World Premier International Research Center Initiative (WPI)
FY 2022 WPI Project Progress Report (The center selected in and before FY2020)

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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 2023) 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: IRCN seeks to understand "how human intelligence (H.I.) arises." By focusing on brain development and its disorders, novel principles are established across species and applied to clinical settings. Ultimately, such insights are intended to inspire further innovation of artificial intelligence (A.I.) based on the brain. This mission comes at a crucial inflection point in the field, with prominent A.I. pioneers proclaiming, "It's quite conceivable that humanity is a passing phase in the evolution of intelligence" (G. Hinton, May 2023). Humanity must now carefully nurture this dramatically advancing technology, lest it enter an unruly adolescence we can no longer control.

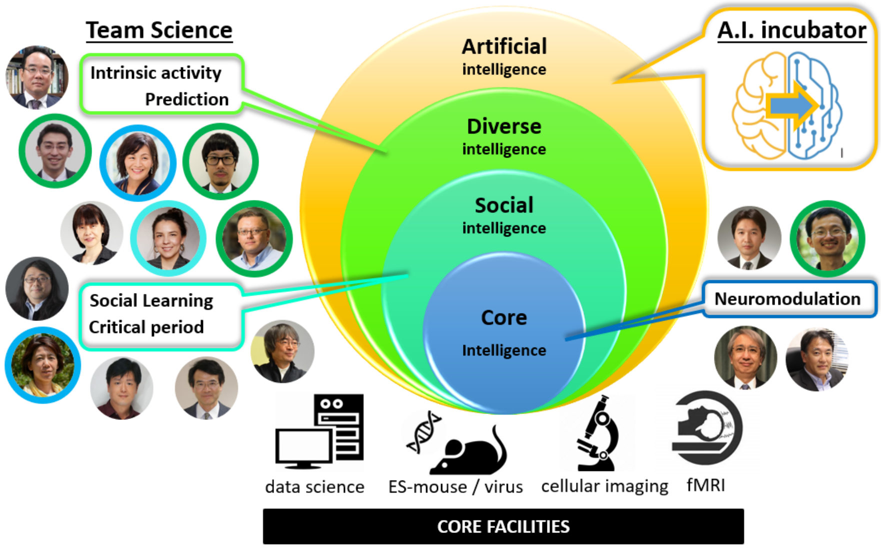
Knowledge creation is a multi-step process that includes 1) exploration (gathering information), 2) incubation (mind wandering) and 3) insight (understanding). While the step 1 performance by Generative Pre-trained Transformers (like ChatGPT) in recent months is truly impressive, they also raise the urgency for a focused academic approach into how they work and can best be aligned with H.I. Human minds support wisdom, creativity, rational reflection and a causal reality model resulting from biological processes; computers can at best simulate these disembodied events. As in Searle's Chinese Room analogy[1], merely sophisticated syntax with no semantic connection to reality, fails to constitute "understanding and knowing" capable of explaining. Our path toward a harmonious co-existence of H.I. with A.I. lies in a deeper understanding of how behavior emerges and hallucinations are avoided in each. IRCN provides a unique interface for this discourse and its ethical implications.

High-level Research: This year marked IRCN's first in phase 2, after passing the midterm review in FY2021 with a score of A+. In FY2022, IRCN scientists published 185 articles (28% in high profile journals, such as Nature publishing, Cell Press, PNAS, eLife, etc), including 116 WPI original and 69 WPI-related papers. The year began with PI Haruo Kasai receiving the Imperial Prize and ended with DD Masanobu Kano receiving the Japan Academy Prize. In between, several honors for computation were awarded, such as to PI Nagai (IEEE RAS Distinguished Lecture), AF Sugiyama (MEXT Commendation for Science and Technology) and DD Aihara (Tateishi Prize "in developing mathematical theory for modelling complex systems and its transdisciplinary applications in science and technology"). Numerous honorary and invited lectures were given around the world by IRCN investigators (see Appendix 1).

Interdisciplinarity: Moving on from phase 1, IRCN began the process of streamlining and pruning its Team Science approach. Initially, twelve Teams were created bottom-up, each combining biology, clinical and computational fields (attention, autism, chromatin, critical period mapping, critical period timing, intrinsic activity, multiscale imaging, neurocreativity, prediction, psychosis risk, reinforcement, social learning). Through an organic convergence and dissolution, the Center's sixteen PIs now focus

1 The argument is based on a hypothetical scenario in which a person who knows only English is locked in a room with a book of rules for manipulating Chinese symbols. The person receives Chinese characters as input and follows the rules to produce other Chinese characters as output. To an outside observer, it may seem that the person in the room "understands" Chinese, but this is not the case. The person is merely simulating the ability without awareness of the meaning or semantics of the symbols.

on five Teams that represent the strength of our faculty. Intrinsic activity and Prediction Teams tackle the inner workings of Diverse intelligence, Social Learning and Critical Period Teams establish the foundations of Social intelligence, and Neuromodulation unmasks the cellular and circuit basis of reinforcement learning. All Teams incorporate a developmental lens that also sheds light on mental illness when these fundamental processes are violated. Notably, specific principles found in the brain now drive A.I. incubation: optimization of E-I balance, pruning, intrinsic activity, object permanence, collective intelligence, generalization/segregation, mechanical synaptic plasticity.



Internationality: IRCN scientists remained diverse with three out of sixteen PIs (19%), eleven of fifty-four (20%) Affiliated Faculty (AF), seven of twenty-one (33%) Associate Research Fellows (ARF), and five of twenty (20%) Research Fellows being non-Japanese. Notably, nineteen Postdoctoral Fellows out of twenty-five (76%) were from abroad. IRCN maintained international connections through numerous guest talks from overseas in the weekly Science Salon series. Once the highly restrictive pandemic travel policies in Japan started to ease, Harvard summer interns and visiting faculty from Brown and Princeton Universities stayed at the Center. A hybrid international symposium on critical period plasticity across species was co-hosted by IRCN and the iPlasticity (MEXT) project led by DD Kano, including several foreign speakers both in-person and by Zoom.

Organizational Reform: IRCN's high-level management continued to be overseen by three complementary 'Offices': Sustainability (led by DD Kano), Synergy (led by DD Emoto) and Community (led by DD Aihara). These are designed to intersect the Director's top-down leadership, PIs' bottom-up proposals, and support from the administration and UTokyo. In addition, to provide more agile oversight of day-to-day issues (academic, technical, administrative), a Director's Office (DO) was established in April 2022, consisting of Director Hensch, Special Advisor to Director (SAD) Masamitsu Iino, General Manager (GM) Yasuko Chika and chaired by Administrative Director (AD) Nobukazu Toge. The voting Steering Committee (SC) was also reorganized and expanded to include all PIs as full members, together with IRCN core managers as observers, to facilitate transparency, expediency and proactive participation in Office activities. After the departure of Executive Director Charles Yokoyama (Science Writing), four core facilities continue to provide professional, cost-effective, and rapid access to research services and technologies by expert IRCN staff under the guidance of a newly assigned Core Director, PI Haruo Kasai. To promote awareness, DEI training was also initiated with an outside company (enjoi Japan KK).

Sustainability: The UTokyo Taskforce on IRCN future sustainability was launched in spring 2022 and is charting a path toward incorporation under the Graduate School of Medicine umbrella by 2027, including a permanent budget for personnel in the future. More immediately, a three-way Alliance for Brain Science with Teikyo University ACRO and RIKEN CBS was formalized by MOUs. Funding from large national program project grants (Moonshot, GakuHenA) and corporate sponsors (Daikin, SoftBank, NTT) provide ongoing support, and new opportunities for entrepreneurship (CSTI) are emerging.

* 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 2022.
* 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.

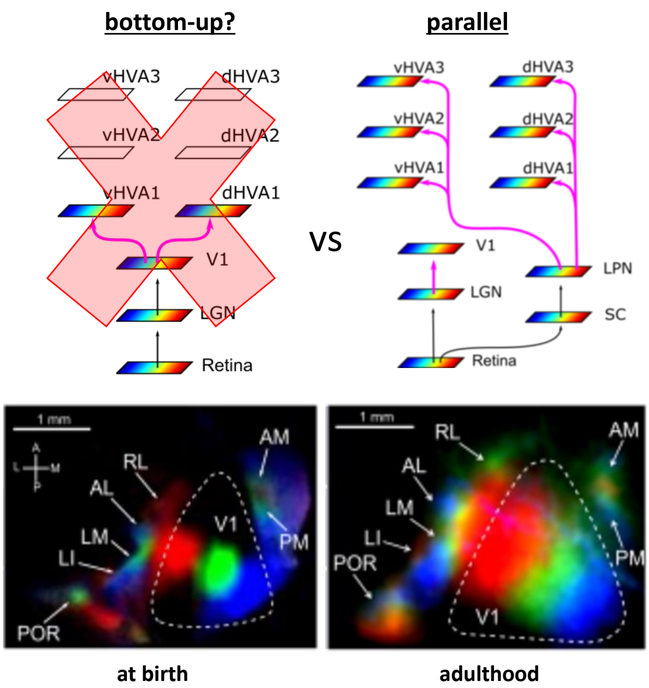
[1] Intrinsic Activity Team

The developing neocortex exhibits spontaneous network activity with various synchrony levels, which has been implicated in the formation of biological circuits but is absent from deep neural networks that underlie current A.I. Deeper insight into the role of intrinsic activity in development and cognitive disorders was achieved by IRCN scientists in FY2022.

[Murakami, T., Matsui, T., Uemura, M., Ohki, K., Modular strategy for development of the hierarchical visual network in mice. *Nature*. 2022 Aug;608(7923):578-585.]
[Tezuka, Y., Hagihara, K.M., Ohki, K., Hirano, T. and Tagawa, Y., Developmental stage-specific spontaneous activity contributes to callosal axon projections. *eLife*. 2022 Aug 24;11:e72435.]

Modular strategy for development of the hierarchical visual network in mice

Hierarchical and parallel networks are fundamental structures of the mammalian brain. During development, lower- and higher-order thalamic nuclei and many cortical areas in the visual system form interareal connections and build hierarchical dorsal and ventral streams. One hypothesis for the development of visual network wiring involves a sequential strategy wherein neural connections are sequentially formed alongside hierarchical structures from lower to higher areas. However, this sequential strategy would be inefficient for building the entire visual network comprising numerous interareal connections. PI Ohki and colleagues showed that neural pathways from the mouse retina to primary visual cortex (V1) or dorsal/ventral higher visual areas (HVAs) through lower- or higher-order thalamic nuclei form as parallel modules before corticocortical connections. Subsequently, corticocortical connections among V1 and HVAs emerge to combine these modules. Retina-derived activity propagating the initial parallel modules is necessary to establish retinotopic inter-module connections. Thus, the visual network develops in a modular manner involving initial establishment of parallel modules and their subsequent concatenation. Findings in this study raise



Hierarchical layered architecture is a hallmark of both human and artificial deep neural networks. These structures were long thought to develop sequentially from the bottom-up. In 2022, IRCN PI Kenichi Ohki and colleagues revealed that multiple visually-related cortical areas in the mouse brain are constructed in a parallel, modular manner. This groundbreaking discovery revolutionizes both our understanding of early blindness and biologically-inspired generalizable A.I. Adapted from (Murakami et al, Nature 2022).

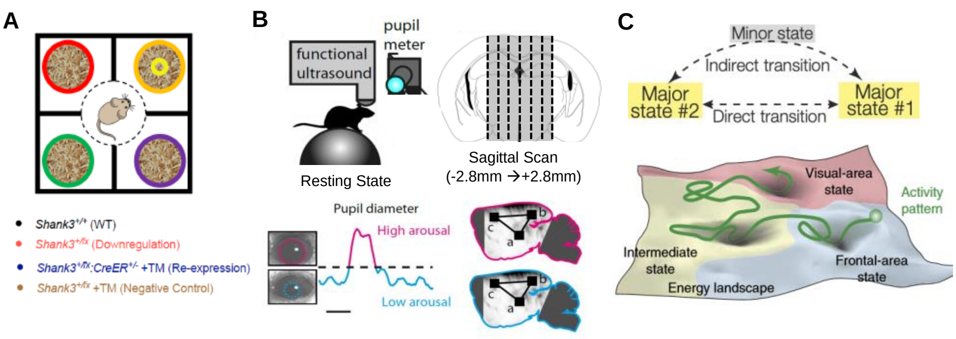
the possibility that parallel modules from higher-order thalamic nuclei to HVAs act as templates for cortical ventral and dorsal streams and suggest that the brain has an efficient strategy for the development of a hierarchical network comprising numerous areas.

Likewise, PI Ohki and collaborators previously reported that the development of callosal axon projections, one of the major long-range axonal projections in the brain, is activity-dependent. However, what sort of activity and when activity is indispensable were not known. Using a genetic method to manipulate network activity in a stage-specific manner, they demonstrated that network activity contributes to callosal axon projections in the mouse visual cortex during a 'critical period'; restoring neuronal activity during that period resumed the projections, whereas restoration after the period failed. Furthermore, in vivo Ca^{2+} imaging revealed that the projections could be established even without fully restoring highly synchronous activity. Overall, their findings suggest that spontaneous network activity is selectively required during a critical developmental time window for the formation of long-range axonal projections in the cortex.

Brain network dynamics in awake mouse models of autism

How brain activity changes over time in individuals with autism spectrum disorder (ASD) remains largely unknown. PI Watanabe previously characterized brain dynamics in autism using an energy-landscape analysis (ELA) applied to resting-state fMRI data. Whereas neurotypical brain activity frequently transits between two major brain states via an intermediate state, adults with ASD show fewer neural transitions due to an unstable intermediate state, and these infrequent transitions predict the severity of autism. Such brain-behavior associations are related to functional segregation between brain networks.

To mechanistically determine whether overly stable neural dynamics in the autistic brain underpin cognitive rigidity, animal models would be useful. PI Hensch and colleagues at Boston Children's Hospital established a pipeline for testing rule reversal learning in mouse models of ASD, followed by functional ultrasound (fUS) imaging of whole-brain resting states in awake, head-fixed animals. Then, PI Watanabe applied his ELA for the first time to mouse datasets, sorted by arousal state as defined by pupillometry. Together, they discovered that *Shank3* gene restoration early in life could correct the reduction of indirect transition frequency which recapitulated the human ASD condition, as well as their behavioral inflexibility. This platform can now be widely applied across various mouse models of syndromic autism or early adversity to capture the internal manifestations of complex cognitive disorders. These results further give hope for gene therapy during critical periods of brain development.



(A) Foraging Rule reversal learning by Shank3-deficient and rescued mice. (B) fUS imaging (sagittal) of awake mice captures default mode network structures. (C) ELA in mice. (modified from Oram, Watanabe & Hensch, in prep.).

[2] Prediction Team

Predictive coding is an emerging general theory of the functional organization of the brain. The basic principle is that brain networks continuously generate and update top-down prediction signals representing sensory inputs that, in turn, drive the bottom-up production of prediction-error signals when the predicted and actual sensory inputs differ. The human brain is proposed to harbor a hierarchical predictive coding neuronal network underlying perception, cognition, and action, which in turn may go awry in mental disorders like autism. IRCN researchers provided evidence for the hierarchical nature of these signals in humans, how they might develop and an animal model for studying it further.

[Chao, Z.C., Huang, Y.T. and Wu, C.T., A quantitative model reveals a frequency ordering of prediction and prediction-error signals in the human brain. *Communication Biology*, 5, 1076, 2022.]
[Ito, Y., Shiramatsu-Isoguchi, T., Ishida, N., Oshima, K., Magami, K. and Takahashi, H., Spontaneous beat synchronization in rats: Neural dynamics and motor entrainment, *Science Advances*, 8, 45, eabo7019, 2022.]
[Philippsen, A. K., Tsuji, S. and Nagai, Y., Simulating developmental and individual differences of drawing behavior in children using a predictive-coding model. *Frontiers in Neurorobotics, 16*, 856184, 2022.]

Frequency ordering of prediction and prediction-error signals
According to predictive coding theory, dynamic communication is achieved by a hierarchical and bidirectional cascade of large-scale cortical signaling to minimize overall prediction errors. In support of this theory, feedforward signals for prediction error have been reported. However, the identification of feedback prediction signals has been elusive due to their causal entanglement with prediction-error signals. PI Chao and colleagues used a quantitative model to decompose these signals in the human EEG during an auditory task and identified their spatio-spectral-temporal signatures across two functional hierarchies. Two prediction signals were identified in the period prior to the sensory input: a low-level signal representing the tone-to-tone transition in the high β-frequency band, and a high-level signal for the multi-tone sequence structure in the low β-band. Subsequently, prediction-error signals dependent on the prior predictions were found in the γ-band. Their findings reveal a frequency ordering of prediction signals and their hierarchical interactions with prediction-error signals supporting predictive coding theory.

To pursue neurobiological underpinnings further, animal models would be useful. Beat perception and synchronization within 120 to 140 beats/min (BPM) are common in humans and frequently used in music composition. Why beat synchronization is uncommon in some species and the mechanism determining the optimal tempo are unclear. AF Takahashi examined physical movements and neural activities in rats to determine their beat sensitivity. Close inspection of head movements and neural recordings revealed that rats displayed prominent beat synchronization and activities in the auditory cortex within 120 to 140 BPM. Mathematical modeling suggests that short-term adaptation underlies this beat tuning. Their results support the hypothesis that the optimal tempo for beat synchronization is determined by the time constant of neural dynamics conserved across species, rather than the species-specific time constant of physical movements. Thus, latent neural propensity for auditory motor entrainment may provide a basis for human entrainment that is much more widespread than currently thought, encouraging Team Science between PI Chao and AF Takahashi. Further studies comparing humans and animals will offer insights into the origins of music and dancing.

Drawing behavior in children by a predictive coding model reveals individual differences
Predictive coding has recently been proposed as a mechanistic approach to explain human perception and behavior based on the integration of perceptual stimuli (bottom-up information) and the predictions about the world based on previous experience (top-down information). However, the gap between the computational accounts of cognition and evidence of behavioral studies remains large. PI Nagai used a computational model of hand drawing based on the mechanisms of predictive coding to systematically investigate the effects of the precision of top-down and bottom-up

information when performing a drawing completion task. The results indicated that sufficient precision of both signals was required for the successful completion of the stimuli and that a reduced precision in either sensory or prediction (i.e., prior) information led to different types of atypical drawing behavior. They compared the drawings produced by their model to a dataset of drawings created by children aged between 2 and 8 years old who drew on incomplete drawings. This comparison revealed that a gradual increase in children's precision of top-down and bottom-up information as they develop effectively explains the observed change of drawing style from scribbling toward representational drawing. Furthermore, individual differences that are prevalent in children's drawings, might arise from different developmental pathways regarding the precision of these two signals. Based on these findings they propose a theory of how both general and individual development of drawing could be explained in a unified manner within the framework of predictive coding.

[3] Social Learning Team

Human intelligence is social; it is embedded within social interactions. Hence, comparing A.I. with a single person would not be right. A.I. should be compared to at least a group of individuals. Notably, individuals are quite diverse, whereas repeated nodes in A.I. networks are identical. While this may offer certain advantages to A.I. in terms of embedded explicit knowledge, it likely hinders the range of creativity and decision-making so vividly captured in social networks. These interactions were severely challenged during the COVID-19 pandemic. IRCN scientists revealed fundamental mechanisms for validating social information in support of accurate song learning in the zebra finch model, and explored the socially relevant impact of masking, isolation and vaccination guidelines as the pandemic was unfolding in real time.

[Katic K., Morohashi Y. and *Yazaki-Sugiyama Y., Neural Circuit for Social Authentication in Song Learning, *Nature Communications,* 13(1):4442, 2022.]
[Crimon, C., Barbir, M., Hagihara, H., Araujo, de, E., Nozawa, S., Shinya, Y., Abboub, N. and Tsuji, S., Mask Wearing in Japanese and French Nursery Schools: The Perceived Impact of Masks on Communication. *Frontiers in Psychology 13,* 874264, 2022.]
[Hagihara, H., Yamamoto, N., Meng, X., Sakata, C., Wang, J., Watanabe, R. and Moriguchi, Y., COVID-19 school and kindergarten closure relates to children's social relationships: a longitudinal study in Japan. *Scientific Reports*, *12*(1), 1-11, 2022.]
[Jeong, Y. D., Ejima, K., Kim, K. S., Joohyeon, W., Iwanami, S., Fujita, Y., Jung, I. H., Aihara, K., Shibuya, K., Iwami, S., Bento, A. I. and Ajelli, M., Designing isolation guidelines for covid-19 patients with rapid antigen tests, *Nature Communications*, 13, 4910, 2022.]

Neural circuit for social authentication in song learning

Social interactions are essential when learning to communicate. In human speech and bird song, infants must acquire accurate vocalization patterns and learn to associate them with live tutors and not mimetic sources. However, the neural mechanism of social reality during vocal learning remains unknown. PI Yazaki and colleagues characterized a neural circuit for social authentication in support of accurate song learning in the zebra finch. They recorded neural activity in the attention/arousal state control center, the locus coeruleus (LC), of juvenile birds during song learning from a live adult tutor. LC activity increased with real, not artificial, social information during learning that enhanced the precision and robustness of the learned song. During live social song learning, LC activity regulated long-term song-selective neural responsiveness in an auditory memory region, the caudomedial nidopallium (NCM). In accord, optogenetic inhibition of LC presynaptic signaling in the NCM reduced NCM neuronal responsiveness to live tutor singing and impaired song learning. These results demonstrate that the LC-NCM neural circuit integrates sensory evidence of real social interactions, distinct from song acoustic features, to authenticate song learning. The findings suggest a general mechanism for validating social information in brain development.

COVID19: mask wearing, school closures, isolation

Due to the global COVID-19 pandemic, covering the mouth region with a face mask became pervasive in many regions of the world, potentially impacting how people communicate with and around children. To explore the characteristics of this masked communication, PI Tsuji and colleagues asked nursery school educators, who were at the forefront of daily masked interaction with children, about their perception of daily communicative interactions while wearing a mask in an online survey. They collected cross-cultural data from French and Japanese nursery school educators to gain an understanding of commonalities and differences in communicative behavior with face masks given documented cultural differences in pre-pandemic mask wearing habits, face scanning patterns, and communicative behavior. Participants (177 French and 138 Japanese educators) reported a perceived change in their own communicative behavior while wearing a mask, with decreases in language quantity and increases in language quality and non-verbal cues. Comparable changes in their team members' and children's communicative behaviors were also reported. Moreover, the results suggest that these changes in educators' communicative behaviors were linked to their attitudes toward mask wearing and their potential difficulty in communicating following its use. These findings shed light on the impact of pandemic-induced mask wearing on children's daily communicative environment.

The COVID-19 pandemic further led children to experience school closures. Although increasing evidence suggests that such intense social quarantine influences children's social relationships with others, longitudinal studies are limited. Using longitudinal data collected during (T1) and after (T2) intensive school closure and home confinement, the impacts of social quarantine on children's social relationships were investigated. Japanese parents of children aged 0–9 years ($n = 425$) completed an online questionnaire that examined children's socio-emotional behavior and perceived proximity to parents or others. The results demonstrated that social quarantine was not significantly related to children's socio-emotional behavior across all age groups. However, changes in children's perceived proximity varied depending on certain age-related factors: elementary schoolers' perceived closeness to parents significantly decreased after the reopening of schools, whereas that to others, such as peers, increased. Such effects were not observed in infants and preschoolers. The follow-up survey 9-month after the reopening of schools (T3; $n = 130$) did not detect significant differences in both children's socio-emotional behavior and perceived proximity from that after the intense quarantine. These findings suggest that school closure and home confinement may have influenced children's social development differently across their age, and its effects were larger in perceived closeness rather than social behavior.

Appropriate isolation guidelines for COVID-19 patients were warranted. While isolating for a fixed time was adopted in most countries, given the variability in viral dynamics between patients, some people might no longer be infectious by the end of isolation, whereas others might still be. Utilizing viral test results to determine isolation length would minimize both the risk of prematurely ending isolation of infectious patients and the unnecessary individual burden of redundant isolation of non-infectious patients. DD Aihara and colleagues developed a data-driven computational framework to compute the population-level risk and the burden of different isolation guidelines with rapid antigen (lateral flow) tests. They showed that when the detection limit is higher than the infectiousness threshold values, additional consecutive negative results are needed to ascertain infectiousness status. Further, rapid antigen tests should be designed to have lower detection limits than infectiousness threshold values to minimize the length of prolonged isolation.

Facing a global epidemic of new infectious diseases such as COVID-19, non-pharmaceutical interventions (NPIs), which reduce transmission rates without medical actions, were implemented around the world to mitigate spread. One of the problems in assessing the effects of NPIs is that different NPIs have been implemented at different times based on the situation of each country; therefore, few assumptions can be shared about how the introduction of policies affects the patient population. Mathematical models can contribute to further understanding these phenomena by obtaining analytical solutions as well as numerical simulations. PI Aihara and colleagues explored the quantitative relationship between the strength of a one-shot intervention within a finite time duration and the reduction in the number of patients with no approximation. Strikingly, they found that the maximum fraction of infected individuals and the final size could be larger if the intervention started too early. The analytical results also suggested that more individuals may be infected at the peak of the second wave with a stronger intervention. Although detailed studies are necessary for the implementation of NPIs in complicated real-world environments, their results suggest the importance of the strength and timing of NPIs.

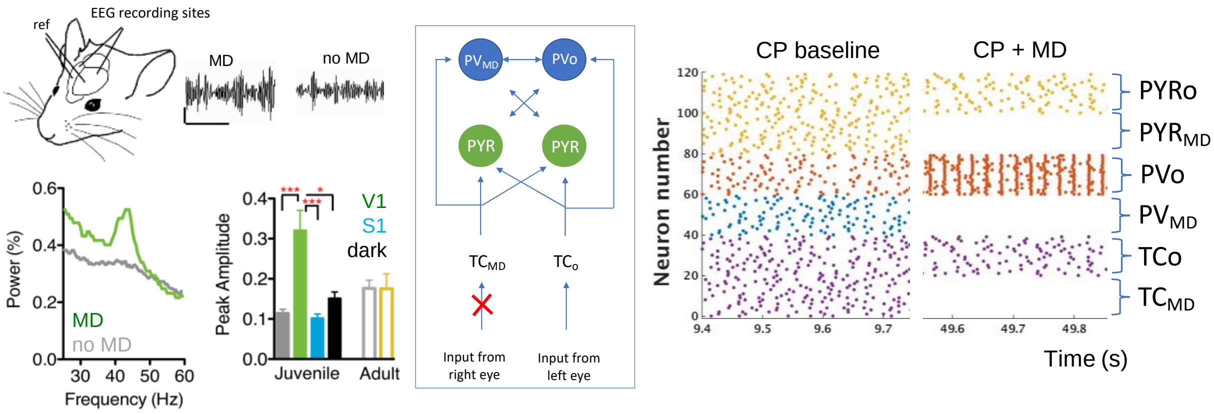
[4] Critical Period Team

Critical periods are developmental windows of rapid plasticity and remodeling of brain networks, whose biological basis are not yet fully understood. Strikingly, such trajectories of plasticity are not incorporated in A.I. but have immediate implications for clinical recovery of function beyond the critical period. IRCN researchers revealed a prominent triggering role for particular fast-spiking inhibitory circuits (also neglected in A.I.) and the consequences for optimal excitatory-inhibitory balance on memory capacity in reservoir computing. Pilot clinical trials for reopening plastic windows by lifting a critical period brake (cholinergic signaling) proved effective, confirming animal models.

[Quast, K.B., Reh, R.K., Caiati, M.D., Kopell, N., McCarthy, M.M. and Hensch, T.K., Rapid synaptic and gamma rhythm signature of mouse critical period plasticity. *Proc Natl Acad Sci USA*. 120(2):e2123182120.]
[Kanamaru, T., Hensch, T.K. and Aihara, K. Maximal memory capacity near the edge of chaos in balanced cortical E-I networks. *Neural Computation*, in press.]
[Wu, C., Gaier, E.D., Nihalani, B.R., Whitecross, S., Hensch, T.K. and Hunter, D.G., Durable Recovery from Amblyopia with Donepezil, a Cholinesterase Inhibitor. *Scientific Reports*, in press.]

Rapid synaptic and gamma rhythm signature of mouse critical period plasticity

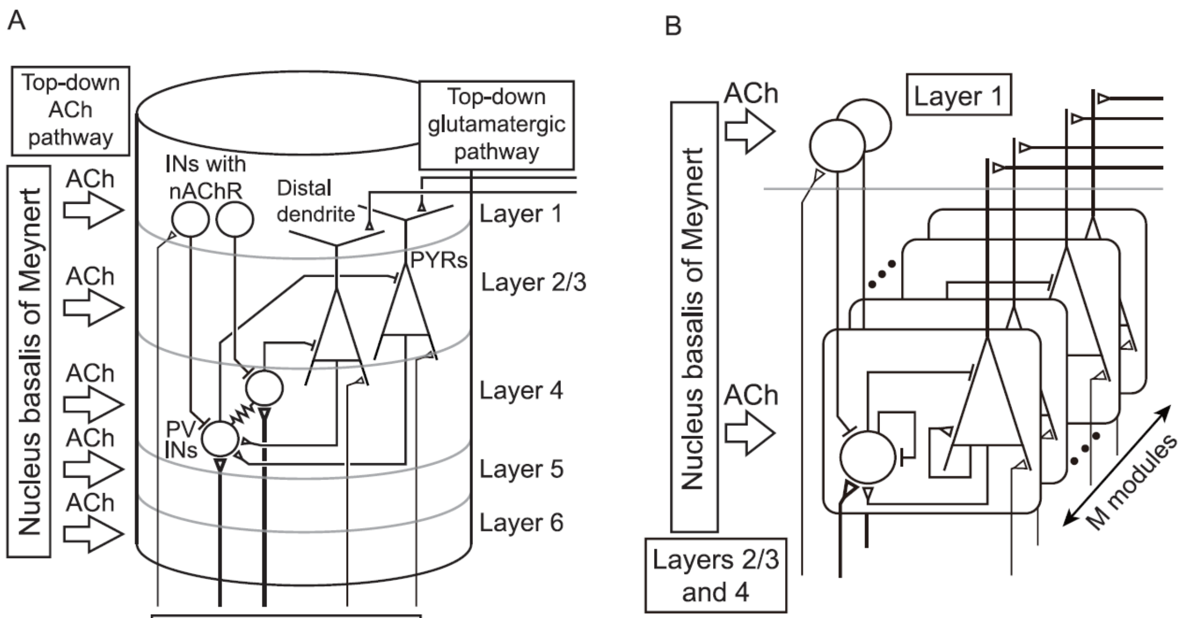
Early-life experience enduringly sculpts thalamocortical (TC) axons and sensory processing. PI Hensch and colleagues identified the very first synaptic targets that initiate critical period plasticity, heralded by altered cortical oscillations. Monocular deprivation (MD) acutely induced a transient (<3 h) peak in EEG γ-power (~40 Hz) specifically within the visual cortex, but only when the critical period was open (juvenile mice or adults after dark-rearing, *Lynx1*-deletion, or diazepam-rescued



GAD65-deficiency). Rapid TC input loss onto parvalbumin-expressing (PV) inhibitory interneurons (but not onto nearby pyramidal cells) was observed within hours of MD in a TC slice preserving the visual pathway – again once critical periods opened. Together with AF Kopell and ARF McCarthy, computational TC modeling of the emergent γ-rhythm in response to MD delineated a cortical interneuronal gamma (ING) rhythm in networks of PV-cells bearing gap junctions at the start of the critical period. The ING rhythm effectively dissociated thalamic input from cortical spiking, leading to rapid loss of previously strong TC-to-PV connections through standard spike-timing-dependent plasticity rules. As a consequence, previously silent TC-to-PV connections could strengthen on a slower timescale, capturing the gradually increasing γ-frequency and eventual fade-out over time. Thus, ING enables cortical dynamics to transition from being dominated by the strongest TC input to one that senses the statistics of population TC input after MD. Taken together, their findings reveal the initial synaptic events underlying critical period plasticity and suggest that the fleeting ING accompanying a brief sensory perturbation may serve as a robust readout of TC network state with which to probe developmental trajectories and disorders.

Maximal memory capacity near the edge of chaos in balanced cortical E-I networks
Reservoir computing is a type of machine learning technique that uses a fixed, random, and sparse network of nodes to process temporal data. It is a type of recurrent neural network (RNN) that has a large, fixed "reservoir" of neurons, which is randomly connected to input and output neurons. The reservoir is initialized with random connections and remains fixed throughout the learning process. During training, the input data is presented to the reservoir, which generates a dynamic state that is mapped to the desired output using a trainable readout layer. The readout layer learns to extract the relevant features from the dynamic state of the reservoir and maps them to the output. Reservoir computing has several advantages over traditional RNNs, including its simplicity, fast training and ability to handle high-dimensional input data. It has been successfully applied in a wide range of applications, such as speech recognition, image and video analysis, and time-series prediction.

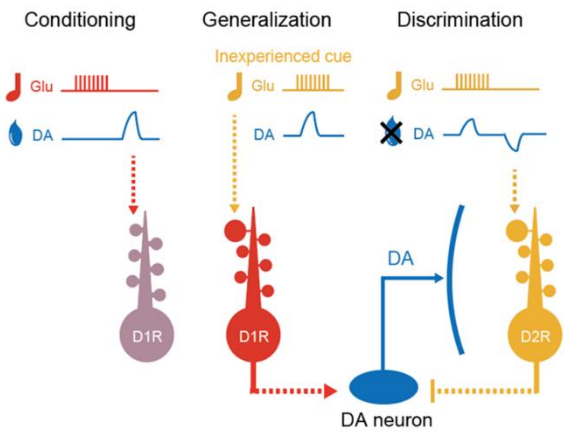
AF Kanamaru, PI Hensch and DD Aihara examined the efficiency of information processing in a balanced excitatory and inhibitory (E-I) network during the developmental critical period, when network plasticity is heightened. A multi-module network composed of E-I neurons was defined, and its dynamics were examined by regulating the balance between their activities. When adjusting E-I activity, both transitive chaotic synchronization with a high Lyapunov dimension and conventional chaos with a low Lyapunov dimension were found. In between, the edge of high-dimensional chaos



was observed. To quantify the efficiency of information processing, they applied a short-term memory task in reservoir computing to the dynamics of their network. They found that memory capacity was maximized when optimal E-I balance was realized, underscoring both its vital role and vulnerability during critical periods of brain development.

Durable Recovery from Amblyopia with Donepezil, a Cholinesterase Inhibitor
An elevated threshold for neuroplasticity limits visual gains with treatment of residual amblyopia ("lazy eye") in older children and adults. PI Hensch previously showed that acetylcholinesterase inhibitors (AChEI) can enable visual neuroplasticity and promote recovery from amblyopia in adult mice. Motivated by these promising findings, together with AF Hunter and colleagues, they sought to determine whether donepezil, a commercially available AChEI, can enable recovery in older children and adults with residual amblyopia. In this open-label pilot efficacy study, participants (mean age 16 years; range 9–37 years) with residual anisometropic and/or strabismic amblyopia were treated with daily oral donepezil for 12 weeks. Donepezil dosage was started at 2.5 or 5.0 mg based on age and increased by 2.5 mg if the amblyopic eye visual acuity did not improve by 1 line from the visit 4 weeks prior for a maximum dosage of 7.5 or 10 mg. Participants <18 years of age further patched the dominant eye. The primary outcome was visual acuity in the amblyopic eye at 22 weeks, 10 weeks after treatment was discontinued. Mean amblyopic eye visual acuity improved 1.2 lines (range 0.0–3.0), and 4/16 (25%) improved by ≥2 lines after 12 weeks of treatment. Gains were maintained 10 weeks after cessation of donepezil and were similar for children and adults. Adverse events were mild and self-limited. Thus, residual amblyopia improves in older children and adults treated with donepezil, supporting the concept that a critical window of visual cortical plasticity can be pharmacologically manipulated to treat amblyopia.

[5] Neuromodulation Team
Dopamine (DA) is a major signaling molecule in the brain that regulates learning through transient changes in firing rate of dopaminergic neurons, proposed to represent reward prediction error in reinforcement learning theory. Prior discoveries by PI H Kasai and colleagues have revealed separable D1 and D2 pathways detecting reward (DA peak) and punishment (DA dip) for generalization and discrimination learning, respectively (Fig). These inspired computational models and human studies in FY2022. Likewise, psychosis was explored in the context of novel dynamical network biomarkers ('criticality') and structural MRI correlates.



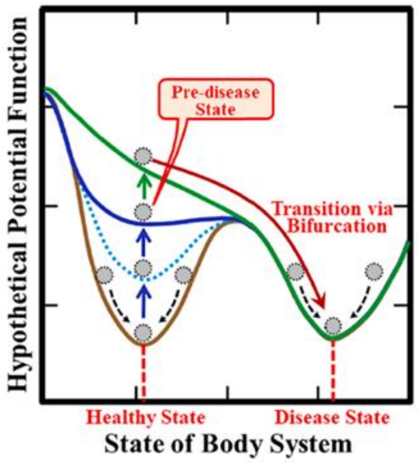
[Yamaguchi, K., Maeda, Y., Nakazato, R., Iino, Y., Sawada, T., Tajiri, M., Kasai, H. and Yagishita, S., A behavioural correlate of the synaptic eligibility trace in the nucleus accumbens. *Scientific Reports,* 12:1921, 2022]
[Song, M., Baah, P. A., Cai, M. B. and Niv, Y., Humans combine value learning and hypothesis testing strategically in multi-dimensional probabilistic reward learning. *PLoS computational biology*, 18(11), e1010699, 2022.]
[Shi, J., Kirihara, K., Tada, M., Fujioka, M., Usui, K., Koshiyama, D., Araki, T., Chen, L., Kasai, K. and Aihara, K., Criticality in the healthy brain. *Frontiers in Network Physiology*. 18 Jan 2022; 1:755685.]
[Sone, M., Koshiyama, D., Zhu, Y., Maikusa, N., Okada, N., Yamasue, H., Abe, O., Kasai, K. and Koike

S., Structural brain abnormalities in schizophrenia patients with a history and presence of auditory verbal hallucination. *Transl Psychiatry* 2022 in press.]

Behavioral correlate of the synaptic eligibility trace in the nucleus accumbens
Reward reinforces the association between a preceding sensorimotor event and its outcome. Reinforcement learning (RL) theory and recent brain slice studies explain the delayed reward action such that synaptic activities triggered by sensorimotor events leave a synaptic eligibility trace for 1 s. The trace produces a sensitive period for reward-related dopamine to induce synaptic plasticity in the nucleus accumbens (NAc). However, the contribution of the synaptic eligibility trace to behavior remains unclear. AF Yagishita and colleagues examined a reward-sensitive period to brief pure tones with an accurate measurement of an effective timing of water reward in head-fixed Pavlovian conditioning, which depended on the plasticity-related signaling in the NAc. They found that the reward-sensitive period was within 1 s after the pure tone presentation and optogenetically-induced presynaptic activities at the NAc, showing that the short reward-sensitive period was in conformity with the synaptic eligibility trace in the NAc. These findings support the application of the synaptic eligibility trace to construct biologically plausible RL models.

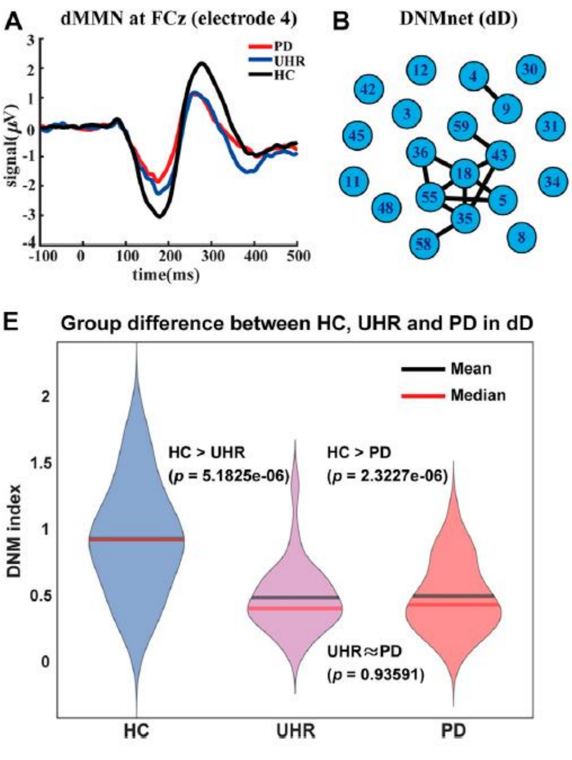
Humans combine value learning and hypothesis testing strategically in multi-dimensional probabilistic reward learning
Realistic and complex decision tasks often allow for many possible solutions. How do we find the correct one? Introspection suggests a process of trying out solutions one after the other until success. However, such methodical serial testing may be too slow, especially in environments with noisy feedback. Alternatively, the underlying learning process may involve implicit reinforcement learning that learns about many possibilities in parallel. PI Cai and colleagues designed a multi-dimensional probabilistic active-learning task tailored to study how people learn to solve such complex problems. Participants configured three-dimensional stimuli by selecting features for each dimension and received probabilistic reward feedback. The authors then manipulated task complexity by changing how many feature dimensions were relevant to maximizing reward, as well as whether this information was provided to the participants. To investigate how participants learned the task, the authors examined models of serial hypothesis testing, feature-based reinforcement learning, and combinations of the two strategies. Model comparison revealed evidence for hypothesis testing that relies on RL when selecting what hypothesis to test. The extent to which participants engaged in hypothesis testing depended on the instructed task complexity: people tended to serially test hypotheses when instructed that there were fewer relevant dimensions and relied more on gradual and parallel learning of feature values when the task was more complex. This demonstrates a strategic use of task information to balance the costs and benefits of the two methods of learning.

Dynamical Network Biomarkers and psychosis prediction
For preventive and preemptive medicine, a major challenge is how to define pre-disease states. Although they are often defined qualitatively as states between healthy and disease states, such a definition is quite obscure, which makes it difficult to study pre-disease states adequately and quantitatively from the viewpoint of science. To solve this problem, DD Aihara and colleagues provided a clear and quantitative definition of the pre-disease states from a mathematical viewpoint as "critical states" just before bifurcation points from healthy to disease states and proposed theoretical methodology to detect early warning signals peculiar to the pre-disease states with Dynamical Network Biomarkers (DNB). The purpose of the studies on early warning signals is to detect imminent critical transitions via bifurcations from one attractor to another such as traffic jams. If early warning signals of such unfavorable critical transitions can be detected, preventive actions can be taken in advance.



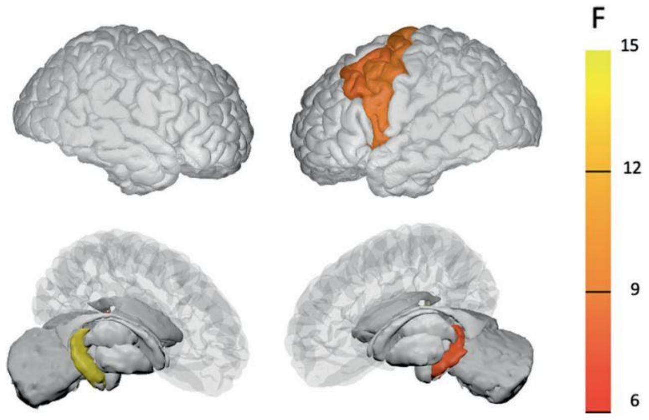
The pre-disease state is defined as a limiting state with destabilization of the healthy state, namely close to a bifurcation point of the attractor of the healthy state (see Figure). Detecting this pre-disease state would allow starting ultra-early treatment before falling into a disease state. But as implied by the Figure, pre-disease states of body systems are similar to the healthy state, making it hard to notice them. The fundamental idea, then, is to detect critical transitions as a critical slowing down: body/biological systems are always subject to noise and keep fluctuating. While fluctuations are fast and small around the healthy state due to its strong stability, fluctuations around the pre-disease state are slow and large due to its instability, including slow recovery from perturbation. DD Aihara and colleagues extended the concept of critical slowing down to high-dimensional systems with structure of complex networks.

The excellence of the brain lies in its robustness under various types of noise and its flexibility under various environments. Criticality plays an important role in the healthy brain. The DNB theory generalizes the approach of detecting early warning signals of critical slowing down phenomena to complex networks. According to DNB theory, a core subnetwork called a dynamical network (DNMnet) can be found, which is the leading subnetwork of the system toward criticality. Its components (called the DNM group) exhibit large deviations in signals and strong correlations between them around the critical state. DNMgroups can not only act as a marker for the criticality of complex systems but also provide an approach for predicting disease, economic crashes, etc.



PI K Kasai in collaboration with DD Aihara used EEG data recorded from healthy control subjects (HCs), ultra-high risk (UHR) individuals, and patients with psychotic disorder (PD) to explore states of the brain using the DNB theory. They found that the brain of HCs remains around a critical state, whereas that of patients with PD falls into more stable states. Meanwhile, the brain of UHR individuals is similar to that of PD in terms of entropy but is analogous to that of HCs in causality patterns. These results not only provide evidence for the criticality of the normal brain but also highlight the practicability of using an analytic biophysical tool to study the dynamical properties of mental diseases.

Although many studies have demonstrated structural brain abnormalities associated with auditory verbal hallucinations in schizophrenia, the results remain inconsistent because of the small sample sizes and the reliability of clinical interviews. PI K Kasai and colleagues further compared brain morphometries in 204 participants, including 58 schizophrenia patients with a history of hallucinations (AVH +), 29 without (AVH−) and 117 healthy controls based on a detailed inspection of medical records. They further divided the AVH+ group into 37 patients with and 21 patients without hallucinations at the time of the MRI scans (AVH++ and AVH+−, respectively) via clinical interviews to explore the morphological differences according to the persistence of hallucinations.

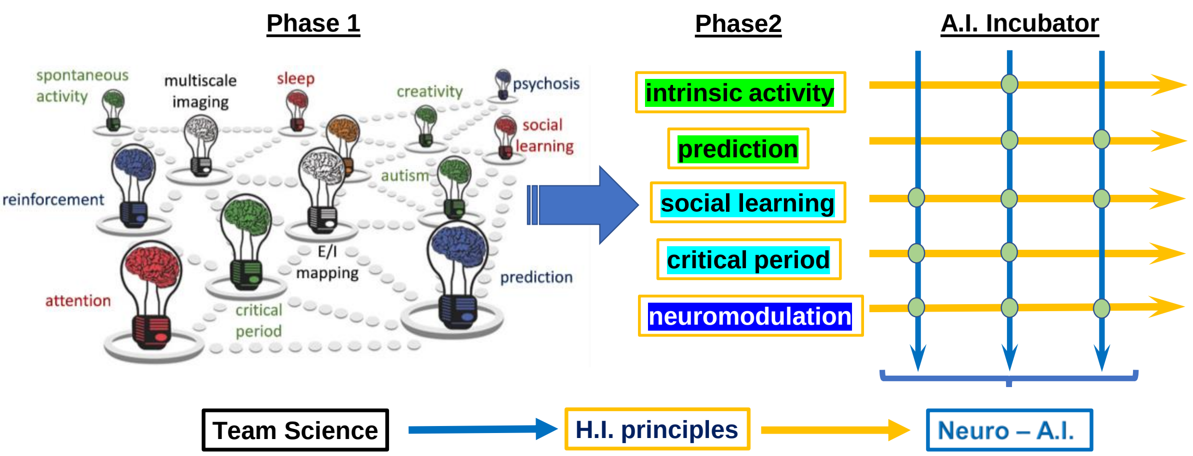


The AVH + group had a smaller surface area in the left caudal middle frontal gyrus ($F = 7.28$, *FDR-corrected* $p = 0.0008$) and precentral gyrus ($F = 7.68$, $p = 0.0006$) compared to AVH−. The AVH+ patients had smaller surface area in the left insula ($F = 7.06$, $p = 0.001$) and subcortical volume in bilateral hippocampus (right: $F = 13.34$, $p = 0.00003$; left: $F = 6.80$, $p = 0.001$) compared to HC. Among these altered areas, the AVH++ group showed significantly smaller bilateral hippocampal volumes compared to the AVH+− group, and smaller surface area in left precentral gyrus and caudal middle frontal gyrus compared to the AVH- group. These highlight a distinct pattern of structural alteration between the history and presence of hallucinations in schizophrenia, and the importance of integrating multiple criteria to elucidate the neuroanatomical mechanisms.

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."

Moving on from phase 1, IRCN began the process of streamlining and pruning its Team Science approach. Initially, twelve Teams were created bottom-up, each combining biology, clinical and computational fields (attention, autism, chromatin, critical period mapping, critical period timing, intrinsic activity, multiscale imaging, neurocreativity, prediction, psychosis risk, reinforcement, social learning). Through an organic convergence and dissolution, the Center's sixteen PIs now focus on five Teams that represent the strength of our faculty. Intrinsic activity and Prediction Teams tackle the inner workings of Diverse intelligence, Social Learning and Critical Period Teams establish the foundations of Social intelligence, and Neuromodulation unmasks the cellular and circuit basis of reinforcement learning. All Teams incorporate a developmental lens that also sheds light on mental illness when these fundamental processes are violated.



Notably, specific principles found in the brain now drive A.I. incubation: optimization of E-I balance, pruning, intrinsic activity, object permanence, collective intelligence, generalization/segregation, mechanical synaptic plasticity. Recruitment of A.I. experts is a global problem, which is particularly difficult in Japan. IRCN will continue to leverage its international network of global partners as well as novel entrepreneurship mechanisms for appropriate manpower. Competing with better resourced companies (Google, Facebook, etc) paired with pandemic restrictions was severely limiting. Instead, an "A.I. incubator" mechanism was proposed to attract young, domestic computational talent. Focused "challenge grant" topics to incorporate principles identified at IRCN into A.I. models will be supported for fast turnaround brainstorming (<10 months). This is a popular model in companies, which we aim to apply in a protected academic environment.

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)

The global foundation was built and maintained through the establishment of a formal research network of sixteen overseas and four domestic partner institutions, which continued through 2022. 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. With the COVID-19 situation showing signs of settling, IRCN reinitiated more opportunities to host face-to-face research gatherings in FY2022, such as the joint IRCN-iPlasticity International Symposium and IRCN Computational Psychiatry Workshop.

The 2022 international composition of IRCN Principal Investigators (PI) was three out of sixteen (19%), with Takao Hensch (USA), Zenas Chao (TWN), and Mingbo Cai (CHN). Eleven out of fifty-four (20%) Affiliated Faculty (AF) were foreign. Associate Research Fellows (ARF) consisted of seven international members out of twenty-one (33%). IRCN employed five Research Fellows who were foreign out of twenty (20%). Finally, nineteen Postdoctoral Fellows out of twenty-five (76%) 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 2022, with the pandemic still 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 FY2022, IRCN held eighteen International Science Salons. These seminars with discussion were popular, typically drawing attendees in the 35-55 range. Fourteen of these speakers (78%) were international or speaking from abroad. Further, the IRCN Postdoctoral Advisory Committee (I-PAC) held seminars to support professional career development of early-stage researchers and co-organized a PosterTown digital poster session to foster collaboration within and around IRCN.

As Japanese pandemic travel restrictions began to loosen in fall of 2022, IRCN received several inquiries from foreign Professors for sabbatical stay. Accordingly, an office suite was prepared on the 13th floor of the Experimental Research Building to welcome them as of January 2023. A vibrant group of prominent visitors is now expected to spend time at UTokyo in rotation throughout FY2023.

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 led by a Deputy Director (DD) is designed to intersect the Director's top-down leadership, PIs' bottom-up proposals, and support from the administration and UTokyo.

- Sustainability Office, led by DD Masanobu Kano, catalyzes 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.
- Synergy Office, led by DD Kazuo Emoto, promotes research fusion and Team Science. It manages Salons proposed by the IRCN Program Committee to foster Team Science and recommends the 'IRCN Director's Collaboration Awards'.
- Community Office, led by DD Kazuyuki Aihara, coordinates education and outreach activities. It offers academic courses for trainees, public events, international workshops and various learning opportunities within IRCN, and ensures logistical support for international visitors.

In addition, a Director's Office (DO) was established in April 2022 to provide more agile oversight of day-to-day issues spanning academic, technical, and administrative matters. The DO is chaired by Administrative Director (AD) Dr. Nobukazu Toge and consists of Director Hensch, Special Advisor to the Director (SAD) Dr. Masamitsu Iino and General Manager (GM) Ms. Yasuko Chika of the Administrative Office.

The IRCN Steering Committee (SC) was also reorganized and expanded to include all PIs as full voting members, together with managers of the IRCN core facilities as observers. This has been done to streamline the efficient and transparent sharing of all key decisions and the exchange of ideas behind them in a timely manner. This reorganization is also expected to facilitate proactive participation of PIs and Core Managers in a wide range of undertakings led by the Sustainability, Synergy and Community Offices.

The five IRCN Core Facilities (ES-Mouse/Virus Core, Imaging Core, Data Science Core, Human fMRI Core, Science Writing Core) continued to provide professional, cost-effective, and rapid access to research services and technologies by expert IRCN staff. In April 2022, a new IRCN Core Director, PI Haruo Kasai, was appointed to formulate the future of the core facilities through a planned expansion of their services to IRCN researchers, AF, ARF and other collaborators. Team Science and internationalization efforts are also expected to benefit from these measures. Science Writing Core is now on hold after departure of Executive Director (ED) Charles Yokoyama due to personal reasons.

Located in the Faculty of Medicine Building No.1 and adjacent Experimental Research Building in a quasi-under-one-roof arrangement, IRCN maintained an extensive domestic and global research network by enlisting 54 AF members and 21 ARF in 2022. They represent an international and diverse mix of established senior and emerging junior researchers in the research areas related to the IRCN mission and participate in the weekly Salon seminars and collaborative research programs.

IRCN continues to support the teaching and training of graduate students. About half of the IRCN PIs (7 out of 16) are based in regular Faculties of UTokyo and carry out standard duties of supervising graduate students. Of the PIs, Core Managers and Research Fellows that are hired primarily at IRCN, three have been invited to participate in graduate training programs at regular UTokyo Faculties. In parallel, IRCN continued its membership in the MEXT WISE Graduate Program "Forefront of Physics and Mathematics Program to Drive Transformation" (FoPM) based in the Graduate School of Science. Several non-tenured IRCN PIs and Core Managers organized and taught FoPM courses. Through these programs, thirteen PIs are eligible to teach courses in the Graduate Schools of UTokyo. In addition, as the COVID-19 situation finally eased, IRCN restarted internship programs to host two student from Harvard University and four from Tsinghua University, as well as five graduate students hosted by individual PIs. Diversity, Equity and Inclusion (DEI) training was also launched near the end of FY2022 to raise awareness and further introspection with the aid of an external company (enjoi Japan KK).

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.

Essential ingredients for the long-term sustainability of IRCN include three distinct yet inter-dependent key elements: (1) establishing its unique research fusion brand and societal values for global excellence and leadership in Neurointelligence, (2) successful integration into the host university and large data-driven global scientific academic ecosystems, and (3) securing long-term financial support from governmental and non-governmental funds.

Prospective research planning for the next five years is one of the main objectives of the Director's reorganization of the IRCN management. The three-office structure and involvement of all PIs in organizational management and planning allows a welcome division of labor for the future development of the Center. The Synergy Office will manage Team Science projects and propose changes in Team composition and mission as needed. This plan will include efforts to strengthen A.I. design and development capabilities by hiring A.I. researchers or working with them as AF, ARF or collaborators.

The process of examining the long-term future of IRCN by the top management of UTokyo was initiated with the establishment of an Executive Working Group under the President of the University of Tokyo in 2021. Through a series of discussions by this Executive Working Group, chaired by Distinguished University Professor Kohei Miyazono, former Dean of the Graduate School of Medicine and former Executive Vice President of the University of Tokyo, a recommendation was made in 2022 that IRCN should eventually be reorganized in the long term as a permanent research Center within the Graduate School of Medicine of the University of Tokyo. This recommendation now sets the framework for discussion of related critical issues such as securing tenure for researchers and staff, a new building space, and inclusion in the internal budget system of UTokyo alongside other Schools and Institutes. It has been agreed that high-level discussions on these issues will be made in FY2023 within a new Taskforce led by Executive Vice President, Prof. Nobuhito Saito.

Regarding mid- to long-term financial planning, the Sustainability Office continues 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. Entrepreneurship is one major avenue for sustainability. The Director has been interacting closely with the Council on Science, Technology and Innovation (CSTI) under the Prime Minister’s initiative to stimulate startup activities in Japan. Regarding prospects with partners outside of UTokyo, IRCN is building long-term relationships with several promising corporate (NTT, Nikon) and NPO sponsors as our mutual interests evolve. Securing philanthropic donations and industrial-academic partnerships is also ongoing. Foreign foundations have been approached, which have scrutinized our DEI efforts. We have initiated training and rebalancing of the management structure accordingly.

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 discussed in Section 4 of this report, IRCN has successfully involved its fixed-term PIs in graduate teaching in various schools and programs. However, this is currently being done in a rather limited way. At this moment, the decision to appoint full teaching positions in graduate courses, including dissertation supervision, for fixed-term PIs in IRCN is entirely in the hands of other Faculties, since it is not possible to create a new graduate school around the IRCN under the present organizational structure and agreement within the University of Tokyo. Our current expectation is that the final resolution of this important issue will have to await the outcome of the new Taskforce under Prof. Saito (above), which will determine the future position of the IRCN and its academic members within the educational ecosystem of the University of Tokyo.

6. Others

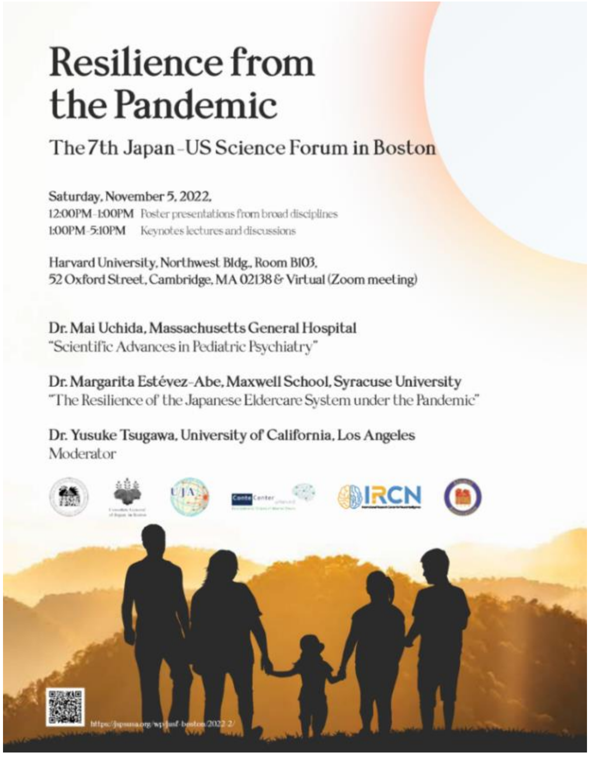
* Describe what was accomplished in the center’s outreach activities last year and how the activities have contributed to enhancing the center’s “globally visibility.” In Appendix 6, describe concretely the contents of these outreach activities. In Appendix 7, describe media reports or coverage, if any, 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.

During the pandemic, IRCN continued to hold public events in 2022 to provide lectures and lab tours, albeit in a "virtual" or "hybrid" format, to students from Super Science High Schools and others. Some of these events were co-hosted with local civic governments.

In the second half of 2022, with the COVID-19 situation slowly subsiding, IRCN hosted a hybrid seminar entitled "How does Human Intelligence arise?" from New York City supported by the newly opened UTokyo NY Office. The seminar took place in October 2022, with the goal to raise awareness

and recognition of the research being conducted by IRCN, its members in Japan, as well as colleagues in the Boston Satellite and was attended by a total of 155 participants.

In November 2022, IRCN co-hosted the 11th WPI Science Symposium themed "Opening infinite perspectives with science," supported financially by JSPS and the participation of all other WPI Centers. The symposium was aimed at middle and high school students, as well as their parents and teachers, to explore the pursuit of scientific research as a career opportunity or as ingredients for thinking about their future path. It was attended by a total of 284 participants.



Earlier the same month, IRCN co-organized with the JSPS Washington D.C. office the 7th annual Japan-US Science Forum in Boston. With a full return to in-person participation, the event was hosted once again by Director Hensch at Harvard University, including a poster session and guest lectures on the theme of "Resilience from the Pandemic" focused on Mental Health in both children and senior citizens. The event marked the first STEM Outreach event for the new Japanese Consul-General Suzuki in Boston and was of great interest both for the timely topic as well as for networking and recruitment by young scientists.

Finally, to welcome in the New Year, IRCN co-hosted its first post-COVID international symposium on-site with the Gakujyutsu Henkaku A program project "iPlasticity" led by DD Kano and Director Hensch. The hybrid format welcomed over 200 participants, including several foreign speakers from the U.S., Europe and Japan. A poster session by iPlasticity trainees further enriched the two-day event held at IRCN in UTokyo. The shared interest in critical period mechanisms and the potential to reopen them in adulthood led to many discussions and future collaborations, marking a strong mid-term progress and return to globalization for both programs.

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

1) *IRCN should strengthen the computation group by recruiting more PIs and leading researchers in the field as affiliated faculty or advisors.*

Recruitment of A.I. experts is a global problem, which is particularly difficult in Japan. Competing with better resourced companies (Google, Facebook, etc) paired with pandemic restrictions was severely limiting. Instead, an "A.I. incubator" mechanism was proposed to attract young, domestic computational talent. Focused "challenge grant" topics to incorporate principles identified at IRCN into A.I. models will be supported for fast turnaround brainstorming (<10 months). This is a popular model in companies, which we aim to apply in a protected academic environment.

2) *IRCN should present concrete milestones toward unravelling the etiology and treatment of mental disorders and toward innovating neuro-inspired AI based on the principles of brain development. The center should clearly define questions regarding the origin of HI to be solved during the WPI funding period.*

Clinical applications are pursued for two developmental stages: infancy (BCH) and adolescence (UTokyo). Critical Period, Intrinsic Activity and Social Learning Team Science are directly focused on the former; Prediction and Neuromodulation Team Science on the latter. As shown in the present report, principles of brain development have already led to new biomarkers for autism and psychosis, rescued amblyopia, and inspired dynamical network biomarkers for disease prediction. Large cohort studies both in Boston and Tokyo have been slowed by the pandemic, but several exciting manuscripts are in preparation for FY2023. Directions for A.I. innovation will instead be largely dictated by the emergent Sustainability plan and partners.

3) *IRCN should overcome significant challenges stemming from the Director being stuck overseas throughout the COVID-19 pandemic. Strong leadership of the Director is needed to innovate neuro-inspired AI and to answer the important question of how human intelligence arises by integrating individual research teams.*

The travel restrictions imposed by Japan during the COVID-19 pandemic were certainly disruptive to "business as usual". However, this brought several silver linings. First, communication improved as everyone realized Zoom meetings were easy and efficient. Second, communication was further increased by creation of the Director's Office for daily needs and expansion of the SC to include all PIs with equal voice. Third, the Director could reclaim valuable time for research, analysis and paper writing rather than commuting. Fourth, Team Science was significantly streamlined and pruned down to three focus areas (5 Teams in total), as PIs reprioritized their efforts. Fifth, new routes for sustainable funding (entrepreneurship, SCP) were explored, which will have a strong influence on which A.I. targets to pursue. Finally, the UTokyo Taskforce clearly established the Graduate School of Medicine as IRCN's future home, which will also impact the direction of A.I. to be pursued (e.g., computational psychiatry, social applications).

4) *The impact of IRCN on UTokyo reform should be addressed.*
5) *UTokyo should present a concrete plan of a new building to establish IRCN as an autonomous institute at UTokyo. The UTokyo working group on the future of IRCN should present an interim*

report by next year’s site visit. The report should include a plan for an IRCN graduate program to foster young scientists.

As mentioned in Section 5, the Executive Working Group under the President of the University of Tokyo recommended in 2022 that the IRCN should eventually be reorganized as a permanent research center within the Graduate School of Medicine of the University of Tokyo. This recommendation now sets the framework for discussion of related critical issues such as securing tenure for researchers and staff, a new building space, and inclusion in the internal budget system of UTokyo along with other schools and institutes. It has been agreed that high-level discussions on these issues will take place in FY2023 within a new task force headed by an Executive Vice President, Prof. Nobuhito Saito.

Appendix 1 FY 2022 List of Center's Research Results and Main Awards

1. Refereed Papers

- List only the Center's papers published in 2022. (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 (the Basic and Generic Research Division at present) 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) (or DOI number), 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.)
- The papers should be divided into A or B categories on separate sheets, not divided by 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.

A. WPI papers

(1) Original articles

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2. Invited Lectures, Plenary Addresses (etc.) at International Conferences and International Research Meetings
- List up to 10 main presentations during FY 2022 in order from most recent.
- For each, write the date(s), lecturer/presenter's name, presentation title, and conference name.

Date(s)	Lecturer/Presenter's name	Presentation title	Conference name
01.11.2022	Yukiko Gotoh	Embryonic and adult neural stem cells: What underlies their difference?	Anne McLaren Lecture, University of Oxford
20.10.2022	Sho Tsuji	SCALa: A blueprint for computational models of language acquisition in social context	Dagstuhl Seminar "Developmental Machine Learning: From Human Learning to Machines and Back"
20.10.2022	Takao Hensch	Balancing Brain Plasticity / Stability	Sylvius lecture (Utrecht)
28.09.2022	Yukie Nagai	Robotics for Understanding and Assisting Neurodiversity	The International Symposium on Robotics Research
06.09.2022	Takao Hensch	Understanding Neural Plasticity: From Animal Models to Human Individuality	Max-Planck Institute Ringberg Conference (Munich)
28.07.2022	Haruo Kasai	Mechanical actions of brain spine synapses underlying learning and memory	"Neural Pathways Underlying Brain Function and Pathologies" Nature Virtual Conference (Zoom)
13.07.2022	Yoko Yazaki Sugiyama	Social Interactions Regulate Auditory Experience-Dependent Song Learning in Zebra Finches	Gordon Conference, Auditory System
01.07.2022	Takao Hensch	Oscillatory signature of critical period plasticity	Japanese Neuroscience Society Annual Meeting
13.06.2022	Takao Hensch	Oscillatory signature of critical period plasticity	Juselius Symposium (Helsinki)
07.06.2022	Kenichi Ohki	Modular strategy for the development of hierarchical networks in the mouse visual system	SPONT2022, Altea, Spain

3. Major Awards

- List up to 10 main awards received during FY 2022 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	Recipient's name	Name of award
13.03.2023	Masanobu Kano	2023 Japanese Academy Prize
16.11.2022	Noboru Mizushima	2022 Highly Cited Researcher by Clarivate Analytics
01.11.2022	Shinsuke Koike	Medical Research Encouragement Prize of The Japan Medical Association
25.10.2022	Yukie Nagai	IEEE RAS Distinguished Lecture
15.09.2022	<u>Jiarui Li</u>, Marisa Casillas, <u>Sho Tsuji</u>, and <u>Yukie Nagai</u>	SmartBot Challenge Finalist of the 2022 IEEE International Conference on Development and Learning
27.06.2022	Haruo Kasai	The imperial Prize, Japan Academy Prize
09.06.2022	Fumiyasu Komaki	The Japan Statistical Society Award 2022
25.05.2022	Kazuyuki Aihara	TATEISHI PRIZE 2022
15.05.2022	Radostin Danev	Seto Award of the Japanese Society of Microscopy, for "Development of Volta phase plate and application to structural biology by cryo-EM"
20.04.2022	Masashi Sugiyama	Awards for Science and Technology, Research Category, The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology

Appendix 2 FY 2022 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 FY2022>					Principal Investigators Total: 16
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	56	Director, Project Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Professor, Molecular and Cellular Biology, Center for Brain Science, Harvard University Professor, Neurology, Kirby Center, Boston Children's Hospital	Ph.D. Neurophysiology	80	2017/10/1	Mainly at the Boston Children's Hospital due to travel limiations in the COVID-19 situation, but resumed stays at UTokyo five times (each >1 week) in FY2022. Communicates often by >20 emails daily, and almost nightly video conferences to promote IRCN's sustainability, synergy, community and global visibility.	Manages and directs center operations
Masanobu Kano	65	Deputy Director, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Professor, Neurophysiology, Physiology, Department of Functional Biology, Graduate School of Medicine, The University of Tokyo	M.D. & Ph.D. Neurophysiology	80	2017/10/1	Stays at the Center and participates in the Center's activities as Deputy Director and an Executive Board member	

Kazuo Emoto	54	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	2017/10/1	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	68	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	2017/10/1	Stays at the Center and participates in the Center's activities as Deputy Director and an Executive Board member	
Haruo Kasai	66	Project Professor, International Research Center for Neurointelligence,The University of Tokyo Institutes for Advanced Study	M.D. & Ph.D. Neurophysiology	100	2017/10/1	Stays at the Center and participates in the Center's activities	

Yasushi Okada	54	Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Professor, Cell Biology, Cell Biology and Anatomy, Department of Molecular Cell Biology, Graduate School of Medicine, The University of Tokyo	M.D. & Ph.D. Bioimaging	32	2017/10/1	Stays at the Graduate School of Science and participates in the Center's activities	
Kiyoto Kasai	52	Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Professor, Neuropsychiatry, Clinical Neuroscience, Department of Neuroscience, Graduate School of Medicine, The University of Tokyo	M.D. & Ph.D. Neuroimaging and Early Intervention for Schizophrenia	80	2017/10/1	Stays at the Center and participates in the Center's activities	
Kenichi Ohki	51	Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Professor, Integrative Physiology, Physiology, Department of Functional Biology, Graduate School of Medicine, the University of Tokyo	M.D. & Ph.D. Neuroscience	80	2017/10/1	Stays at the Center and participates in the Center's activities	

Shoji Takeuchi	50	Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Professor, Department of Mechano-Informatics, Graduate School of Information Science and Technology, The University of Tokyo	Ph.D. Biohybrid Systems	80	2017/10/1	Stays at the Institute of Industrial Science and participates in the Center's activities	
Yukiko Gotoh	58	Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Professor, Molecular Biology, Department of Pharmaceutical Sciences, Graduate School of Pharmaceutical Sciences, the University of Tokyo	Ph.D. Neural Stem Cells	80	2017/10/1	Stays at the Graduate School of Pharmaceutical Sciences and participates in the Center's activities	
Yukie Nagai	48	Project Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study	Ph.D. Engineering	100	2019/4/1	Stays at the Center and participates in the Center's activities	

Zenas C. Chao	47	Associate Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study	Ph.D. Biomedical Engineering	100	2019/9/1	Stays at the Center and participates in the Center's activities	
Takamitsu Watanabe	41	Associate Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study	M.D. & Ph.D. Cognitive Neuroscienc e	100	2020/4/1	Stays at the Center and participates in the Center's activities	
Yoko Yazaki-Sugiyama	51	Project Associate Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study Associate Professor, Neuronal Mechanism for Critical Period Unit, Okinawa Institute of Science and Technology Graduate University	Ph.D. Biological Science	80	2018/4/1	Stays at the Center and participates in the Center's activities	
Sho Tsuji	38	Assistant Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study	Ph.D. Psycholingu istics	100	2019/4/1	Stays at the Center and participates in the Center's activities	

Mingbo Cai	37	Assistant Professor, International Research Center for Neurointelligence, The University of Tokyo Institutes for Advanced Study	Ph.D. Neuroscience	100	2019/12/1	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 2022

Name	Affiliation (Position title, department,	Starting date of project participation	Reasons	Measures taken
None				

Appendix 2a Biographical Sketch of a New Principal Investigator

(within 3 pages per person)

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 2022 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 continued to be hampered worldwide due to strict quarantine and travel restrictions for COVID-19. Nonetheless, we have continued to expand Team Science trainees with domestic candidates, where a unique fusion research experience, as each of them must be co-mentored by two PI / AFs in different fields (e.g. clinical and computational) of exercised. Toward the end of FY2022, we slowly resumed exchanges of researchers to and from abroad.

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) RIKEN Center for Brain Science (CBS)	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

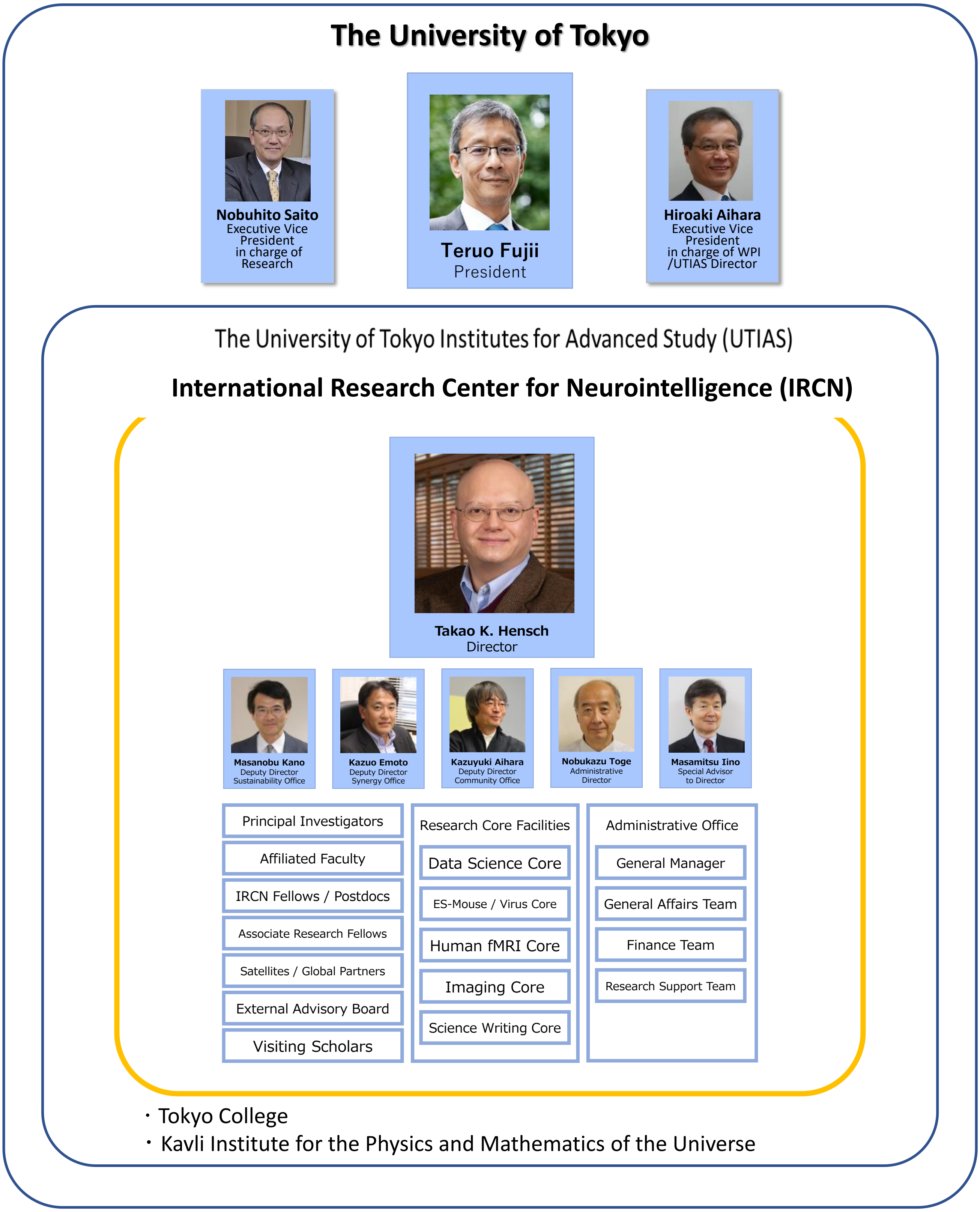
- Indicate the number of international research conferences or symposiums held in FY2022 and give up to three examples of the most representative ones using the table below.

FY 2022: 2 meetings

Major examples (meeting titles and places held)	Number of participants
IRCN-iPlasticity International Symposium, Tokyo	From domestic institutions: 201 From overseas institutions: 7
IRCN Computational psychiatry workshop, Tokyo	From domestic institutions: 53 From overseas institutions: 6
	From domestic institutions: OO From overseas institutions: OO

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 FY2022

Total: 1,098,029,069 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: 99,550,000 yen
Grant-in-Aid for Scientific Research on Innovative Areas: 39,470,000 yen
Grant-in-Aid for Specially Promoted Research: 5,850,000 yen
Grant-in-Aid for Scientific Research S: 100,400,000 yen
Grant-in-Aid for Scientific Research A: 9,400,000 yen
Grant-in-Aid for Scientific Research B: 4,400,000 yen
Grant-in-Aid for JSPS Fellows: 700,000 yen

MLHW Health and Labor Sciences Research Grant: 3,020,000 yen

MEXT TICPOC: 8,333,000 yen

JST
Moonshot Research and Development Program: 224,000,000 yen
CREST: 108,868,000 yen
ACT-X: 8,814,000 yen
JST-Mirai Program: 64,115,000 yen

AMED
Brain/MINDS: 47,000,000 yen
Brain/MINDS Beyond: 48,000,000 yen
AMED-CREST: 116,159,410 yen
SICORP: 6,230,000 yen

Beyond AI (collaborative research with Softbank): 104,358,544 yen

Collaborative research with Daikin: 47,580,000 yen

Collaborative research with Toyota Central R&D Labs.: 23,000,000 yen

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

Others: 13,396,500 yen

Appendix 3-1a FY 2022 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 2022	Final goal (Date: March, 2027)
Researchers from within the host institution	12	14	10
Researchers invited from overseas	2	1	1
Researchers invited from other Japanese institutions	0	1	0
Total principal investigators	14	16	11

b) Total members

	At the beginning of project		At the end of FY 2022		Final goal (Date: March, 2027)	
	Number of persons	%	Number of persons	%	Number of persons	%
Researchers	27		137		65	
Overseas researchers	5	19	46	34	23	35
Female researchers	5	19	25	18	13	20
Principal investigators	14		16		11	
Overseas PIs	3	21	3	19	3	27
Female PIs	4	29	4	25	3	27
Other researchers	13		96		40	
Overseas researchers	2	15	24	25	10	25
Female researchers	1	8	15	16	5	13
Postdocs	0		25		14	
Overseas postdocs	0	0	19	76	10	71
Female postdocs	0	0	6	24	5	36
Research support staff	0		37		20	
Administrative staff	3		21		10	
Total number of people who form the "core" of the research center	30		195		95	

	At the beginning of project		At the end of FY 2022		Final goal (Date: March, 2027)	
	Number of persons	%	Number of persons	%	Number of persons	%
Doctoral students	0		7			
Employed	0	-	4	57		

※b) The number of doctoral students in the lower table can be duplicated in the upper table of overall composition.

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	46	46
	Principal investigators (no. of persons):16	192	48
	Other researchers (no. of persons):23	150	143
	Research support staff (no. of persons):13	29	29
	Administrative staff (no. of persons):21	153	70
	Subtotal	570	336
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):0	0	0
	Research startup cost (no. of persons):11	11	11
	Rental fees for facilities	79	79
	Cost of international symposiums (no. of symposiums):1	5	5(4)
	Cost of utilities	11	11
	PR cost	2	2
	Cost of consumables	12	4
	Cost of satellite organizations (no. of satellite organizations):1	83	83
	Core facility management expenses	51	37
	Other costs	55	29(15)
	Subtotal	309	261(19)
Travel	Travel expenses (domestic･international)	25	25(6)
	Subtotal	25	25(6)
Equipment	Depreciation of buildings	8	8
	Depreciation of equipment	129	129(1)
	Subtotal	137	137(1)
Research projects (Detail items must be fixed)	Project supported by other government subsidies, etc. *1	39	0
	KAKENHI	271	0
	Commissioned research projects, etc.	623	0
	Joint research projects	190	0
	Ohers (donations, etc.)	13	0
	Subtotal	1136	0
Total		2177	759(26)

Costs (Million yens)

WPI grant in FY 2022	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	170
・fMRI system for brain function measurement 1set	36
Others	134

*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	83	83
Travel	Subtotal		
Equipment	Subtotal		
Research projects	Subtotal		
Total		83	83

Appendix 4 FY 2022 Status of Collaboration with Overseas Satellites

1. Coauthored Papers

- List the refereed papers published in FY 2022 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. 2023 and not described in Appendix 1.

Overseas Satellite 1 Boston Children's Hospital (Total: 8 papers)

1) [App1 list #89] *Cornelissen, L.*, Underwood, E., Gabard-Durnam, L.J., Soto, M., Tao, A., Lobo, K., *Hensch, T.K.* and *Berde, C.B.*, Tactile sensitivity and motor coordination in infancy: Effect of age, prior surgery, anaesthesia & critical illness. PLoS One. 2022 Dec 30;17(12):e0279705. doi: 10.1371/journal.pone.0279705.

2) Quast, K.B., Reh, R.K., Caiati, M.D., Kopell, N., McCarthy, M.M. and *Hensch, T.K.*, Rapid synaptic and gamma rhythm signature of mouse critical period plasticity. Proc Natl Acad Sci USA. 120(2):e2123182120. doi: 10.1073/pnas.2123182120.

3) Wu, C., Gaier, E.D., Nihalani, B.R., Whitecross, S., *Hensch, T.K.* and Hunter, D.G., Durable Recovery from Amblyopia with Donepezil, a Cholinesterase Inhibitor. Sci Reports, in press.

4) [App1 list #164] Zhu, Y., Wang, M.J., Crawford, K.M., Ramírez-Tapia, J.C., Lussier, A.A., Davis, K.A., de Leeuw, C., Takesian, A.E., Major Depressive Disorder Working Group of the Psychiatric Genomics Consortium, *Hensch, T.K.*, Smoller, J.W. and Dunn, E.C., 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. Epub 2021 Oct 23. PMID: 34689167; PMCID: PMC8674315.

5) [App1 list #165] Shonkoff, J.P., Boyce, W.T., Bush, N.R., Gunnar, M.R., *Hensch, T.K.*, Levitt, P., Meaney, M.J., *Nelson, C.A.*, Slopen, N., Williams, D.R. and Silveira, P.P., Translating the Biology of Adversity and Resilience Into New Measures for Pediatric Practice. Pediatrics. 2022 Jun 1;149(6):e2021054493. doi: 10.1542/peds.2021-054493.

6) [App1 list #166] Hameed, M.Q., Hodgson, N., Lee, H.H.C., Pascual-Leone, A., MacMullin, P.C., Jannati, A., Dhamne, S.C., *Hensch, T.K.*, Rotenberg, A., N-acetylcysteine treatment mitigates loss of cortical parvalbumin-positive interneuron and perineuronal net integrity resulting from persistent oxidative stress in a rat TBI model. Cereb Cortex. 2022 Sep 20:bhac327. doi: 10.1093/cercor/bhac327.

7) Kanamaru T, *Hensch, T.K.*, Aihara, K., Maximal memory capacity near the edge of chaos in balanced cortical E-I networks. Neural Computation, in press.

8) Awad PN, Zerbi V, Johnson-Venkatesh EM, Damiani F, Pagani M, Markicevic M, Nickles S, Gozzi A, Umemori H, *Fagiolini M.* CDKL5 sculpts functional callosal connectivity to promote cognitive flexibility. Mol Psychiatry. 2023 Feb 3. doi: 10.1038/s41380-023-01962-y.

2. Status of Researcher Exchanges

- Using the below tables, indicate the number and length of researcher exchanges in FY 2022. 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: Boston Children's Hospital

<To satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2022					

<From satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2022	0	5	0	0	5
	0	0	0	0	0

Appendix 5 FY 2022 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: 6

	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	Ganna Mamonova	51	Associate Professor, Department of Computer Mathematics and Information Security, Kyiv National Economic University	Ukraine	Ph.D. in Physics and Mathematics	・Member of the group of compilers of 2-3 volumes of the Great Ukrainian Encyclopedia (2020 edition) ・Member of Ukrainian-German research project "Asymptotic methods of research of complex systems" (University of Bielefeld, Germany March-April 2008)	1.8.2022 - 31.7.2023	A comic-based mathematics training program for elementary school children Mathematics is a creative endeavor
2	Jerome Sanes	70	Professor, Department of Neuroscience, Robert J. & Nancy D. Carney Institute for Brain Science, Brown University	USA	Ph.D. in Neuroscience	・Director, Brown University Magnetic Resonance Imaging Research Facility (2001-present) ・President's Award for Excellence in Faculty Governance, Brown University (2018)	1.1.2023 - 30.9.2023	Human neuroimaging research on brain mechanisms underlying voluntary movement, motor skill learning and cognitive flexibility
3	Nathaniel Daw	48	Professor, Department of Psychology, Princeton University	USA	Ph.D. in Computer Science with certification in Cognitive Neuroscience	・Huo Professor in Computational and Theoretical Neuroscience (2019-) ・NEURIPS Outstanding Paper Award (2022)	28.3.2023 - 13.4.2023	Deep learning project on computational psychiatry
4	Yael Niv	49	Professor, Department of Psychology, Princeton University	USA	Ph.D. in Computational Neuroscience	・Nirit and Michael Shaoul Fellow, The Mortimer and Raymond Sackler Institute of Advanced Studies, Tel Aviv University (2019) ・National Academy of Sciences Troland Research Award (2015)	28.3.2023 - 13.4.2023	Deep learning project on computational psychiatry
5	Jonas Hansen	21	Harvard University	USA	Junior	・NASA JPL; Harvard-Smithsonian Center for Astrophysics; Amazaon Audible Division; LLRISE, MIT Lincoln Laboratory ・USA Fencing: Harvard Captain, NCAA champion (epee)	10.07.2022 - 26.08.2022	AF Kuniyoshi lab intern
6	Anna Blanchfield	21	Harvard University	USA	Junior	George Whitesides research group, Harvard U	17.06.2022 - 21.08.2022	PI Takeuchi lab intern

Appendix 6 FY2022 State of Outreach Activities

* Fill in the numbers of activities and times held during FY2022 by each activity.
* Describe the outreach activities in the "6. Others" of Progress Report, including those stated below that warrant special mention.

Activities	FY2022 (number of activities, times held)
PR brochure, pamphlet	IRCN pamphlet 1 (Japanese and English)
Lectures, seminars for the general public	22
Teaching, experiments, training for elementary, secondary, and high school students	7
Science café	3
Open houses	3
Participating, exhibiting in events	3
Press releases	7
Publications of the popular science books	6
Others（ ）	N/A

*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 2022 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

- Exhibition at Komaba Museum of UTokyo

  From October 1, 2022 to November 27, 2022, IRCN held an exhibition titled "Advancing 'Neurointelligence': Brain Observers and Creators" at the Komaba Museum of the University of Tokyo. During this period, 4,385 people visited the exhibition.

  The exhibition aimed to introduce the concept of "Neurointelligence" by showcasing the unique fusion of brain research and artificial intelligence (AI) research conducted at IRCN. Hands-on activities and thought-provoking panels were designed to make visitors ask the fundamental questions: "What is intelligence?" or "What makes human intelligence different from AI?" and share the vision of the future where we can use AI to contribute to the well-being of human society. Part of the presented materials is derived from IRCN's public exhibition that was held in the previous fiscal year (March 25, 2021 - March 6, 2022) at Miraikan, a science museum operated by the Japan Science and Technology Agency (JST).

2. Collaboration with Global Partners and Global Outreach

- UTokyo New York Office Event Series "How does Human Intelligence arise?"

  IRCN held a public event in New York, USA, entitled: "IRCN and UTokyo NY Office Event: How does human intelligence arise?" on October 20, 2022 (US time, October 19). The event was held at the Verizon Executive Education Center at Cornell Tech, located on Roosevelt Island, and was simultaneously broadcast via webinar. The purpose of this first overseas event was to introduce the activities of the IRCN which addresses the ambitious question of "How does human intelligence arise?

The speakers in the lecture session included: Dr. Takao Hensch (IRCN Director and Professor), Dr. Yukiko Gotoh (IRCN Principal Investigator and Professor at the Graduate School of Pharmaceutical Sciences), Dr. Kenichi Ohki (IRCN Principal Investigator and Professor at the Graduate School of Medicine) and Dr. Laurel Gabard-Durnam (IRCN Associate Research Fellow and Associate Professor at Northeastern University). Each gave a presentation on their findings from their cutting-edge research. In the discussion session that followed, the speakers answered questions from the on-site audience and webinar participants.

In the reception hall for on-site attendees, panel displays highlighted some of the key differences between human and artificial intelligence, and the possibilities that can be unlocked when the two are better understood and combined. A video was also shown to outline the activities of the IRCN. These exhibits showed the essence of IRCN's unique approach of combining neuroscience and artificial intelligence.

15 people (26 registrants) attended the on-site event and 140 people (approximately 250 registrants) participated in the webinar. Positive feedback was received from participants worldwide.

3. General Public Books Published in FY2022

Printed or online books are powerful outreach venues 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 to promoting the importance of basic research.

- 「AIから読み解く社会 – 権力化する最新技術」The Society as Viewed from AI - The Latest Technology Becoming Empowering
  Yukie Nagai (Principal Investigator)
  The University of Tokyo Press (UTP)（東京大学出版会）ISBN 978-4-13-053033-0
  (Published on 31.3.2023)

- 「深層学習からマルチモーダル情報処理へ」From Deep Learning to Multimodal Information Processing
  Hideki Nakayama (Affiliated Faculty)
  Science (サイエンス社) ISBN: 978-4781915548
  (Published on 04.11.2022)

- 「マスク社会が危ない 子どもの発達に「毎日マスク」はどう影響するか？」Risks in the mask society: How does "daily masking" affect children's development?
  Masako Myowa (Affiliated Faculty)
  Takarajimasha-shinsho (宝島社新書) ISBN 978-4-299-03372-7
  (Published on 24.10.2022)

- 「勉強しないで身につく英語　脳科学による画期的メソッド」Mastering English without Studying: An Epoch-Making Method Based on Brain Science
  Kuniyoshi Sakai (Affiliated Faculty)
  PHP Institute, Kyoto, ISBN 978-4-569-85330-7
  (Published on 26.09.2022)

- 「脳 大図鑑」The Picture Book of the Brain
  Haruo Kasai（Principal Investigator）
  Newton Press (Published on 25.09.2022)　ISBN 978-4-315-52599-1
  (Published on 15.09.2022)

- 「感染症流行を読み解く数理」Mathematical understanding of outbreaks of infectious diseases
  Nishiura, Hiroshi; Kobayashi, Tetsuro; Anzai, Asami; Aihara, Kazuyuki (Principal Investigator)
  Nihon Hyoronsha (日本評論社)　ISBN 978-4-535-78759-9
  (Published on July 2022)

Appendix 7 FY 2022 List of Project's Media Coverage

* List and describe media coverage (e.g., articles published, programs aired) in FY2022.

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

	Date	Types of Media (e.g., newspaper, magazine, television)	Description
1	28.03.2023	NHK E-television (Television)	【Touhara, K】 "HEN-TENA (Curious Antenna)" on "Olfaction". Olfactory Special. 特集番組「へんテナ」「嗅覚特集」
2	14.03.2023	World Science Festival (Website (Video))	【Hensch】Panelist for "REWIRING THE BRAIN: THE PROMISE AND PERILS OF NEUROPLASTICITY"
3	13.03.2023	Nikkei Online (Website)	【Kano】"Japan Academy Prize awarded to 11 for Outstanding Achievements, including Invention of QR Code"「日本学士院賞に11人 QRコードなど優れた業績を顕彰 」
4	26.12.2022	Monthly "Brain" (Senden-Kaigi) (Magazine)	【Daikoku】Monthly "Brain" (Senden-Kaigi) Aoyama Design Conference (Roundtable Discussion) "How to get in the 'zone' for creators"
5	20.12.2022	NHK BS (Television)	【Touhara, K】Guest Expert for "HUMANIENCE: Degeneration - Another form of evolution"
6	28.11.2022	UTokyo Biblio Plaza (Website)	【H.Takahashi】UTokyo Biblio Plaza: "Life Intelligence and Artificial Intelligence: How to use and nurture the brain in the age of AI"「生命知能と人工知能　AI時代の脳の使い方・育て方」
7	25.11.2022	mynavi NEWS (Website)	【Aihara】"Chiba Institute of Technology Invents 'RC-Spike' for High-Performance Low-Power Deep Learning Circuits"「千葉工大、低消費電力型深層学習用回路を高性能化する「RC-Spike」を考案」
8	25.11.2022	TECH+ (Website)	【Aihara】"Chiba Institute of Technology Invents 'RC-Spike' for High-Performance Low-Power Deep Learning Circuits"「千葉工大、低消費電力型深層学習用回路を高性能化する「RC-Spike」を考案」
9	12.11.2022	The Univ. of Tokyo (Website)	【H.Takahashi】The University of Tokyo Research News: "Rats bop to the beat. Rats can move their heads in time to music, demonstrating innate beat synchronization in animals for the first time" *The press release was covered by many media outlets (37domestic reports, 174 international reports)
10	05.11.2022	The 7th Japan-US Science Forum in Boston, JSPS Washington Office (Website)	【Hensch】Co-hosted the seminar "Resilience from the Pandemic"
11	31.10.2022	MY VISION, NIRA (Website)	【Aihara】"Find the 'fluctuations' and deal with uncertain occurrences before they happen"「『揺らぎ』を見つけて、不確実な出来事が起こる前に対処する」
12	29.10.2022	Woman (Magazine)	【Mamonova】"Press of Ukraine"
13	17.10.2022	SYSMEX MEDICAL MEETS TECHNOLOGY (Website)	【Aihara】"Development of a Mathematical Model to Predict the Therapeutic Effectiveness of Nilotinib for CML - The University of Tokyo et al."「CMLに対するニロチニブの治療効果を予測できる数理モデルを開発－東大ほか」

14	17.10.2022	QLIFE PRO (Website)	【Aihara】"Development of a Mathematical Model to Predict the Therapeutic Effectiveness of Nilotinib for CML - The University of Tokyo et al."「CMLに対するニロチニブの治療効果を予測できる数理モデルを開発－東大ほか」
15	14.10.2022	Tii SEIMEIKAGAKU (Website)	【Aihara】"Proposal for a Patient-Specific Early Prediction Method for the Efficacy of Leukemia Drugs Using Mathematical Modeling." "数理モデルを用いた白血病治療薬の効果の患者別早期予測手法の提案"
16	13.10.2022	Nikkei Online (Website)	【Aihara】"UTokyo and others have developed a mathematical model that can predict the therapeutic effect of nilotinib, a treatment for chronic myeloid leukemia, on a patient-by-patient basis and at an early stage." 「東大など、慢性骨髄性白血病の治療薬であるニロチニブの治療効果を患者ごとにかつ早期に予測できる数理モデルを開発」
17	06.10.2022	Casa Italia (Television)	【Dalila】The daily program "Casa Italia"
18	06.10.2022	Special discussion (YouTube)	【Aihara】Special discussion (Tamura, Atsushi; Aihara, Kazuyuki): "What is a society that uses mathematics to prevent disease [Cabinet Office's "Moonshot R&D System" Goal 2 Explained]," YouTube aaasyych~2nd~.「数学で病気を防ぐ社会とは【内閣府『ムーンショット型研究開発制度』目標2解説】」YouTubeアーシーch~2nd~ (3)Expert guest, Degeneration - Forgotten Evolution-
19	04.10.2022	Yomiuri TV (Television)	【Myowa】Science Director for "Children's Challenge Variety IRORIRO" (Tuesdays 10:25-10:55 a.m. from October 4, 2022, streamed on IRORIRO's official Youtube channel) こどもちょうせんバラエティいろりろ 監修（2022年10月4日～, 火曜午前10:25~10:55放送, いろりろ公式youtubeで配信
20	30.09.2022	Medical Tribune (Website)	【K.Kasai】"Young Carers Tend to be More Anxious and Depressed, 7.4% of Japanese junior high and high school students fall into this category"「ヤングケアラーは不安や抑うつが強い傾向　日本の中高生の7.4%が該当」
21	30.09.2022	Jiji Medical (Website)	【K.Kasai】"Young carers tend to be more anxious and depressed"「ヤングケアラーは不安や抑うつが強い傾向」
22	30.09.2022	KAGAKU SHIMBUN (Newspaper)	【Aihara】"Ultra-Early Diagnosis of Diseases by Mathematical Engineering" DNB Theory to Change Medicine, Constructed by Special Professor Gohara of Tokyo University."「『数理工学で病気を超早期診断』医療を変えるDNB理論　東大合原特別教授が構築」
23	30.09.2022	THE SCIENCE NEWS (Website)	【Aihara】"Ultra-Early Diagnosis of Diseases by Mathematical Engineering" Changing Medicine, DNB Theory Constructed by Dr. Kazuyuki Aihara." 「『数理工学で病気を超早期診断』医療を変える DNB理論　合原一幸氏が構築」
24	29.09.2022	QLifePro Medical News (Website)	【K.Kasai】"Survey of 5,000 junior high and high school students reveals 7.4% presence of 'young carers' in Japan - University of Tokyo Hospital, etc." 「日本の『ヤングケアラー』実態、中高生5,000人調査で存在率7.4%－東大病院ほか」
25	26.09.2022	University Journal (Website)	【K.Kasai】"Japanese version of British Young Carer Scale Created, surveyed 5,000 junior high and high school students" 「英国ヤングケアラー尺度の日本版作成、中高生 5,000 名を実態調査」
26	22.09.2022	Yahoo news (Website)	【Daikoku】"What appears useless is what is more important? Six acts to enhance the 'power of creation'"「無駄こそ大事!? "創造するチカラ"を高める6つのアクション」
27	15.09.2022	NHK (Television)	【Touhara, K】Guest Expert on the combination of flavors of food for "Torisetsu-show"
28	14.09.2022	Science Japan (Website)	【Tanaka, Aihara】"Group from the University of Tokyo improves the performance of time series prediction in artificial neural networks"
29	07.09.2022	CVA (Izu Ito Cable TV) (Television)	【Barbir】Interview: Emiko Iwasaki, Barbir, M.
30	26.08.2022	Todai TV (YouTube)	【Y.Okada】UTokyo Friday Lecture for High School students: "Super-uber microscope to examine living cells."

31	22.08.2022	NHK Text (Magazine)	【K.Kasai】"Today's Health" (p32-39). Also on NHK "Today's Health" and "NHK Health Channel"
32	12.08.2022	NHK Web report (Website)	【K.Kasai】Cooperation for the interview
33	12.08.2022	NHK E-television "Today's Health" (Television)	【K.Kasai】"Schizophrenia"
34	11.08.2022	Seikyo Shimbun (Newspaper)	【Myowa】"Raising Children is an Intellectual Activity"「子育ては知的な営み」
35	07.08.2022	Website Technology.org (Website)	【Ohki】"The eyes have it"
36	05.08.2022	Website Nach Welt (Website)	【Ohki】"Studie enthüllt Details über die komplizierten visuellen Netzwerkformen bei Mäusen"
37	05.08.2022	Website News Medical Lifesciences (Website)	【Ohki】"Study reveals details about the complicated visual network forms in mice"
38	04.08.2022	Nikkei Online (Website)	【Ohki】"UTokyo Unveils Parallel Module Strategy for Efficiently Creating Connections Between Many Fields of the Cerebral Cortex"「東大、大脳皮質の多数の領野を結ぶ結合を効率よく作るための並列モジュール戦略を解明」
39	04.08.2022	Website Medical Express (Website)	【Ohki】"New insight into the development of the visual system in mice"
40	04.08.2022	Website Science Daily (Website)	【Ohki】"How the visual system develops in mice"
41	04.08.2022	Website TechRegister (Website)	【Ohki】"How the visual system develops in mice"
42	03.08.2022	Less is More (Website)	【Hagihara】"Less is More, Undifferentiated language tells us the world children see: Interview with Dr. Hiromichi Hagihara"
43	03.08.2022	ASCII.JP × BUSINESS (Website)	【Aihara】"New Method to Improve the Performance of Time Series Prediction of Neural Networks = University of Tokyo, etc."「ニューラルネットの時系列予測性能を向上させる新手法＝東大など」
44	03.08.2022	MIT TECHNOLOGY REVIEW (Website)	【Aihara】"New Method to Improve the Performance of Time Series Prediction of Neural Networks = University of Tokyo, etc." 「ニューラルネットの時系列予測性能を向上させる新手法＝東大など」
45	29.07.2022	NHK (Television)	【K.Kasai】"Mental illness classes begin at high schools", cooperation for interview "Ohayo Nippon"
46	28.07.2022	Nikkei Online (Website)	【Tanaka, Aihara】"University of Tokyo and Toyota Central R&D Labs find that time series prediction performance can be improved by imposing variation on the characteristics of neurons."「東大と豊田中央研究所、ニューロン群に特性ばらつきを与えることで時系列予測性能が向上することを発見」
47	19.07.2022	Honobono Butsuri (YouTube)	【Y.Okada】UTokyo Department of Physics YouTube Channel "Hono-bono Physics #13 Motor Proteins" (Editorial cooperation and materials provision)「ほのぼの物理#13 モータータンパク質」(編集協力、素材提供)
48	09.07.2022	NHK Radio (Radio)	【Myowa】NHK Radio Late Night News: "Words for Tomorrow"　NHKラジオ深夜便「明日へのことば」

49	22.06.2022	Wiley's Research Headlines (Website)	【K.Kasai】"Implementation of online classes during national school closure due to COVID-19 and mental health symptoms of adolescents: A cross-sectional survey of 5,000 students,"
50	14.06.2022	Todai shimbun (Newspaper)	【H.Kasai】"Nerve Pushes Nerve to Transmit Information!" Commemorative Interview for the Academy Award and Imperial Prize「神経が神経を押して情報伝達!?」学士院賞・恩賜賞記念インタビュー
51	10.06.2022	Nikkei Online (Online News)	【Touhara】"Elucidation of the mechanism of pheromones that induce aggressive behavior in mice"
52	06.06.2022	Nihon Keizai Shimbun (Newspaper)	【Myowa】Multiple Perspectives: "How Long Should I Wear a Mask" 複眼 「マスクいつまで着けるか」
53	01.06.2022	Gendai kagaku (Magazine)	【Y.Okada】Interview, Y. Okada & H. Noji, "What is Life?"
54	31.05.2022	Yomiuri Shimbun (Newspaper)	【Myowa】"They were supposed to grow up watching others' mouth"「口元見て 育つはずが」
55	29.05.2022	Neuroscience News (Online News)	【Touhara】"Seeing How Odor Is Processed in the Brain"
56	29.05.2022	NHK (Television)	【Tsuji, Myowa】NHK Special: "Connect the circles of wisdom! How to deal with child-care concerns" NHKスペシャル「つながれ！チエノワ＃子育てのもやもや解消」取材協力
57	24.05.2022	Nana-sensei's Language Development Radio (Radio)	【Hagihara】Nana-sensei's Language Development Radio: Interview with Dr. Hiromichi Hagihara, IRCN Babylab, The University of Tokyo: "How does children's vocabulary increase?"
58	24.05.2022	NHK-BS (Television)	【Emoto】HUMANIENCE: "Pain is the origin of the mind"
59	22.05.2022	TBS (Television)	【Myowa】Special feature 1: "Infants and young children in high risk. Does 'wearing masks' affect children's development? Doubts and concerns raised by continued trials and errors in education", cooperation for an interview. 特集１「最もリスクがあるのは乳幼児」"マスク着用"が子どもたちの発達に影響か 試行錯誤続く教育現場から上がる疑問と不安 取材協力
60	20.05.2022	Yomiuri Chukokusei Shimbun (Newspaper)	【Myowa】"Is it OK to Remove Masks Outdoors? Invisible Facial Expressions Affect Brain Development"「マスク屋外は外してもOK? 見えぬ表情 脳の発達に影響か」
61	17.05.2022	NHK (Television)	【Myowa】NHK Sogo (Nagoya) Marutto!: "Children's Masks: How Do They Affect Children's Brain Development" NHK総合（名古屋）まるっと！「子どものマスク その影響は」
62	11.05.2022	Seibundo shinkosha koka-net (Website)	【Y.Okada】Doctors' Relay Series June 22 Issue: "Interview with Dr. Yasushi Okada, research on 'Molecular Motors'"
63	10.05.2022	Seibundo shinkosha (Magazine)	【Y.Okada】Interview, "Doctors' relay"
64	07.05.2022	Yomiuri Shimbun (Newspaper)	【Myowa】"How long do we have to live with masks?「マスク生活いつまで？」
65	01.05.2022	Nature Digest (Website)	【H.Kasai】"Information transfer between neurons is also mediated by pushing forces!"「ニューロン間の情報伝達は押す力でも引き起こされる！」
66	01.05.2022	Mainichi Shimbun (Newspaper)	【Myowa】"Seeing the face advances learning. Transparent masks are introduced at childcare workplaces under COVID19" 「新型コロナ 顔が見える、学びが進む 保育現場など、透明マスク広がる」

67	29.04.2022	Yomiuri Shimbun (Newspaper)	【Myowa】"Preterm infants, weak alternating attention" 「早産児、注意転換力弱く」
68	29.04.2022	Yomiuri Shimbun (Newspaper)	【Myowa】"Cultivating Rich Facial Expressions"「豊かな表情を育てる」
69	21.04.2022	NHK-BS (Television)	【Hensch】HUMANIENCE: "'The souls of a three year old' - the Big Bang in small bodies" 「"三つ子の魂" 小さな体のビックバン」
70	11.04.2022	esse-sense (Website)	【Daikoku】"Where music comes from and how it evolves: Perspectives from a researcher and a musician"「音楽はどこから生まれ、どう進化するのか、研究者と音楽家の両面からアクセスし解明したい」
71	08.04.2022	NHK (Television)	【Myowa】Metropolitan Area Information Netadori!: "Children's Mental Health during the Pandemic" Cooperation for an interview. NHK総合（首都圏） 首都圏情報ネタドリ！「コロナ禍の子どものメンタルヘルス」 取材協力
72	07.04.2022	NHK (Television)	【Myowa】NHK General (Kyoto) News 630: "COVID Pandemic and Childcare" Cooperation for an interview.　NHK総合（京都） ニュース６３０「コロナ禍と保育」取材協力