, Provenzano G, Banerjee A, Helmchen F, Basson MA, Ellegood J, Lerch JP, Rudin M, Gozzi A, Wenderoth N. Brain mapping across 16 autism mouse models reveals a spectrum of functional connectivity subtypes. Mol Psychiatry. 2021 Dec;26(12):7610-7620. doi: 10.1038/s41380-021-012454.

214. Morriss NJ, Conley GM, Hodgson N, Boucher M, Ospina-Mora S, Fagiolini M, Puder M, Mejia L, Qiu J, Meehan W, Mannix R. Visual Dysfunction after Repetitive Mild Traumatic Brain Injury in a Mouse Model and Ramifications on Behavioral Metrics. J Neurotrauma. 2021 Oct 15;38(20):2881-2895. doi:10.1089/neu.2021.0165. Epub 2021 Sep 2.

215. Tutelman PR, Chambers CT, Cornelissen L, Fernandez CV, Flanders A, MacLeod J, Sherry SB, Stewart SH, Urquhart R, de Gagne S, Guilcher GMT, Hashmi J, Heathcote LC, Noel M, Schulte FSM, Stinson JN, Stern M. Long-term alterations in somatosensory functioning in survivors of childhood cancer. Pain. 2021 Sep 25. doi: 10.1097/j.pain.0000000000002486.

216. Guedj R, Marini M, Kossowsky J, Berde C, Mateo C, Fleegler EW. Explicit and implicit bias based on race, ethnicity, and weight among pediatric emergency physicians. Acad Emerg Med. 2021 Sep; 28(9):1073-1076. doi: 10.1111/acem.14301. Epub 2021 Jun 28.

217. Donado C, Nedeljkovic K, Wangnamthip S, Solodiuk JC, Bourgeois FT, Berde CB. Trends in Gabapentin and Pregabalin Prescribing in a Tertiary Pediatric Medical Center. Hosp Pediatr. 2021 Aug;11(8):909-914. doi: 10.1542/hpeds.2020-003582.

218. Kaczynski KJ, Chang CYH, Chimoff J, Koike C, Berde CB, Logan DE, Nelson S, Kossowsky J. Initial Adjustment to the COVID-19 Pandemic and the Associated Shutdown in Children and Adolescents With Chronic Pain and Their Families. Front Pain Res (Lausanne). 2021 Sep 30;2:713430. doi: 10.3389/fpain.2021.713430.

219. Pittman-Polletta BR, Wang Y, Stanley DA, Schroeder CE, Whittington MA, Kopell NJ. Differential contributions of synaptic and intrinsic inhibitory currents to speech segmentation via flexible phase-locking in neural oscillators. PLoS Comput Biol. 2021 Apr 14;17(4):e1008783. doi: 10.1371/journal.pcbi.1008783.

220. Llorens A, Tzovara A, Bellier L, Bhaya-Grossman I, Bidet-Caulet A, Chang WK, Cross ZR, Dominguez-Faus R, Flinker A, Fonken Y, Gorenstein MA, Holdgraf C, Hoy CW, Ivanova MV, Jimenez RT, Jun S, Kam JWY, Kidd C, Marcelle E, Marciano D, Martin S, Myers NE, Ojala K, Perry A, Pinheiro-Chagas P, Riès SK, Saez I, Skelin I, Slama K, Staveland B, Bassett DS, Buffalo EA, Fairhall AL, Kopell NJ, Kray LJ, Lin JJ, Nobre AC, Riley D, Solbakk AK, Wallis JD, Wang XJ, Yuval-Greenberg S, Kastner S, Knight RT, Dronkers NF. Gender bias in academia: A lifetime problem that needs solutions. Neuron. 2021 Jul 7;109(13):2047-2074. doi: 10.1016/j.neuron.2021.06.002.

221. Peck FC, Gabard-Durnam LJ, Wilkinson CL, Bosl W, Tager-Flusberg H, Nelson CA. Prediction of autism spectrum disorder diagnosis using nonlinear measures of language-related EEG at 6 and 12 months. J Neurodev Disord. 2021 Nov 30;13(1):57. doi: 10.1186/s11689-021-09405-x.

222. Saby JN, Benke TA, Peters SU, Standridge SM, Matsuzaki J, Cutri-French C, Swanson LC, Lieberman DN, Key AP, Percy AK, Neul JL, Nelson CA, Roberts TPL, Marsh ED. Multisite Study of Evoked Potentials in Rett Syndrome. Ann Neurol. 2021 Apr;89(4):790-802. doi: 10.1002/ana.26029.

223. Romeo RR, Choi B, Gabard-Durnam LJ, Wilkinson CL, Levin AR, Rowe ML, Tager-Flusberg H, Nelson CA 3rd. Parental Language Input Predicts Neuroscillatory Patterns Associated with Language Development in Toddlers at Risk of Autism. J Autism Dev Disord. 2021 Jun 29. doi: 10.1007/s10803-021-05024-6.

224. Mariscal MG, Levin AR, Gabard-Durnam LJ, Xie W, Tager-Flusberg H, Nelson CA. EEG Phase-Amplitude Coupling Strength and Phase Preference: Association with Age over the First Three Years after Birth. eNeuro. 2021 Jun 24; 8(3):ENEURO.0264-20.2021. doi: 10.1523/ENEURO.0264-20.2021.

225. Mariscal MG, Berry-Kravis E, Buxbaum JD, Ethridge LE, Filip-Dhima R, Foss-Feig JH, Kolevzon A, Modi ME, Mosconi MW, Nelson CA, Powell CM, Siper PM, Soorya L, Thaliath A, Thurm A, Zhang B, Sahin M, Levin AR; Developmental Synaptopathies Consortium. Shifted phase of EEG cross-frequency coupling in individuals with Phelan-McDermid syndrome. Mol Autism. 2021 Apr 28;12(1):29. doi: 10.1186/s13229-020-00411-9.

226. VanTieghem M, Korom M, Flannery J, Choy T, Caldera C, Humphreys KL, Gabard-Durnam L, Goff B, Gee DG, Telzer EH, Shapiro M, Louie JY, Fareri DS, Bolger N, Tottenham N. Longitudinal changes in amygdala, hippocampus and cortisol development following early caregiving adversity. Dev Cogn Neurosci. 2021 Apr; 48:100916. doi: 10.1016/j.dcn.2021.100916.

227. Bach AM, Xie W, Piazzoli L, Jensen SKG, Afreen S, Haque R, Petri WA, Nelson CA. Systemic inflammation during the first year of life is associated with brain functional connectivity and future cognitive outcomes. Dev Cogn Neurosci. 2022 Feb;53:101041. doi: 10.1016/j.dcn.2021.101041.

228. Mukerji CE, Wade M, Fox NA, Zeanah CH, Nelson CA. Growth in self-regulation over the course of adolescence mediates the effects of foster care on psychopathology in post-institutionalized children: a randomized clinical trial. Clin Psychol Sci. 2021 Sep;9(5):810-822. doi: 10.1177/2167702621993887.

229. Lee AC, Cherkerzian S, Olson IE, Ahmed S, Chowdhury NH, Khanam R, Rahman S, Andrews C, Baqui AH, Fawzi W, Inder TE, Nartey S, Nelson CA, Oken E, Sen S, Fichorova R. Maternal Diet, Infection, and Risk of Cord Blood Inflammation in the Bangladesh Projahnmo Pregnancy Cohort. Nutrients. 2021 Oct 26;13(11):3792. doi: 10.3390/nu13113792.

230. Hillis SD, Blenkinsop A, Villaveces A, Annor FB, Liburd L, Massetti GM, Demissie Z, Mercy JA, Nelson CA, Cluver L, Flaxman S, Sherr L, Donnelly CA, Ratmann O, Unwin HJT. COVID-19-Associated Orphanhood and Caregiver Death in the United States. Pediatrics. 2021 Oct 7:e2021053760. doi: 10.1542/peds.2021-053760.

231. Turesky TK, Shama T, Kakon SH, Haque R, Islam N, Someshwar A, Gagoski B, Petri WA Jr, Nelson CA, Gaab N. Brain morphometry and diminished physical growth in Bangladeshi children growing up in extreme poverty: A longitudinal study. Dev Cogn Neurosci. 2021 Dec;52:101029. doi: 10.1016/j.dcn.2021.101029.

232. Tang A, McLaughlin KA, Sheridan MA, Nelson CA, Zeanah CH, Fox NA. Autonomic reactivity to social rejection, peer difficulties, and the buffering effects of adolescent friendships following early psychosocial deprivation. Emotion. 2022 Mar;22(2):318-330. doi: 10.1037/emo0001016.

233. Hillis SD, Blenkinsop A, Villaveces A, Annor FB, Liburd L, Massetti GM, Demissie Z, Mercy JA, Nelson CA 3rd, Cluver L, Flaxman S, Sherr L, Donnelly CA, Ratmann O, Unwin HJT. COVID-19-Associated Orphanhood and Caregiver Death in the United States. Pediatrics. 2021 Oct 7:e2021053760. doi: 10.1542/peds.2021-053760.

234. Bosquet Enlow M, Kane-Grade F, De Vivo I, Petty CR, Nelson CA. Corrigendum to "Patterns of change in telomere length over the first three years of life in healthy children" Psychoneuro-endocrinology. 2021 Nov;133:105419. doi:10.1016/j.psyneuen.2021.105419.

235. Hillis SD, Unwin HJT, Chen Y, Cluver L, Sherr L, Goldman PS, Ratmann O, Donnelly CA, Bhatt S, Villaveces A, Butchart A, Bachman G, Rawlings L, Green P, Nelson CA 3rd, Flaxman S. Global minimum estimates of children affected by COVID-19-associated orphanhood and deaths of caregivers: a modelling study. Lancet. 2021 Jul 31;398(10298):391-402. doi: 10.1016/S0140-6736(21)01253-8.

236. Vincent KM, Xie W, Nelson CA. Using different methods for calculating frontal alpha asymmetry to study its development from infancy to 3 years of age in a large longitudinal sample. Dev Psychobiol. 2021 Sep;63(6):e22163. doi: 10.1002/dev.22163.

237. Nelson CA, Meaney-Delman D, Fleck-Derderian S, Cooley KM, Yu PA, Mead PS; Contributors. Antimicrobial Treatment and Prophylaxis of Plague: Recommendations for Naturally Acquired Infections and Bioterrorism Response. MMWR Recomm Rep. 2021 Jul 16;70(3):1-27. doi: 10.15585/mmwr.rr7003a1.

238. Richardson H, Taylor J, Kane-Grade F, Powell L, Bosquet Enlow M, Nelson CA. Preferential responses to faces in superior temporal and medial prefrontal cortex in three-year-old children. Dev Cogn Neurosci. 2021 Aug;50:100984. doi:10.1016/j.dcn.2021.100984.

239. Jensen SKG, Xie W, Kumar S, Haque R, Petri WA, Nelson CA 3rd. Associations of socioeconomic and other environmental factors with early brain development in Bangladeshi infants and children. Dev Cogn Neurosci. 2021 Aug;50:100981. doi: 10.1016/j.dcn.2021.100981.

240. Bowman LC, McCormick SA, Kane-Grade F, Xie W, Bosquet Enlow M, Nelson CA. Infants' neural responses to emotional faces are related to maternal anxiety. J Child Psychol Psychiatry. 2022 Feb;63(2):152-164. doi: 10.1111/jcpp.13429.

241. Jack A, Sullivan CAW, Aylward E, Bookheimer SY, Dapretto M, Gaab N, Van Horn JD, Eilbott J, Jacokes Z, Torgerson CM, Bernier RA, Geschwind DH, McPartland JC, Nelson CA, Webb SJ, Pelphrey KA, Gupta AR; GENDAAR Consortium. A neurogenetic analysis of female autism. Brain. 2021 Jul 28;144(6):1911-1926. doi: 10.1093/brain/awab064.

242. Alarcão FSP, Shephard E, Fatori D, Amável R, Chiesa A, Fracolli L, Matijasevich A, Brentani H, Nelson CA, Leckman J, Miguel EC, Polanczyk GV. Promoting mother-infant relationships and underlying neural correlates: Results from a randomized controlled trial of a home-visiting program for adolescent mothers in Brazil. Dev Sci. 2021 Nov;24(6):e13113. doi: 10.1111/desc.13113.

243. Choi B, Castelbaum L, McKechnie R, Rowe ML, Nelson CA, Tager-Flusberg H. Brief Report: Parents' Declarative Use of Deictic Gestures Predict Vocabulary Development in Infants at High and Low Risk for Autism Spectrum Disorder. J Autism Dev Disord. 2022 Feb;52(2):914-922. doi: 10.1007/s10803-021-04989-8.

244. Pierce LJ, Carmody Tague E, Nelson CA 3rd. Maternal stress predicts neural responses during auditory statistical learning in 26-month-old children: An event-related potential study. Cognition. 2021 Aug;213:104600. doi:10.1016/j.cognition.2021.104600.

245. Xie W, Leppänen JM, Kane-Grade FE, Nelson CA. Converging neural and behavioral evidence for a rapid, generalized response to threat-related facial expressions in 3-year-old children. Neuroimage. 2021 Apr 1;229:117732. doi:10.1016/j.neuroimage.2021.117732.

246. Choi B, Shah P, Rowe ML, Nelson CA, Tager-Flusberg H. A Longitudinal Study of Parent Gestures, Infant Responsiveness, and Vocabulary Development in Infants at Risk for Autism Spectrum Disorder. J Autism Dev Disord. 2021 Nov; 51(11):3946-3958. doi: 10.1007/s10803-020-04855-z.

247. Valdes V, Berens AE, Nelson CA 3rd. Socioeconomic and psychological correlates of postpartum depression at 6 months in Dhaka, Bangladesh. Int J Psychol. 2021 Oct;56(5):729-738. doi: 10.1002/ijop.12735.

248. Colich NL, Sheridan MA, Humphreys KL, Wade M, Tibu F, Nelson CA, Zeanah CH, Fox NA, McLaughlin KA. Heightened sensitivity to the caregiving environment during adolescence: implications for recovery following early-life adversity. J Child Psychol Psychiatry. 2021 Aug;62(8):10.1111/jcpp.13347. doi: 10.1111/jcpp.13347.

249. Quillen LJ, Borstelmann NA, Stanton KE, Nelson CA, Chien SA, Bowers SM, Swift CL, Gonzalez Y, Yi SM, Park EM. Addressing the needs of parents with advanced cancer: Attitudes, practice behaviors, and training experiences of oncology social workers. Palliat Support Care. 2021 Jun;19(3):329-334. doi:10.1017/S1478951520001005.

250. Pierce LJ, Reilly E, Nelson CA. Associations Between Maternal Stress, Early Language Behaviors, and Infant Electroencephalography During the First Year of Life. J Child Lang. 2021 Jul;48(4):737-764. doi: 10.1017/S0305000920000501.

(2) Review articles

251. Mazuka R. A Hybrid Approach to Infant-Directed Speech. In G Martohardjono & S Flynn (Eds), Language in Development: A Crosslinguistic Perspective, "The MIT Press(ISBN: 978-0262542005), 181-202, 2021, 10.1111/cogs.12946

252. Minami Y., Yuan Y., Ueda H.R, Towards organism-level systems biology by next-generation genetics and whole-organ cell profiling., Biophys, 13, 1113-1126, 2021, 007/s12551-021-00859-w

253. Kashiwagi, Y., Okabe, S, Imaging of spine synapses using super-resolution microscopy, Anatomical Science International, 83, 1563-1601, 2021, 10.1007/s12565-021-00603-0

254. Yim,W.W., Mizushima N, Autophagosome maturation stymied by SARS-CoV-2, Dev. Cell, 56, 400-402, 2021, 10.1016/j.devcel.2021.02.002

255. Mizushima, N., White E, Rubinsztein DC, Breakthroughs and bottlenecks in autophagy research., Trends Mol. Med, 11, S1471-4914(21)00179-9, 2021, 10.1016/j.molmed.2021.06.012

256. Quaglio G, Toia P, Moser EI, Karapiperis T, Amunts K, Okabe S, Poo MM, Rah JC, Koninck Y, Ngai J, Richards L, Bjaalie JG, The International Brain Initiative: enabling collaborative science., Lancet Neurology, 20, 985-986, 2021, 10.1016/S1474-4422(21)00389-6

257. Richardson D.S., Guan W., Matsumoto K., Pan C., Chung K., Ertürk A., Ueda H.R., Lichtman J.W, TISSUE CLEARING., Nat. Rev. Methods Primers, 1, 84, 2021, 10.1038/s43586-021-00080-9

258. Klionsky D.J., et al, Guidelines for the use and interpretation of assays for monitoring autophagy (4th edition)., Autophagy, 17, 1-382, 2021, 10.1080/15548627.2020.1797280

259. Morishita, H., Kanda, Y., *Mizushima, N, No air without autophagy: autophagy is important for lung and swim bladder inflation., Autophagy, 17(4), 1040-1041, 2021, 10.1080/15548627.2021.1885148

260. Schultz, S.W., Agudo-Canalejo, J., Chino, H., Migliano, S., Saito, C., Koyama-Honda, I., Stenmark, H., Brech, A., Mizushima, N., *Knorr, R. L., *May, A.I, Should I bend or should I grow: the mechanisms of droplet-mediated autophagosome formation., Autophagy, 17, 1046-1048, 2021, 10.1080/15548627.2021.1887548

261. *Morishita, H., Eguchi, T., *Mizushima, N, A new insight into the lens: cytosolic PLAAT phospholipases degrade organelles to make the lens transparent., Autophagy, 17, 2645-2647, 2021, 10.1080/15548627.2021.1950372

262. Obashi, K, Taraska, J. W., Okabe, S, The role of molecular diffusion within dendritic spines in synaptic function., Journal of General Physiology, 153, e202012814, 2021, 10.1085/jgp.202012814

263. Hashimoto A, Sugiura K, Hoshino A, Impact of exosome-mediated feto-maternal interactions on pregnancy maintenance and development of obstetric complications., The Journal of Biochemistry, 169, 163-171, 2021, 10.1093/jb/mvaa137

264. Zhang, S., Hama, Y., *Mizushima, N, The evolution of autophagy proteins: diversification in eukaryotes and potential ancestors in prokaryotes., J. Cell. Sci, 134, jcs233742, 2021, 10.1242/jcs.233742

265. Hama, Y., Zhang, S., *Mizushima, N, ZZ domains keep cytosol to vacuole delivery whiZZing along., EMBO J, 25, e108777, 2021, 10.15252/embj.2021108777

266. Klionsky, D.J., Petroni, G., Amaravadi, R.K., Baehrecke, E.H., Ballabio, A., Boya, P., Bravo-San Pedro, J.M., Cadwell, K., Cecconi, F., Choi, A.M.K., Choi, M.E., Chu, C.T., Codogno, P., Colombo, M.I., Cuervo, A.M., Deretic, V., Dikic, I., Elazar, Z., Eskelinen, E.L., Fimia, G.M., Gewirtz, D.A., Green, D.R., Hansen, M., Jäättelä, M., Johansen, T., Juhász, G., Karantza, V., Kraft, C., Kroemer, G., Ktistakis, N.T., Kumar, S., Lopez-Otin, C., Macleod, K.F., Madeo, F., Martinez, J., Meléndez, A., Mizushima, N., Münz, C., Penninger, J.M., Perera, R.M., Piacentini,

M., Reggiori, F., Rubinsztein, D.C., Ryan, K.M., Sadoshima, J., Santambrogio, L., Scorrano, L., Simon, H.U., Simon, A.K., Simonsen, A., Stolz, A., Tavernarakis, N., Tooze, S.A., Yoshimori, T., Yuan, J., Yue, Z., Zhong, Q., *Galluzzi, L., *Pietrocola, F, Autophagy in major human diseases., EMBO J, 40, e108863, 2021, 10.15252/embj.202110886

267. Yamamoto, Y., *Mizushima, N, Autophagy and Ciliogenesis., JMA J, 15, 207-215 , 2021, 10.31662/jmaj.2021-0090

268. Morris K, Nami M, Bolanos JF, Lobo MA, Sadri-Naini M, Fiallos J, Sanchez GE, Bustos T, Chintam N, Amaya M, Strand SE, Mayuku-Dore A, Sakibova I, Biso GMN, DeFilippis A, Bravo D, Tarhan N, Claussen C, Mercado A, Braun S, Yuge L, Okabe S, Taghizadeh-Hesary F, Kotliar K, Sadowsky C, Chandra PS, Tripathi M, Katsaros V, Mehling B, Noroozian M, Abbasioun K, Amirjamshidi A, Hossein-Zadeh GA, Naraghi F, Barzegar M, Asadi-Pooya AA, Sahab-Negah S, Sadeghian S, Fahnestock M, Dilbaz N, Hussain N, Mari Z, Thatcher RW, Sipple D, Sidhu K, Chopra D, Costa F, Spena G, Berger T, Zelinsky D, Wheeler CJ, Ashford JW, Schulte R, Nezami MA, Kloor H, Filler A, Eliashiv DS, Sinha D, DeSalles AAF, Sadanand V, Suchkov S, Green K, Metin B, Hariri R, Cormier J, Yamamoto V, Kateb B, Neuroscience20 (BRAIN20, SPINE20, and MENTAL20) Health Initiative: A Global Consortium Addressing the Human and Economic Burden of Brain, Spine, and Mental Disorders Through Neurotech Innovations and Policies, Journal of Alzheimer's Disease, 83, 1563-1601, 2021, 10.3233/JAD-215190

269. Endo M, Maruoka H, Okabe S, Advanced technologies for local neural circuits in the cerebral cortex., Frontiers in Neuroanatomy, 15, 757499, 2021, 10.3389/fnana.2021.757499

270. Uchigashima M, Cheung A, Futai K, A Circuit-Specific Synapse Organizer That Shapes Normal Function and Autism Spectrum Disorder-Associated Dysfunction., Front Mol Neurosci, 14, 749164, 2021, 10.3389/fnmol.2021.749164

271. Gervain J, Christphe A, Mazuka R. Prosodic bootstrapping. In C. Gussenhoven & A. Chen (Eds.), The Oxford Handbook of Language Prosody, Oxford University Press (ISBN: 978-0198832232), 2021, N/A

(3) Proceedings

272. Kashima T, Hataya R, Nakayama H, Visualizing Association in Exemplar-based Classification, 46th IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 1780-1784, 2021, 10.1109/ICASSP39728.2021.9413574

273. Katsumata K, Nakayama H, Semantic Image Synthesis from Inaccurate and Coarse Masks, IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2285-2289, 2021, 10.1109/ICASSP39728.2021.9414521

274. Takumi Takada, Yoshiyuki Ohmura, and Yasuo Kuniyoshi, Unsupervised Learning of Shape-invariant Lie Group Transformer by Embedding Ordinary Differential Equation, 2021 IEEE International Conference on Development and Learning (ICDL). IEEE, Beijing, China, Aug 23-26,2021, 2021, 10.1109/ICDL49984.2021.9515615

275. Xu Y, Nakayama H, DCT-based Fast Spectral Convolution for Deep Convolutional Neural Networks, International Joint Conference on Neural Networks (IJCNN), 1-8, 2021, 10.1109/IJCNN52387.2021.9534135

276. Heecheol Kim, Yoshiyuki Ohmura, Yasuo Kuniyoshi, Transformer-based deep imitation learning for dual-arm robot manipulation, EEE/RSJ International Conference on Intelligent Robots and Systems (IROS2021), 2021, 10.1109/IROS51168.2021.9636301

277. Takayuki Komatsu, Yoshiyuki Ohmura, and Yasuo Kuniyoshi, Unsupervised Temporal Segmentation Using Models That Discriminate Between Demonstrations and Unintentional Actions, 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) ThCT5.6, Sep 30, 2021, 2021, 10.1109/IROS51168.2021.9636688

278. Wang S, Nakayama H, Stochastic Observation Prediction for Efficient Reinforcement Learning in Robotics, 4th IEEE International Conference on Multimedia Information Processing and Retrieval (MIPR), 131-137, 2021, 10.1109/MIPR51284.2021.00027

279. Ryota Morimoto, Satochi Nishikawa, Ryuma Niiyama, Yasuo Kuniyoshi, Model-Free Reinforcement Learning with Ensemble for a Soft Continuum Robot Arm, 2021 IEEE International Conference on Soft Robotics (RoboSoft 2021), online, April 14, 2021, 141-148, 2021, 10.1109/RoboSoft51838.2021.9479340

280. Tomoya Kimura, Ryuma Niiyama, Yasuo Kuniyoshi:, Modularized genotype combination to design multiobjective soft-bodied robots, IEEE International Conference on Soft Robotics (Robosoft), online, April 14, 2021, 295–301, 2021, 10.1109/RoboSoft51838.2021.9479428

281. Hiroki Noda, Satoshi Nishikawa, Ryuma Niiyama, and Yasuo Kuniyoshi, Competitive physical interaction by reinforcement learning agents using intention estimation, 2021 IEEE International Conference on Robot and Human Interactive Communication (RO-MAN 2021) TuP2T4.4, Aug 10,2021, 2021, 10.1109/RO-MAN50785.2021.9515411

282. Yuhu Liu, Satoshi Nishikawa, Young ah Seong, Ryuma Niiyama and Yasuo Kuniyoshi, ThermoCaress: A Wearable Haptic Device with Illusory Moving Thermal Stimulation, 2021 CHI Conference on Human Factors in Computing Systems (CHI '21), Yokohama, May 8-13, 2021, 2021, 10.1145/3411764.3445777

283. Zdenek J, Nakayama H, JokerGAN: Memory-Efficient Model for Handwritten Text Generation with Text Line Awareness, 29th ACM International Conference on Multimedia (ACMMM), 5655-5663, 2021, 10.1145/3474085.3475713

284. Yuta Horii, Katsuma Inoue, Satoshi Nishikawa, Kohei Nakajima, Ryuma Niiyama, Yasuo Kuniyoshi, Physical reservoir computing in a soft swimming robot, International Conference on Artificial Life (ALIFE), online, Jul 19,2021, 1–9 (92), 2021, 10.1162/isal_a_00426

285. Xie Z, Sato I, Sugiyama M., A diffusion theory for deep learning dynamics: Stochastic gradient descent exponentially favors flat minima, Proceedings of Ninth International Conference on Learning Representations (ICLR2021), online, May 4-8, 2021, 28 pages, 2021, 査読あり

286. Kento Sekiya, Yoshiyuki Ohmura, Yasuo Kuniyoshi, Learning to grasp multiple objects with a robot hand using tactile information, 第26回ロボティクスシンポジア講演論文集, 239-244, 2021, 査読あり

287. Chen H, Huang Y, Takamura H, Nakayama H, Commonsense Knowledge Aware Concept Selection for Diverse and Informative Visual Storytelling, 35th AAAI Conference on Artificial Intelligence (AAAI), 999-1008, 2021, 査読あり

288. Chen H, Shu R, Takamura H, Nakayama H, GraphPlan: Story Generation by Planning with Event Graph, 14th International Conference on Natural Language Generation (INLG), 377-386, 2021, 査読あり

289. Charoenphakdee N, Cui Z, Zhang Y, Sugiyama M., Classification with rejection based on cost-sensitive classification, Proceedings of 38th International Conference on Machine Learning (ICML2021), online, Jul. 18-24, 2021, 1507-1517, 査読ありISSN:2640-3498"

290. Xie Z, Yuan L, Zhu Z, Sugiyama M., Positive-negative momentum: Manipulating stochastic gradient noise to improve generalization, Proceedings of 38th International Conference on Machine Learning (ICML2021), online, Jul. 18-24, 2021, 11448-11458, 2021, "査読あり ISSN:2640-3498"

291. Hirose Y, Mazuka R, Developmental changes in the interpretation of an ambiguous structure and an ambiguous prosodic cue in Japanese International Symposium on Issues in Japanese Psycholinguistics from Comparative Perspectives, 11-13, 2021, 招待（査読なし）

292. Mazuka R, Taking cross-linguistic differences seriously in language development research: Acquisition of the Japanese sound system International Symposium on Issues in Japanese Psycholinguistics from Comparative Perspectives, 12-14, 2021, 招待（査読なし）

(4) Other English articles

293. Daikoku T., Discovering the Neuroanatomical Correlates of Music with Machine Learning. Handbook of Artificial Intelligence for Music. Part 1. Miranda E R (Eds.), Springer Nature (ISBN: 978-3-030-72115-2), 2021, N/A

294. Danev R. Practical considerations: defocus, stigmation, coma-free illumination, and phase plates. In: Glaeser RM, Nogales E, Chiu W, editors, Single-particle Cryo-EM of Biological Macromolecules, IOP Publishing, 2021, 10.1088/978-0-7503-3039-8

295. Gervain J, Christphe A, Mazuka R. Prosodic bootstrapping. In C. Gussenhoven & A. Chen (Eds.), The Oxford Handbook of Language Prosody, Oxford University Press (ISBN: 978-0198832232), 2021, N/A

2. Invited Lectures, Plenary Addresses (etc.) at International Conferences and International Research Meetings

- List up to 10 main presentations during FY 2021 in order from most recent.
- For each, write the date(s), lecturer/presenter's name, presentation title, and conference name.

Date (dd.mm.yyyy)	Lecturer/Presenter's name	Presentation title	Conference name
18.03.2022	Haruo Kasai	Mechanical interactions of dendritic-spine synapses.	JST-CREST "Opt Bio" / IIIS Joint Symposium (Sendai and Zoom).
16.03.2022	Yoko Yazaki-Sugiyama	Variable axon connectivity of song memory ensembles in developmental zebra finch song learning	International Symposium on Development and Plasticity of Neural Systems
19.02.2022	Takao Hensch	Re-configuring and repairing impacted brain circuits	AAAS Conference
10.02.2022	Yukiko Gotoh	The embryonic root of adult subventricular neural stem cells	Lecture Series, Centre for Developmental Neurobiology, King's College London
17.12.2021	Yasushi Okada	Live cell imaging technologies for single-cell analysis – How can imaging meets genomics?	Pacifichem 2021
01.12.2021	Mingbo Cai	Learning internal models of the world: brain and machine	The 21st workshop on Mechanism of Brain and Mind
22.11.2021	Masashi Sugiyama	Towards robust and reliable machine learning (Invited talk)	The 7.5th International Symposium on Dialogue for Global Innovation
25.10.2021	Kazuyuki Aihara	Data Analysis on Critical Transitions in Complex Systems and its Application to Early Precision Medicine	Critical Transitions in Complex Systems
22.08.2021	Takamitsu Watanabe	Global and local brain dynamics underlying typical and atypical human intelligence.	IEEE ICDL 2021.
10.08.2021	Yukie Nagai	Robots as Mirrors of Human Cognition (Keynote talk)	The 30th IEEE International Conference on Robot and Human Interactive Communication

3. Major Awards

- List up to 10 main awards received during FY 2021 in order from the most recent.
- For each, write the date issued, the recipient's name, and the name of award.
- In case of multiple recipients, underline those affiliated with the center.

Date (dd.mm.yyyy)	Recipient's name	Name of award
14.03.2022	Haruo Kasai	Imperial prize and Japan academy prize
08.03.2022	Tatsuya Daikoku	AIP Challenge Award 2021 (AIP Challenge Program, JST)
03.02.2022	Ayuko Hoshino	The 18th JSPS Prize
19.11.2021	Charles Nelson	Jacobs Research Prize (Jacobs Foundation)
23.09.2021	Kazuyuki Aihara	2021 JNNS (Japanese Neural Network Society) Academic Award
23.08.2021-26.08.2021	Takumi Takada, Yoshiyuki Ohmura, and Yasuo Kuniyoshi:	IEEE International Conference on Development and Learning (ICDL) 2021 Best Paper Award
28.07.2021	Masanori Matsuzaki	Tsukahara Nakaakira Prize
14.07.2021	Shinsuke Koike	The Japanese Society of Biological Psychiatry (JSBP) The 8th young resesarchers' Training Program Best Encouragement Prize 日本生物学的精神医学会　第８回若手研究者育成プログラム最優秀奨励賞
29.04.2021	Noboru Mizushima	Medal with Purple Ribbon
14.04.2021	Ayuko Hoshino	The Young Scientist Prize of the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology

Appendix 2　FY 2021 List of Principal Investigators

NOTE:

*Underline names of principal investigators who belong to an overseas research institution.

*In the case of researcher(s) not listed in the latest report, attach a "Biographical Sketch of a New Principal Investigator"(Appendix 2a).

*Enter the host institution name and the center name in the footer.

<Results at the end of FY2021> **Principal Investigators Total: 18**

Name	Age	Affiliation (Position title, department, organization)	Academic degree, specialty	Effort (%)*	Starting date of project participation	Status of project participation (Describe in concrete terms)	Contributions by PIs from overseas research institutions
Center Director Takao Kurt Hensch*	55	Director, Project Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study	Ph.D. Neurophysiology	80	2017-10-01	Communicates often by 20 emails or more per day, and multiple weekly video conferences. Cannot enter Japan in 2021-2022 due to the coronavirus pandemic, but stays at the Boston Children's Hospital IRCN Satellite, and promotes IRCN's interests at universities, research institutions, and academic societies around the world	manages and directs center operations

Masanobu Kano*	64	Deputy Director, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Professor, Department of Neurophysiology, Division of Functional Biology, Graduate School of Medicine, The University of Tokyo	M.D. & Ph.D. Neurophysiology	80	2017-10-01	Stays at the center and participates in the center's activities as Deputy Director and an Executive Board member	
Kazuo Emoto*	53	Deputy Director, International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study Professor, Department of Biological Sciences, Graduate School of Science, The University of Tokyo	Ph.D. Neural Network	80	2017-10-01	Stays at the Graduate School of Science next to the center building, and participates in the center's activities as Deputy Director and an Executive Board member	
Kazuyuki Aihara*	67	Deputy Director, International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study University Professor, The University of Tokyo	Ph.D. Biological Information Systems	80	2017-10-01	Stays at the Center and participates in the center's activities as Deputy Director and an Executive Board member	
Haruo Kasai*	65	Professor, Center for Disease Biology and Integrative Medicine, Graduate School of Medicine, The University of Tokyo	MD & PhD Neurophysiology	80	2017-10-01	usually stays at center and participates in the center's activities as a Steering Comittee member	

Kiyoto Kasai*	51	Professor, Department of Neuropsychiatry, Graduate School of Medicine, The University of Tokyo	MD & PhD Neuroimaging and Early Intervention for Schizophrenia	80	2017-10-01	Stays at the center and participates in the center's activities as a Steering Comittee member	
Kenichi Ohki*	50	Professor, Department of Integrative Physiology, Division of Functional Biology, Graduate School of Medicine, The University of Tokyo	M.D. & Ph.D. Neuroscienc e	80	2017-10-01	Stays at the center and participates in the center's activities as a Steering Comittee member	
Arthur Konnerth*	68	Director, Institute of Neuroscience, Technical University of Munich	M.D. & Ph.D. Neurophysio logy	50	2017-10-01	Joined 1st IRCN RETREAT and regularly communicates by email.	
Yukiko Gotoh*	57	Professor, Department of Pharmaceutical Sciences, Graduate School of Pharmaceutical Sciences, The University of Tokyo	Ph.D. Neural Stem Cells	80	2017-10-01	Stays at the Graduate School of Pharmaceutical Sciences and participates in the center's activities	
Yasushi Okada*	53	Professor, Department of Physics, Graduate School of Science, The University of Tokyo	M.D. & Ph.D. Bioimaging	32	2017-10-01	Stays at the Graduate School of Science and participates in the center's activities	
Shoji Takeuchi*	49	Professor, Department of Mechanical and Biofunctional Systems, Institute of Industrial Science, The University of Tokyo	Ph.D. Biohybrid Systems	80	2017-10-01	Stays at the Institute of Industrial Science and participates in the center's activities	

Masashi Sugiyama*	47	Professor, Department of Complexity Science and Engineering, Graduate School of Frontier Sciences, The University of Tokyo	Ph.D. Statistical Machine Learning	16	2017-10-01	Stays at the Graduate School of Frontier Sciences and participates in the center's activities	
Takamitsu Watanabe	40	Associate Professor,International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study	MD & PhD Cognitive Neuroscienc e	100	2020-04-01	Stays at the center and participates in the center's activities	
Yoko Yazaki-Sugiyama	50	Project Associate Professor,International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study	Ph.D. Biological Science	80	2018-04-01	Stays at the center and participates in the center's activities	
Yukie Nagai	47	Project Professor,International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study	Ph.D. Engineering	100	2019-04-01	Stays at the center and participates in the center's activities	
Sho Tsuji	37	Assistant Professor,International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study	Ph.D. Psycholingui stics	100	2019-04-01	Stays at the center and participates in the center's activities	
Zenas C. Chao	46	Associate Professor,International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study	Ph.D. Biomedical Engineering	100	2019-09-01	Stays at the center and participates in the center's activities	

Mingbo Cai	36	Assistant Professor,International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study	Ph.D. Neuroscienc e	100	2019-12-01	Stays at the center and participates in the center's activities	

*Percentage of time that the principal investigator devotes to working for the center vis-à-vis his/her total working hours.

Principal investigators unable to participate in project in FY 2021

Name	Affiliation (Position title, department,	Starting date of project participation	Reasons	Measures taken

Appendix 2a Biographical Sketch of a New Principal Investigator

(within 3 pages per person)

Does not apply for FY2021

Name (Age)

Affiliation and position (Position title, department, organization, etc.)

Academic degree and specialty

Effort **%**

* Percentage of time that the principal investigator devote to working for the center vis-à-vis his/her total working hours.

Research and education history

Achievements and highlights of past research activities

Achievements

(1) International influence * Describe the kind of attributes listed below.

a) Recipient of international awards

b) Member of a scholarly academy in a major country

c) Guest speaker or chair of related international conference and/or director or honorary member of a major international academic society in the subject field

d) Editor of an international academic journal

e) Peer reviewer for an overseas competitive research program (etc.)

(2) Receipt of major large-scale competitive funds (over the past 5 years)

(3) Major publications (Titles of major publications, year of publication, journal name, number of citations)

(4) Others (Other achievements indicative of the PI's qualification as a top-world researcher, if any.)

Appendix 3-1 FY 2021 Records of Center Activities

1. Researchers and center staff, satellites, partner institutions

1-1. Number of researchers in the "core" established within the host institution

- Regarding the number of researchers at the Center, fill in the table in Appendix 3-1a.

Special mention

- Enter matters warranting special mention, such as concrete plans for achieving the Center's goals, established schedules for employing main researchers, particularly principal investigators.
- As background to how the Center is working on the global circulation of world's best brains, give good examples, if any, of how career paths are being established for the Center's researchers; that is, from which top-world research institutions do researchers come to the Center and to which research institutions do the Center's researchers go, and how long are their stays at those institutions.

The global circulation of the world's best brains was prevented worldwide due to strict quarantine and travel restrictions for COVID-19. During the pandemic, we have continued to expand Team Science trainees with domestic candidates. This offers a unique fusion research experience, as each of them must be co-mentored by two PI / AFs in different fields (eg clinical and computational). Once the pandemic lifts, we aim to resume internship and exchange programs with our global partners.

1-2. Satellites and partner institutions

- List the satellite and partner institutions in the table below.
- Indicate newly added and deleted institutions in the "Notes" column.
- If satellite institutions have been established overseas, describe by satellite the Center's achievements in coauthored papers and researcher exchanges in Appendix 4.

<Satellite institutions>

Institution name	Principal Investigator(s), if any	Notes
Boston Children's Hospital	Takao Kurt Hensch	

< Partner institutions>

Institution name	Principal Investigator(s), if any	Notes
The Max Planck Florida Institute for Neuroscience		
The Agency For Science, Technology And Research (A*STAR)		
Istituto Italiano di Tecnologia (IIT)		
RIKEN Center for Advanced Intelligence Project (AIP), RIKEN Center for Biosystems Dynamics Research (BDR)	Masashi Sugiyama Yasushi Okada	
National Centre Competence in Research (NCCR) Synapsy		
Edwin O. Reischauer Institute of Japanese Studies at Harvard University	Takao Hensch	
Asian Consortium on MRI studies on Psychosis	Kiyoto Kasai	
Okinawa Institute of Science and Technology Graduate University	Yoko Yazaki-Sugiyama	
The University of British Columbia		
The Hong Kong University of		

Science and Technology		
Collège de France		
CIFAR, The Canadian Institute for Advanced Research	Takao Hensch	
Institute of Neuroscience (ION), Center for Excellence in Brain Science and Intelligence Technology, Chinese Academy of Sciences		
Stockholm University		
KTH Royal Institute of Technology		
Karolinska Institutet		
Tsinghua University		
Bielefeld University		
École normale supérieure		

2. Holding international research meetings

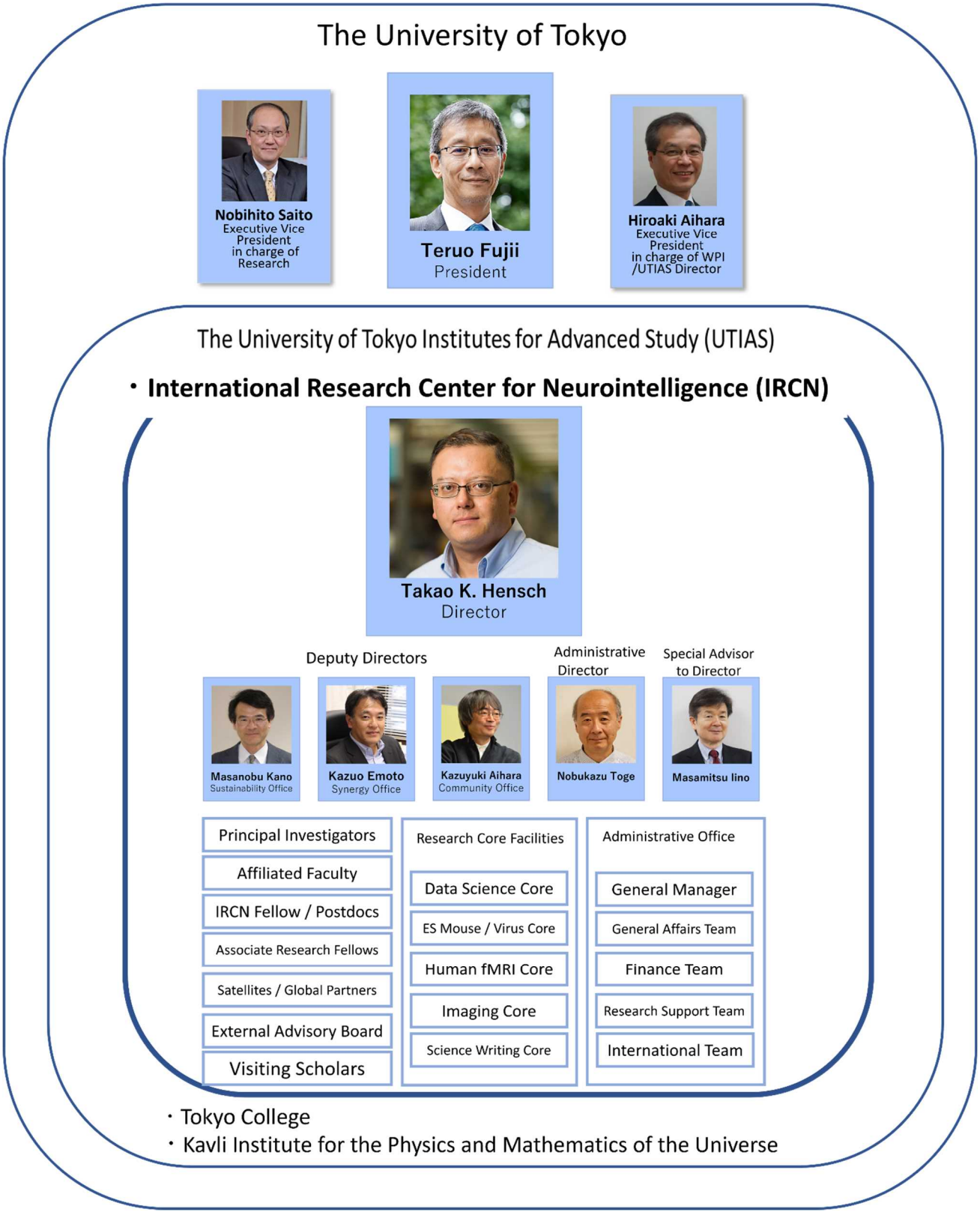
- Indicate the number of international research conferences or symposiums held in FY2021 and give up to three examples of the most representative ones using the table below.

FY 2021: 0 meetings

Major examples (meeting titles and places held)	Number of participants
None	From domestic institutions: None From overseas institutions: None

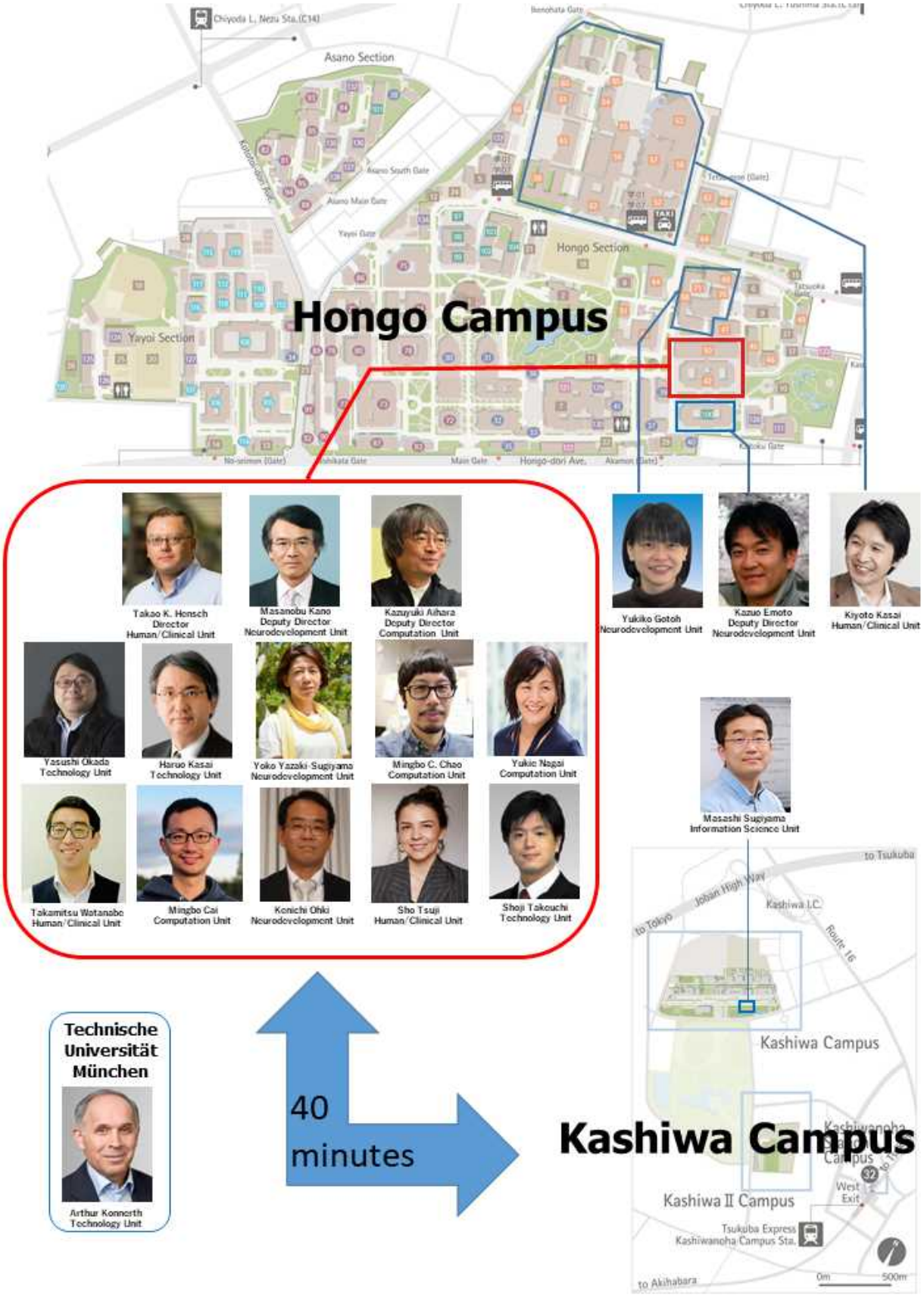
3. Diagram of management system

- Diagram the center's management system and its position within the host institution in an easily understood manner.
- If any new changes have been made in the management system from that in the latest "center project" last year, describe them. Especially describe any important changes made in such as the center director, administrative director, head of host institution, and officer(s) in charge at the host institution (e.g., executive vice president for research).



4. Campus Map

- Draw a simple map of the campus showing where the main office and principal investigator(s) are located.



5. Securing external research funding*

External research funding secured in FY2021

Total: 1,397,503,846 yen

- Describe external funding warranting special mention. Include the name and total amount of each grant.
* External research funding includes "KAKENHI," funding for "commissioned research projects," "joint research projects," and for others (donations, etc.) as listed under "Research projects" in Appendix 3-2, Project Expenditures.

JSPS Grant-in-Aid for Transformative Research Areas A: 78,500,000 yen
Grant-in-Aid for Scientific Research on Innovative Areas: 89,051,505 yen
Grant-in-Aid for Scientific Research A: 6,600,000 yen
Grant-in-Aid for Scientific Research B: 9,200,000 yen
Grant-in-Aid for Scientific Research C: 800,000 yen
Grant-in-Aid for Scientific Research S: 68,100,000 yen
Grant-in-Aid for Specially Promoted Research: 600,000 yen
Grant-in-Aid for Young Scientists (Start-up): 1,100,000 yen
Grant-in-Aid for JSPS Fellows: 1,100,000 yen

MLHW Health and Labor Sciences Research Grant: 2,847,000 yen

JST Moonshot Research and Development Program: 443,200,000 yen
CREST: 137,350,000 yen
ACT-X: 3,498,000 yen
JST-Mirai Program: 111,438,000 yen

AMED Brain/MINDS: 42,000,000 yen
Brain/MINDS Beyond: 48,000,000 yen
AMED-CREST: 58,020,900 yen
Project for Regenerative / Cellular Medicine and Gene Therapies: 39,230,000 yen
SICORP: 5,130,000 yen

Beyond AI (collaborative research with Softbank): 67,750,000 yen

Collaborative research with Daikin: 57,760,000 yen

Collaborative research with NTT Research: 15,384,615 yen

Others: 110,843,826 yen

Appendix 3-1a FY 2021 Records of Center Activities

Researchers and other center staff

Number of researchers and other center staff

* Fill in the number of researchers and other center staff in the table blow.
* Describe the final goals for achieving these numbers and dates when they will be achieved described in the last "center project."

a) Principal Investigators

(full professors, associate professors or other researchers of comparable standing)

(number of persons)

	At the beginning of project	At the end of FY 2021	Final goal (March, 2027)
Researchers from within the host institution	12	15	14
Researchers invited from overseas	2	2	1
Researchers invited from other Japanese institutions	0	1	1
Total principal investigators	14	18	16

b) Total members

	At the beginning of project		At the end of FY 2021		Final goal (March, 2027)	
	Number of persons	%	Number of persons	%	Number of persons	%
Researchers	27		123		70	
Overseas researchers	3	11	45	37	23	33
Female researchers	4	15	20	16	14	20
Principal investigators	14		18		16	
Overseas PIs	2	14	4	22	3	19
Female PIs	1	7	4	22	4	25
Other researchers	13		81		40	
Overseas researchers	1	8	20	25	10	25
Female researchers	3	23	11	14	5	13
Postdocs	0		24		14	
Overseas postdocs	0		21	88	10	71
Female postdocs	0		5	21	5	36
Research support staffs	0		38		20	
Administrative staffs	3		20		10	
Total number of people who form the "core" of the research center	30		181		100	

Appendix 3-2 Project Expenditures

1) Overall project funding

* In the "Total costs" column, enter the total amount of funding required to implement the project, without dividing it into funding sources.
* In the "Amount covered by WPI funding" column, enter the amount covered by WPI within the total amount.
* In the "Personnel," "Project activities," "Travel," and "Equipment" blocks, the items of the "Details" culumn may be changed to coincide with the project's actual content.

(Million yens)

Cost items	Details (For Personnel - Equipment please fill in the breakdown of fiscal expenditure, and the income breakdown for Research projects.)	Total costs	Amount covered by WPI funding[*3]
Personnel	Center director and administrative director	49	49
	Principal investigators (no. of persons):17	173	28
	Other researchers (no. of persons):18	161	161(24)
	Research support staff (no. of persons):11	54	54(12)
	Administrative staff (no. of persons):22	156	77
	Subtotal	593	369(36)
Project activities	Gratuities and honoraria paid to invited principal investigators	0	0
	(no. of persons):0	0	0
	Cost of dispatching scientists (no. of persons):1	0	0
	Research startup cost (no. of persons):14	26	26
	Cost of satellite organizations (no. of satellite organizations):1	85	85
	Cost of international symposiums (no. of symposiums):0	0	0
	Rental fees for facilities	74	74
	Cost of consumables	40	37(16)
	Cost of utilities	7	7
	Other costs	77	75(32)
	Subtotal	309	304(48)
Travel	Domestic travel costs	1	1(1)
	Overseas travel costs	1	1
	Travel and accommodations cost for invited scientists	0	0
	(no. of domestic scientists):0	0	0
	(no. of overseas scientists):0	0	0
	Travel cost for scientists on transfer	0	0
	(no. of domestic scientists):2	1	1
	(no. of overseas scientists):1	0	0
	Subtotal	3	3(1)
Equipment	Depreciation of buildings	7	7
	Depreciation of equipment	125	125(1)
	Subtotal	132	132(1)
Research projects (Detail items must be fixed)	Project supported by other government subsidies, etc. [*1]	64	0
	KAKENHI	258	0
	Commissioned research projects, etc.	888	0
	Joint research projects	141	0
	Ohers (donations, etc.)	111	0
	Subtotal	1462	0
Total		2499	808(86)

Costs (Million yens)

WPI grant in FY 2021	0
Costs of establishing and maintaining facilities	0
Establishing new facilities	0
(Number of facilities: , OO m²)	
Repairing facilities	0
(Number of facilities: , OO m²)	
Others	0
Costs of equipment procured	74
・fMRI system for brain function measurement 1set	41
Others	33

*1. Management Expenses Grants (including Management Enhancements Promotion Expenses (機能強化経費)), subsidies including National university reform reinforcement promotion subsidy (国立大学改革強化推進補助金) etc., indirect funding, and allocations from the university's own resources.
*2 When personnel, travel, equipment (etc.) expenses are covered by KAKENHI or under commissioned research projects or joint research projects, the amounts should be entered in the "Research projects" block.
*3.Figures in brackets are carry-over amounts.

*1 運営費交付金（機能強化経費を含む）、国立大学改革強化推進補助金等の補助金、間接経費、その他大学独自の取組による学内リソースの配分等による財源
*2 科研費、受託研究費、共同研究費等によって人件費、旅費、設備備品等費を支出している場合も、その額は「研究プロジェクト費」として計上すること
*3 括弧内は繰り越し分

2) Costs of satellites

(Million yens)

Cost items	Details	Total costs	Amount covered by WPI funding
Personnel	Principal investigators (no. of persons):OO		
	Other researchers (no. of persons):OO		
	Research support staff (no. of persons):OO		
	Administrative staff (no. of persons):OO		
	Subtotal	0	0
Project activities	Subtotal	85	85
Travel	Subtotal		
Equipment	Subtotal		
Research projects	Subtotal		
Total		85	85

Appendix 4 FY 2021 Status of Collaboration with Overseas Satellites

1. Coauthored Papers

- List the refereed papers published in FY 2021 that were coauthored between the center's researcher(s) in domestic institution(s) (include satellite institutions) and overseas satellite institution(s). List them by overseas satellite institution in the below blocks.
- Transcribe data in same format as in Appendix 1. Italicize the names of authors affiliated with overseas satellite institutions.
- For reference write the Appendix 1 item number in parentheses after the item number in the blocks below. Let it free, if the paper is published in between Jan.-Mar. 2022 and not described in Appendix 1.

Overseas Satellite 1 **Boston Children's Hospital** (Total: 6 papers)

1. Sviridova N, **Artoni P**, **Fagiolini M**, **Hensch TK**, Aihara K. Dynamical Characteristics of Wild-Type Mouse Spontaneous Pupillary Fluctuations. Annu Int Conf IEEE Eng Med Biol Soc. 2021 Nov;2021:853-856. doi: 10.1109/EMBC46164.2021.9630747.

2. Emoto K, **Hensch TK**, Yuzaki M. "Scrap & build" functional circuits: Molecular and cellular basis of neural remodeling. Neurosci Res. 2021 Jun;167:1-2. doi: 10.1016/j.neures.2021.04.005.

3. Matsuda YT, Miyamoto H, Joho RH, **Hensch TK**. $K_V3.1$ channels regulate the rate of critical period plasticity. Neurosci Res. 2021 Jun;167:3-10. doi: 10.1016/j.neures.2021.04.003. Epub 2021 Apr 16.

4. Reh RK, **Hensch TK**, Werker JF. Distributional learning of speech sound categories is gated by sensitive periods. Cognition. 2021 Aug; 213:104653. doi: 10.1016/j.cognition.2021.104653.

5. Zhu Y, Wang MJ, Crawford KM, Ramírez-Tapia JC, Lussier AA, Davis KA, de Leeuw C, Takesian AE; Major Depressive Disorder Working Group of the Psychiatric Genomics Consortium, **Hensch TK**, Smoller JW, Dunn EC. Sensitive period-regulating genetic pathways and exposure to adversity shape risk for depression. Neuropsychopharmacology. 2022 Jan;47(2):497-506. doi: 10.1038/s41386-021-01172-6.

6. Benham RS, Choi C, Hodgson NW, Hewage NB, Kastli R, Donahue RJ, Muschamp JW, Engin E, Carlezon WA Jr, **Hensch TK**, Rudolph U. α2-containing γ-aminobutyric acid type A receptors promote stress resiliency in male mice. Neuropsychopharmacology. 2021 Nov;46(12):2197-2206. doi: 10.1038/s41386-021-01144-w. Epub 2021 Aug 18.

2. Status of Researcher Exchanges

- Using the below tables, indicate the number and length of researcher exchanges in FY 2021. Enter by institution and length of exchange.
- Write the number of principal investigator visits in the top of each space and the number of other researchers in the bottom.

Overseas Satellite 1:

<To satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2021	0	0	0	0	0
	0	0	0	0	0

<From satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2021	0	0	0	0	0
	0	0	0	0	0

Appendix 5 FY 2021 Visit Records of Researchers from Abroad

* If researchers have visited/ stayed at the Center, provide information on them in the below table.
* Enter the host institution name and the center name in the footer.

Total: 0

	Name	Age	Affiliation		Academic degree, specialty	Record of research activities (Awards record, etc.)	Time, duration	Summary of activities during stay at center (e.g., participation as principal investigator; short-term stay for joint research; participation in symposium)
			Position title, department, organization	Country				
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Appendix 6 FY2021 State of Outreach Activities

* Fill in the numbers of activities and times held during FY2021 by each activity.
* Describe the outreach activities in the "6. Others" of Progress Report, including those stated below that warrant special mention.

Activities	FY2021 (number of activities, times held)
PR brochure, pamphlet	N.A.
Lectures, seminars for general public	9
Teaching, experiments, training for elementary, secondary and high school students	10
Science café	3
Open houses	N.A
Participating, exhibiting in events	6
Press releases	12
Publications of the popular science books	7
Others（ ）	18

*If there are any rows on activities the center didn't implement, delete that (those) row(s). If you have any activities other than the items stated above, fill in the space between parentheses after "Others" on the bottom with the name of those activities and state the numbers of activities and times held in the space on the right. A row of "Others" can be added, if needed.

Outreach Activities and Their Results

List up to three of the Center's outreach activities carried out in FY 2021 that have contributed to enhancing the brand or recognition of your Center and/or the brand of the overall WPI program, and describe its concrete contents and effect in narrative style. (Where possible, indicate the results in concrete numbers.)

Examples:
- As a result of using a new OO press-release method, a OO% increase in media coverage was obtained over the previous year.
- By holding seminars for the public that include people from industry, requests for joint research were received from companies.
- We changed our public relations media. As a resulting of using OO to disseminate information, a OO% increase in inquiries from researchers was obtained over the previous year.
- As a result of vigorously carrying out OO outreach activity, ¥OO in external funding was acquired.

1. Fusion of Research and Outreach

- Miraikan Exhibition and Open Lab

From 25 March 2021 until 6 March 2022, IRCN hosted a public exhibition "Advancing 'neurointelligence' Brain Observers and Creators" at Miraikan, a science museum run by Japan Science and Technology Agency (JST). The exhibition was part of the "Visionaries Lab", a Miraikan's specially featured project. The exhibition aimed to showcase the fusion of the research of human brain and artificial intelligence and provided visitors hands-on experience and opportunities to participate in experiments, and in doing so share the joy and excitement of scientific discovery. During the exhibition period, over 150 thousand people visited the Miraikan.

Open Lab

As part of the exhibition, IRCN organized two experiments and a workshop which visitors can participate.

1. 「文字に色を感じる? 感じない? ～「共感覚」から考える脳の発達」("Do you sense colors in letters? Understanding brain development through Synesthesia"): Between 3 November 2021 and 26 December, Dr. Takao Hensch (Director) and Dr. Mingbo Cai (PI) organized experiments for 16 days to provide an opportunity to deepen understanding of synesthesia and to know about brain science. 864 people participated in the experiment.
2. 「子どもは社会環境の中でどうことばを習うの？」("How do children learn language in a social environment?") : Between 7 November 2021 and 25 December 2021, Dr. Sho Tsuji (PI) organized game-formatted experiments for 7 days and provided participants to think about what are the important aspects when human learns a language. 66 people participated.
3. カードゲーム型ワークショップ「脳×AIで発想を広げよう」(A workshop using card game: Imagine what combination of brain and AI research can bring to our future") : On 23 February 2022, Dr. Tatsuya Daikoku (Research Fellow) and

Dr. Masafumi Kuroda (Research Fellow) organized a workshop to provide participants an opportunity to envision the future where research on human brain and artificial intelligence are fully utilized. 15 people participated.

2. Collaboration with Global Partners and Global Outreach

- Tokyo Forum 2021

On 3 December 2021, IRCN organized a specially featured panel session during the Tokyo Forum 2021, an international symposium co-organized by the University of Tokyo and Chey Institute of Advanced Studies aimed to provide a meeting place of people from all over the world to exchange new knowledge and ideas to tackle global issues and to envision a shared future of humanity. Dr. Takao Hensch (Director), Dr. Masamitsu Iino (PI) and Dr. Kiyoto Kasai (PI) organized a panel session "The Resilient Brain: Mental Health in Balance with Society and Planet", inviting renowned scholars such as Dr. Ichiro Kawachi (Professor, Harvard T.H. Chan School of Public Health), Dr. Richard Davidson (Founder and Director, Center for Healthy Minds, University of Wisconsin-Madison) and Dr. Daphne Bavelier (Professor, University of Geneva). The panel discussion focused on resilience, which has been gaining attention recently from the perspectives of neuroscience, psychology, psychiatry, preventive medicine, social science, and child development. Tokyo Forum 2021 was held online for two days on 2 and 3 December, invited a total of more than 40 speakers from across the globe and from variety of sectors and attracted 21,446 viewers from 112 countries. By participating in this event, IRCN was able to share the cutting-edge knowledge of research on human brain to the audience from around the world and effectively promoted the importance of WPI initiative and basic science.

3. General Public Books Published in FY2021

Books are effective outreach channel to share the excitement of discovery and cutting-edge research. The following books were published by the members of the IRCN in FY2021 and contributed significantly in promoting the importance of basic research.

- 「文系のためのめっちゃやさしい脳」("Very easy-to-understand brain for the liberal-arts-minded")
  Haruo Kasai（Principal Investigator）
  Newton Press (Published on 25.03.2022)

- Good vibrations
  Tatsuya Daikoku (Research Fellow)
  (Yukie Nagai Laboratory)
  YAMAHA music media publishing. (ヤマハミュージックエンタテイメントホールディングズ.) (ISBM: 978-4636976816)
  (Published on 24.02.2022)

- 音楽する脳 ("Musical Brain")
  Tatsuya Daikoku (Research Fellow)
  (Yukie Nagai Laboratory)
  Asahi-Shinbun publishing （朝日新聞出版社）(ISBM: 978-4022951632)
  (Published on 10.2.2022)

- 「脳とAI一言語と思考へのアプローチ」("Brain vs AI – How we approach our language and thoughts")
  Kazuyuki Aihara (Principal Investigator)
  Kuniyoshi Sakai (Affiliated Faculty)
  CHUOKORON-SHINSHA, INC.(中央公論新社)
  (Published on 07.01.2022)

- "Encyclopedia of Food and Nutrition" (Supplement 2nd Edition)
  Collaborator： Mechanism to distinguish odors, pp108-109
  Kazushige Touhara (Affiliated Faulty)
  Newton extra issue (Published on 05.08.2021)

- AI時代に[自分の才能を伸ばす]ということ（"Human ability in AI society"）
  Tatsuya Daikoku (Research Fellow)
  (Yukie Nagai Laboratory)
  Asahi-Shinbun publishing (朝日新聞出版) (ISBN: 978-4023319509)
  (Published on 20.04.2021)

- 生命知能と人口知能　AI時代の脳の使い方・育て方 ("Living intelligence and artificial intelligence – How to use and nurture our brain in the AI era")
  Hirokazu Takahashi (Affiliated Faculty)
  Kodansha Ltd.(講談社)（全322頁）(ISBN 978-4-06-527051-6)

Appendix 7 FY 2021 List of Project's Media Coverage

* List and describe media coverage (e.g., articles published, programs aired) in FY2021.

* Enter the host institution name and the center name in the footer.

No.	Date (dd.mm.yyyy)	Types of Media (e.g., newspaper, magazine, television)	Description
1	24.03.2022	NHK (television)	【Ueda】Humanience (ヒューマニエンス, NHK) and presented on time information in life sciences including circadian clocks.
2	24.03.2022	DEMPA DIGITAL (website)	【Aihara】 "「第7回立石賞」決まる　功績賞に中村仁彦東大名誉教授　特別賞に合原一幸東大名誉教授" ("7th Tateishi award annnounced. Special award for Prof K.Aihara and Achievement award for Prof N.Nakamura")
3	24.03.2022	DEMPA SHIMBUN (newspaper)	【Aihara】"「第7回立石賞」決まる　功績賞に中村仁彦東大名誉教授　特別賞に合原一幸東大名誉教授" written by DEMPA SHIMBUN (Morning edition, page 4) ("7th Tateishi award annnounced. Special award for Prof K.Aihara and Achievement award for Prof N.Nakamura")
4	24.03.2022	NIKKAN KOGYO SHIMBUN WEB (website)	【Aihara】"立石賞に東大・中村氏ら　立石科技振興財団が選定" ("Tateishi award for Prof K.Aihara and Achievement and Prof N.Nakamura")
5	24.03.2022	NIKKAN KOGYO SHIMBUN (newspaper)	【Aihara】 "立石賞に東大・中村氏ら　立石科技振興財団が選定" (Morning edition, page) ("Tateishi award for Prof K.Aihara and Achievement and Prof N.Nakamura")
6	24.03.2022	New Scientist (magazine)	【Kuniyoshi】an article about a paper by Heecheol Kim, Yoshiyuki Ohmura, Yasuo Kuniyoshi titled "Robot peels banana with goal-conditioned dual-action deep imitation learning"
7	23.03.2022	KYOTO SHIMBUN ONLINE (website)	【Aihara】 "立石賞に中村氏と合原氏　運動時の関節可視化や複雑系の制御で功績" ("Tateishi award for Prof K.Aihara and Achievement and Prof N.Nakamura")
8	23.03.2022	KYOTO SHIMBUN (newspaper)	【Aihara】"立石賞に中村氏ら2人　運動時の関節可視化を評価" (Morning edition, page 13) ("Tateishi award for Prof N.Nakamura and others")
9	22.03.2022	NIHON KEIZAI SHIMBUN ONLINE (website)	【Aihara】 "人と機械の調和を促進、立石賞に中村氏と合原氏" ("Tateishi award for Prof N.Nakamura and others")
10	22.03.2022	OMRON (website)	【Aihara】 "公益財団法人 立石科学技術振興財団 第7回立石賞受賞者決定のお知らせ" ("Tateishi award announced")
11	19.03.2022	NHK E-tel (television)	【Nagai】NHK E-tele "Sukusuku Kosodate" (NHK Eテレ「すくすく子育て」) ("NHK E-channel - Happy parenting")
12	19.03.2022	YAMAHA monthly piano (magazine)	【Nagai】YAMAHA monthly piano: April issue. How to use music to create the best physical condition. (YAMAHA月刊ピアノ4月号 読書ノススメ. 最高の体調をつくる音楽の活用法.)
13	12.03.2022	Nature website (website)	【Hoshino】An interview with Associate Professor Hoshino was published on the Nature website.
14	07.03.2022	Precious (online magazine)	【Tsuji】Special corner on SDGs
15	03.03.2022	Nihon Keizai Shimbun (newspaper)	【HTakahashi】目利きが選ぶ３冊「人工知能と生命知能　高橋宏知著　共存の鍵は人間の意識に（サイエンス作家　竹内薫）」，日本経済新聞（夕刊12面），Nihon Keizai Shimbun evening edition page 12 (Book review: "Artificial intelligence and life intelligence," by H.Takahashi)
16	02.03.2022	Aera dot. (online magazine)	【Nagai】AERA dot. Why the brain is moved by classical music. (AERA dot. 脳はなぜクラシックに感動するのか？)
17	01.03.2022	Quest for Knowledge (website)	【Hoshino】Z-kai Web Magazine "Quest for Knowledge"
18	15.02.2022	Yahoo news (website)	【Nagai】Contemporary music expresses what is still unexplained by science and logic through 'sensitivity' first. (現代音楽は「科学や論理ではまだ未解明なものを"感性"によって先に表現しているもの」)
19	11.02.2022	Azolifesciences (online news)	【Touhara】Azolifesciences: Hemoglobin plays role as a chemosensory signal for mother mice to protect offspring
20	20.02.2022	Yomiuri Shimbun (newspaper)	【HTakahashi】本よみうり堂「『生命知能と人工知能　AI時代の脳の使い方・育て方』高橋宏知著（講談社）　自律化と自動化を対比 (評・西成活裕)」 Yomiuri Shimbun morning edition page 13 (Book review: "Artificial intelligence and life intelligence," by H.Takahashi)
21	01.02.2022	Life Science DOKIDOKI Laboratory (website)	【Hoshino】Interview with Associate Professor Hoshino appeared on the website "Life Science DOKIDOKI Laboratory".
22	14.01.2022	Gendai Business (online)	【HTakahashi】「生命知能と人工知能 (3)　米国に倣ってきた日本が，決められない社会になったワケ」，現代ビジネス　社会 ("Artificial intelligence and life intelligence (3) - Why the society in Japan has become unable to 'decide'?," by H.Takahashi)
23	13.01.2022	Gendai Business (online)	【HTakahashi】「生命知能と人工知能 (2)　人工知能が人間をダメにする?　人間と人工知能の"脳"を分析」，現代ビジネス　社会 ("Artificial intelligence and life intelligence (2) - Analyze the difference between human intelligence and artificial intelligence" by H.Takahashi)
24	12.01.2022	Gendai Business (online)	【HTakahashi】「生命知能と人工知能 (1)　人工知能と苦手分野が一致!?　"人工知能化"する若者たち」，現代ビジネス　社会 ("Artificial intelligence and life intelligence (1) - Young generation who act like dictated by artificial intelligence" by H.Takahashi)
25	12.01.2022	SYNCRONOUS (online)	【Myowa】2022 シンクロナス　脳に性差はない！ 子育てに必要な「親性脳」を育てる方法　第４回 比較認知発達科学からみる
26	26.12.2021	KOBE SHIMBUN (newspaper)	【KKasai】Kobe Shimbun December 26, 2021
27	14.12.2021	Asahi Shimbun morning edition (newspaper)	【HKasai】脳の神経細胞「推す力」で情報伝達 Information transmission with brain neurones "pussing power"
28	21.12.2021	The University of Tokyo Shimbun (newspaper)	【HTakahashi】「【受験生応援】高橋宏知准教授に聞く、受験勉強と音楽の関係」，東京大学新聞， the University of Tokyo Shimbun ("University entrance exams and music")

29	03.12.2021	The Science News (newspaper)	【HKasai】記憶形成に筋肉同様の圧力が関与 Memory formation is related to pressure similar to muscle.
30	03.12.2021	The Science News (newspaper)	【NOkada】Birth order and prosociality in the early adolescent brain
31	01.12.2021	Toshin Times (magazine)	【Hoshino】Special Lecture by Associate Professor Hoshino on Science Seminar for High School Students appeared in the Toshin Times.
32	25.11.2021	TBS NEWS (website)	【HKasai】脳で記憶は「力」によって作られる？ 第3の伝達方式発見 Is memory in the brain made from "power"? Discovery of the 3rd transmission method.
33	24.11.2021	Bessatsu Nikkei Science 248 (magazine)	【Hoshino】An interview with Associate Professor Hoshino is featured in this issue
34	06.11.2021	JIJI.COM (website)	【Myowa】2021 時事ドットコム（時事通信ニュース）コロナ禍が子供の脳と心に及ぼす影響 ("How does the COVID-19 situation affects children's brain and heart")
35	05.11.2021	Adeco Power of Work Vol.28 (magazine)	【Nagai】Adecco "Power of Work Vol. 28". Divergent and Convergent Thinking are Two Important Thinking Tips for Creativity and Learning from Brain Science. (アデコ「Power of Work Vol.28」. 拡散的思考と収束的思考の 2 つが重要 脳科学から見た創造性と学びのための思考のヒント.)
36	04.11.2021	Mainichi Shimbun(newspaper)	【Hoshino】Interview of Associate Professor Hoshino in The Mainichi Shimbun
37	04.11.2021	NHK (television)	【Ushiba】NHK-BS "Humanience", Human potentials, "Brain Power" as flexibility
38	03.11.2021	NHK (television)	【Myowa】2021 NHKスペシャル ジェンダーサイエンス（1）「男X女 性差の真実」 取材協力・出演（NHK総合1，2021年11月3日19:30-20:19, 再放送2021年11月10日23:35-0:24）("NHK special - Genger science (1) - The truth of gender difference")
39	02.11.2021	Nikkei Sangyo Shimbun (newspaper)	【Hoshino】Nikkei Sangyo Shimbun
40	27.10.2021	Mail Online Science &Tech (online)	【HTakahashi】Mail Online Science &Tech. Thinking' robot with neurons grown in a lab from living brain cells is taught to steer its way around walls and obstacles. (By Jonathan Chadwick for Mail Online).
41	27.10.2021	Express (online)	【HTakahashi】Express. Scientists raise alarm as world's first 'thinking' robot with BRAIN created. (By Sebastian Kettley).
42	27.10.2021	Space Daily (online)	【HTakahashi】Space Daily. Teaching robots to think like us. (By Staff Writers).
43	27.10.2021	The Science Times (online)	【HTakahashi】The Science Times. Japan Develops 'Thinking Robot' Through Physical Reservoir Computing; Learns and Moves by Artificial Neurons. (By Ron Jefferson).
44	27.10.2021	Hackster. io. (online)	【HTakahashi】Hackster. io. FORCE Physical Reservoir Computing Uses Living Neurons to Teach Robots to "Think" Like Humans Do. (By Gareth Halfacree).
45	26.10.2021	AIP publishing (online)	【HTakahashi】AIP publishing. Teaching Robots to Think Like Us.
46	25.10.2021	DIAMOND online (website)	【Myowa】2021 「マスク世代の子ども」に知能低下リスク？専門家が考える対策とは（田中慧：清談者）DIAMONND online（2021年10月25日）("How does mask-earing affect children?")
47	14.10.2021	UTokyo homepage (website)	【Nagai】UTokyo FOCUS: Diversity & Inclusion Research 02. AI to understand and support people with disabilities.
48	13.10.2021	the YouTube channel of the School of Bioscience and Biotechnology, Tokyo Tech (youtube)	【Hoshino】Associate Professor Hoshino's video introducing the research of Hoshino Lab. has been uploaded on the YouTube channel of the School of Bioscience and Biotechnology, Tokyo Tech.
49	13.10.2021	ICT E-NEWS NET (website)	【Aihara】Website article entitled "中部大学、AI数理データサイエンスセンター キックオフシンポジウムを17日開催" written by ICT E-NEWS NET ("Chubu University hosts the kick-off symposium of AI mathematical data science center")
50	13.10.2021	Nihon Keizai Shinbun (website)	【KKasai】Nihon Keizai Shimbun, October 13,
51	13.10.2021	Qlife Pro Medical NEWS (website)	【KKasai】QLife Pro Medical NEWS October
52	01.10.2021	the alumni magazine of Tokyo Institute of Technology (magazine)	【Hoshino】Associate Professor Hoshino contributed to Kuramae Journal "Laboratory Visit", the alumni magazine of Tokyo Institute of Technology
53	09.08.2021	TO-O NIPPO PRESS (newspaper)	【Aihara】Newspaper article entitled "コロナ薬 早期投与が鍵「バーチャル治験」で解明" (Morning edition, page 8) ("Critical importance of early medication treatment for COVID-19, as revealed by virtual clinical trials")
54	02.09.2021	MAINICHI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "不要な隔離期間、短縮" ("Reduction of unnucessary quarantine period") (Morning edition, page 11)
55	31.08.2021	YOMIURI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ患者の隔離期間試算"("Estimating the duration of isolation needed for patients infected with coronavirus") (Morning edition, page 6)
56	26.08.2021	MAINICHI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ治療薬の臨床試験 発症後すぐ調べ効率的に" ("Clinical trials for novel coronavirus treatments: Increase efficiency by investigating soon after onset of symptoms") (Morning edition, page 3)
57	24.08.2021	KAGAKU KOGYO SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "名古屋大など、新型コロナの適切な隔離期間計算、シミュレーションソフト開発" ("Nagoya University and collaborators develop simulation software to calculate appropriate isolation period for patients infected with novel coronavirus") (Morning edition, page 5)
58	23.08.2021	NISHI-NIPPON SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ治療薬、早期投与かぎ" ("Drugs to treat coronavirus infection; early administration is key") (Morning edition, page 9)

59	23.08.2021	YAMANASHI NICHINICHI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ薬 早期投与が鍵" ("Drugs to treat coronavirus infection; early administration is key") (Morning edition, page 12)
60	21.08.2021	YOMIURI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ隔離期間の試算法開発" ("Development of a method for estimating the duration of isolation needef for patients infected with coronavirus) (Morning edition, page 3)
61	19.08.2021	IBARAKI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ薬効果の臨床治験 発症後早期投与が鍵" ("Clinical trials of treatment efficacy for coronavirus infection; early administration after the onset is key") (Morning edition, page 17)
62	18.08.2021	Dream Navi (magazine)	【Hoshino】An interview with Associate Professor Hoshino appeared in Dream Navi
63	13.08.2021	SHIMOTSUKE SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ治療薬候補の効果確認 発症直後の早期投与が鍵"("Efficacy of candidate drug for coronavirus infection confirmed; early administration immediately after onset of illness is key") (Morning edition, page 16)
64	31.8.2021	NHK (television)	【KKasai】NHK News Database of brain images of about 1,600 people available online Dr. Saori Tanaka (ATR)
65	12.08.2021	KOBE SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ薬治療 早期投与が鍵" ("Drugs to treat coronavirus infection; early administration is key") (Morning edition, page 14)
66	12.08.2021	SHINANO MAINICHI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "治療薬の治験 早期投与が鍵" ("Clinical trials for therapeutic drugs, early administration is key") (Morning edition, page 13)
67	12.08.2021	KIDSNA (website)	【Tsuji】Articles on language acquisition targeted at educators/parents(2)
68	11.08.2021	SAGA SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ薬治療 早期投与が鍵" ("Drugs to treat coronavirus infection; early administration is key") (Morning edition, page 15)
69	11.08.2021	SAITAMA SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ薬 早期投与が鍵"("Drugs to treat coronavirus infection; early administration is key") (Morning edition, page 13)
70	11.08.2021	RYUKYU SHIMPO (newspaper)	【Aihara】Newspaper article entitled "コロナ薬治験 早期投与が鍵 仮想システム活用し確認" ("Coronavirus drug trial; early administration is key; a virtual system has confirmed") (Morning edition, page 17)
71	06.08.2021	MIYANICHI E-PRESS (website)	【Aihara】Website article entitled "医療新世紀「コロナ薬、早期投与が鍵」" ("Drugs to treat coronavirus infection; early administration is key")
72	02.08.2021	YAMAGUCHI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "医療新世紀「コロナ薬、早期投与が鍵」("Drugs to treat coronavirus infection; early administration is key") " (Morning edition, page 5)
73	02.08.2021	DAILY TOHOKU (newspaper)	【Aihara】Newspaper article entitled "医療新世紀「コロナ治療薬 早期投与が鍵」("Drugs to treat coronavirus infection; early administration is key") (Morning edition, page 19)
74	02.08.2021	CHIBA NIPPOU (newspaper)	【Aihara】Newspaper article entitled "医療新世紀「コロナ薬、早期投与が鍵」("Drugs to treat coronavirus infection; early administration is key") (Morning edition, page 14)
75	31.07.2021	KYOTO SHIMBUN ONLINE (website)	【Aihara】Website article entitled "新型コロナ治療薬は早期投与が鍵か 治験での効果確認で研究結果" ("Early administration of new coronavirus drug is key? Efficacy confirmed in clinical trial studies")
76	28.07.2021	CHUNICHI SHIMBUN ONLINE (website)	【Aihara】Website article entitled "コロナ患者隔離「10 日間は妥当」" (Coronavirus-infected patient isolation, "10 days is reasonable")
77	28.07.2021	CHUNICHI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ患者隔離「10 日間は妥当」" (Coronavirus-infected patient quarantine, "10 days is reasonable") (Morning edition, page 25)
78	28.07.2021	MAINAVI NEWS (website)	【Aihara】Website article entitled "東大、低費電力回路向け「スパイキングニューラルネットワークモデル」を開発" (University of Tokyo Develops "Spiking Neural Network Model" for Low Cost Power Circuits)
79	27.07.2021	Yume-Navi (website)	【Hoshino】Associate Professor Hoshino's message to high school students on Yume-Navi
80	26.07.2021	Nikkei Science Magazine (magazine)	【Hoshino】An interview with Associate Professor Hoshino is featured in Nikkei Science Magazine
81	16.07.2021	KAGAKU SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "新型コロナ感染症の臨床試験シミュレータ開発"("Development of a clinical trial simulator for novel coronavirus infection") (Morning edition, page 4)
82	11.07.2021	NIPPON HOSO (radio)	【Myowa】2021 ニッポン放送「すくすく育て 子どもの未来健康プロジェクト（ナビゲーター 自見はなこ)」("Happy parenting: Project for children's future health"（Navigator: Nanako Jimi))（2021年7月11，18，25日，8月1日，6:04-6:13）
83	07.07.2021	CHUNICHI SHIMBUN ONLINE (website)	【Aihara】Website article entitled "コロナ治験、より早く" ("Expedite clinical trials on Coronavirus infections")
84	07.07.2021	CHUNICHI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "コロナ治験、より早く" ("Expedite clinical trials on Coronavirus infections") (Morning edition, page 2)
85	07.07.2021	NIHON KEIZAI SHIMBUN ONLINE (website)	【Aihara】Website article entitled "数理モデルによる臨床試験シミュレータを開発" ("Development of a Clinical Trial Simulator Using Mathematical Models")
86	07.07.2021	YOMIURI SHIMBUN ONLINE (website)	【Aihara】Website article entitled "ウイルス残る期間は７～２８日程度、個人差あり臨床試験の「壁」に" ("Issue in the clinical trial - Duration of virus remaining in human bodies has a large variation, 7 - 28 days.)
87	07.07.2021	PRESIDENT WOMAN (magazine)	【Myowa】2021 大門小百合のメディアから読み解く世界とニッポン「お手伝い感覚では親になれない」 育休を取らない男性は脳科学的に損をしている("Sayuri Daimon's Reading of the World and Japan from the Media. Being a parent requires commitment: Brain science reveals that men who don't take maternity leave are losing out on many things")
88	07.06.2021	Nihon Keizai Shimbun (newspaper)	【HTakahashi】「計算機に意識は宿るか」，（朝刊26面 (サイエンス)) (Can a comptuer have consciousness?)

89	03.07.2021	KIDSNA (website)	【Tsuji】Articles on language acquisition targeted at educators/parents(1)
90	24.06.2021	NHK (television)	【Ueda】Ueda appeared on a television program called Humanience (ヒューマニエンス, NHK) and presented on sleep research.
91	14.06.2021	NIHON KEIZAI SHIMBUN ONLINE (website)	【Aihara】Website article entitled "NTT・東大、脳を模倣「空気読めるAI」めざす" (NTT and UTokyo to develop AI that 'reads between the lines')
92	11.06.2021	NIKKEI SANGYO SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "脳を模倣「空気読めるAI」状況に応じ最適な情報処理" (Morning edition, page 7) (Mimicking our brain. Information processing that 'reads between the lines'.)
93	26.05.2021	Chunichi Shimbun (newspaper)	【Myowa】2021 中日新聞　素顔のまま子ども育てたい マスク保育発達に影響懸念（2021年5月26日 1面，朝刊）("Use of masks - Concerns in child raising")
94	25.05.2021	NHK (television)	【Ushiba】NHK Close-UP Gendai, Moving paralyzed hand again. Frontiers in Rehabilitation and Brain Sciences.
95	24.05.2021	ASAHI SHIMBUN (newspaper)	【Myowa】2021 朝日新聞「その笑顔，伝わってないかも!? マスク時代の人間関係」（デジタル版, 2021年5月24日）(Human relations when everyone is wearing a mask. Is your smile communicated?")
96	21.05.2021	Aera dot. (website)	【Nagai】AERA dot. What We Have Learned from Finnish Education about the Importance of "Boosting Creativity. (AERA dot. フィンランドの教育から学んだ「創造性を高めるため」に大切なこと.) ("Education in Finland shows what is needed for higher creativity")
97	20.05.2021	Aera dot. (online magazine)	【Nagai】AERA dot. A Neuroscientist Tells Us Why It's Important to Be Excited in the AI. (AERA dot. 脳科学者が教える「AI時代こそワクワクすることが大切」な理由.) ("Neuroscientists tell why excitement is called for in the AI ara")
98	18.05.2021	Tokyo Tech website (website)	【Hoshino】Interview with Associate Professor Hoshino appeared in “NEXT-generation” on the Tokyo Tech website
99	05.05.2021	TOKYO SHIMBUN (newspaper)	【Myowa】2021　東京新聞　ハグ・豊かな　表情意識を（2021年5月5日22面，朝刊）("Hugging - Value of expressing your feelings")
100	28.4.2021	Qlife Pro Medical NEWS (website)	【KKasai】Kiyoto Kasai et al.Discovery of a new network of auditory responses throughout the brain
101	26.04.2021	NIHON KEIZAI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "数理モデルが導くコロナ対策－感染の連鎖を断ち切る" (Morning edition, page 9) ("An effective strategy for mitigating the chain of infection with a mathematical model")
102	25.04.2021	ASAHI SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "薬がよく効くのは発症後２日程度"（Morning edition, page 22) ("Medication is effective for approximately two days after symptoms")
103	25.04.2021	ASAHI SHIMBUN ONLINE (website)	【Aihara】Website article entitled "薬がよく効くのは発症後２日程度" ("Medication is effective for approximately two days after symptoms")
104	23.04.2021	IT media NEWS (website)	【Aihara】Website article entitled "“光イジング計算機”で人工の神経ネットワークを作成、神経の性質を再現　NTTと東大" written by IT media NEWS ("Construction of neural network with light Ising computing")
105	22.04.2021	NHK (television)	【Myowa】2021　NHK BSプレミアム「ヒューマニエンス」“出産”ヒトは難産を選んだ ("NHK BS Premium - Humanience - Why the human has adopted difficult labor")
106	15.04.2021	CareNet (website)	【Aihara】Website article entitled "発症後2日でウイルス排出量ピーク、新型コロナ治療が困難な理由を解明" ("Difficulty in treatment for COVID-19 infection - viral shedding reaches maximum in two days after the symptoms are identified")
107	10.04.2021	NIHON KEIZAI SHIMBUN ONLINE (website)	【Aihara】Website article entitled "感染の連鎖を断ち切る　数理モデルが導いた「広島方式」" ("Hiroshima method - An effective strategy for mitigating the chain of infection with a mathematical model")
108	04.04.2021	TOKYO SHIMBUN (newspaper)	【Aihara】Newspaper article entitled "有効性見極め難しく" (Morning edition, page 12)