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Abstracts

Abstracts for the 36th Conference of the Japan Society for Twin Studies, 22 January 2022

SPECIALLY INVITED ORAL PRESENTATION
Unusual Behavioral Similarities in Twins Reared Apart: Genetic Effects, Random Chance, or Both?

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A wealth of twin research shows that monozygotic (MZ) twins are more alike in virtually all measured behavioral traits, relative to dizygotic (DZ) twins. These results apply to twins both reared apart (MZA, DZA) and reared together (MZT, DZT). This recurring pattern of findings is consistent with contributions from genetic effects on intelligence, personality, height and weight, to name a few. However, the lack of perfect MZ twin resemblance indicates that environmental influences before and/or after birth also shape behavioral outcomes. A related and continually posed question remains unresolved: Are MZA twin similarities in unusual behaviors and atypical characteristics best explained with reference to genetic factors, random chance, or a combination of the two? Some insights into this complex question were provided by a psychology graduate student class project undertaken in spring 2021 at California State University, Fullerton. Prior to describing the methods, early outcomes, and future directions of this project is an overview of relevant research in selected domains of human behavioral and physical development. These summaries are needed for the purpose of providing a meaningful context to the issue under consideration.

COMMEMORATIVE LECTURE
Generation of Emotion and Decision-Making Based on Predictive Coding of Interoception: Contributions of Genetic and Environmental Factors

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In theories of emotion in psychology and neuroscience, the importance of roles of the body has been recognized. Interoception, which means sensations of inner body signals and regulation of the body to maintain homeostasis, has been considered to play key roles in the generation of emotion and decision-making. Recently, the theory of predictive coding has been focused on as a theoretical framework to explain the association between interoception, emotion, and decision-making. In the perspective of predictive coding, any perception including interoception is considered as not just a passive and bottom-up processing but to generate through comparison between prediction by inner models in the brain and actual signals (prediction error). The brain regulates the systems by minimizing prediction errors through (1) updating the inner models and (2) alteration of bodily states. Success to reduce prediction error might be linked with positive emotional states and expansion and maintenance of prediction error might result in negative emotional states. Furthermore, the success of prediction error reduction and accompanying positive emotions can work as reward and increase values of related behaviors and objects. Inversely, failure of prediction error reduction devaluates related behaviors and objects. Consequently, probabilities of choices of the behaviors and objects can be modulated.

Such a theoretical framework can consistently combine several important psychological phenomena, such as interoception, emotion, reward, and decision-making. A computational model describing dynamics of the predictive coding of interoception can explain patterns of empirical data in neuroimaging and psychophysiological experiments. Such a theoretical framework can be expanded into clinical settings in psychiatry and psychosomatic medicine. Depression can be characterized by poor regulation of interoception, and thus resulting in chronic inflammation. Developmental disorders are characterized by hypersensitivity and/or blunted sensitivity of interoception and external perception. Risk-taking behaviors and crimes are considered to root on the impairment of systems of evaluation of reward and decision-making, especially under risk and uncertainty. This theoretical framework should shed a new light for understanding about human nature, for predictions of decision-making, and furthermore for developing new tools for diagnosis and treatment of mental and psychosomatic diseases.

Twin studies provide implications about the contributions of genetic and environmental factors on the dynamics of the model. For example, the ADORA2A genotype modulates interoceptive and exteroceptive processing in the frontal-insula network in the brain, while the variance in interoceptive accuracy is rather explained by nonshared environmental factors. Reward prediction error signals in the ventral striatum decreased in twin pairs with high risk of mood disorders. Individual differences of aspects of decision-making, such as delay discounting, risk taking, and impulsive activity in the brain reward system can be at least modestly explained by genetic factors. In future, systematic exploration about heritability of each component and process of the dynamics of interoception, emotion, and decision-making should be conducted.

ORALS
Oral-A1
*Japanese Only Oral-A2 No Evidence of a Genetic Correlation Between Alcohol Consumption and Sleep Duration

Momo Tsujibayashi[1], Kae Nakatani[1], Koji Ono[1], Chika Honda[2,4], Rie Tomizawa[3,4], Daisuke Matsumoto[1,4] Osaka Twin Research Group[4] and Fujio Inui[1,4]

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In Japan, 37.8% of men and 8.9% of women were classified as heavy drinkers as of 2016 (World Health Organization, 2018), and health problems associated with alcohol consumption have become a social issue. Regarding the relationship between alcohol consumption and sleep, some studies have reported that drinking alcohol shortens the time taken to fall asleep or impairs the second half of sleep, and others have reported that compared with heavy drinking, moderate drinking is more likely to cause sleep disturbance. There are also reports that alcohol consumption interferes with sleep. The relationship between alcohol consumption and sleep duration is not simple, and it is unclear which is the cause and which is the effect. Therefore, we examined the relationship between alcohol consumption and sleep duration by decomposing it into genetic and environmental factors. Adult twins registered in the Osaka University Twin Registry were the study subjects, and the data were obtained through secondary use of 2014 and 2019 data from a self-administered questionnaire survey conducted at the Center for Twin Research, Osaka University Graduate School of Medicine, Japan. The study was approved by the Osaka University Observational Research Ethics Committee (No. 13581-6). The items analyzed were (1) alcohol consumption (type, consumption, frequency) and (2) sleep duration. All items were analyzed by the classical twin method after adjusting for sex and age by regression analysis. Responses had been received from 719 of 1419 people in the 2014 survey, and from 882 of 1604 people in the 2019 survey. In those who responded in both years, the 2019 data were used, and 1178 people were included in the analysis. There were 356 pairs of monozygotic twins and 79 pairs of dizygotic twins, and mean age was 58.96 (±19.84) years. There was no correlation between alcohol consumption and sleep duration on weekdays ($r = -.03$) or between alcohol consumption and sleep duration on the weekend ($r = .01$). However, the directions of the genetic and environmental correlations between alcohol consumption and sleep duration were opposite, and may have cancelled each other out. Therefore, the correlation was decomposed into genetic and environmental effects. For alcohol consumption and weekday sleep duration, 36% of the variance was explained by an additive genetic effect and 60% by an intrinsic environmental (including error) effect. For alcohol consumption and weekend sleep duration, 32% of the variance was explained by an additive genetic effect and 68% by an intrinsic environmental (including error) effect. However, genetic factors explaining both alcohol consumption and weekday sleep duration, and genetic factors explaining both alcohol consumption and weekend sleep duration were both less than 1%. Heritability in both alcohol consumption and sleep duration, estimated by univariate analysis, revealed no genetic correlation between the two. The data used in this study did not include many people who were heavy drinkers or have sleep disorders, which may have biased the study to include only healthy people. No evidence was found for a genetic correlation between alcohol consumption and sleep duration in healthy individuals. As the situation may be different for heavy drinkers and people with sleep disorders, further research is needed.

Oral-A3
Genetic and Environmental Associations Between Self-Efficacy and Fatigue: A Twin Study

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Fatigue is a biological signal alerting the individual to physical abnormalities and indicating the need to rest in order to prevent overload. Recovery from physiological fatigue occurs quickly with normal amounts of rest or sleep. However, a research group from the Ministry of Health, Labour and Welfare in Japan showed that 59.1% of people feel fatigued daily, and 35.8% experience chronic fatigue for a period of 6 months or longer. Fatigue is a major social issue in Japan and is related to both depression and the phenomenon of death from overwork called *karoshi*. Moreover, psychosomatic correlations show that stress affects the nervous system and immune system. Consequently, the maintenance of health or the onset of and recovery from diseases are affected by psychological states. Self-efficacy is one of the most important personality characteristics in health promotion and the recovery from or control of diseases. Low self-efficacy is associated with depressive symptoms and recurrence of depression. Using data from secondary use of the self-reported questionnaire surveys from 2014 to 2019 performed by the Center for Twin Research, Osaka University Graduate School of Medicine, 1030 subjects (2014: 258 males and 438 females, mean age 59.8 ± 18.6 years, 213 monozygotic [MZ] complete pairs and 44 dizygotic [DZ] complete pairs; 2019: 233 males, 555 females, mean age 54.9 ± 19.8 years, 262 MZ complete pairs, 55 DZ complete pairs) were identified and analyzed. Self-efficacy scores were measured by the General Self-Efficacy Scale Japanese version (GSE) and fatigue symptoms by the Chalder Fatigue Scale Japanese version (CFQ) adjusted for age and sex by regression analysis. The phenotypic correlations between GSE and CFS were −0.37 in 2014 and −0.40 in 2019 ($p < .05$). We performed structural equation modelling analysis using the univariate. The additive genetic/specific environment (AE) model offered the best fit according to Akaike Information Criterion (AIC). For the GSE-2014, 41% of the variance was explained by additive genetic effects and 59% was explained by unique environmental (including error) effects. For the CFQ-2014, 33% of the variance was explained by additive genetic effects and 67% was explained by unique environmental (including error) effects. For the GSE-2019, 41% of the variance was explained by additive genetic effects and 59% was explained by unique environmental (including error) effects. For the CFQ-2019, 44% of the variance was explained by additive genetic effects and 66% was explained by unique environmental (including error) effects. When comparing trivariate Cholesky decomposition (GSE-2014, CFQ-2014, and

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CFQ-2019) genetic models, two A and three E components showed the best fit according to AIC. Genetic correlation between the GSE-2014 and CFQ-2014 was r = −.75, and that between the GSE-2014 and CFQ-2019 was $r = -.61$. Our results show the genetic associations between self-efficacy and present and future fatigue symptoms.

Oral-B1
Assessment of Genetic and Environmental Influences on the Nigrosome 1 Region Using MRI : A Twin Study of Normal Brain

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The Substantia Nigra pars compacta (SNpc) is a crucial area in patients with Parkinson's disease (PD). Within the SNpc, the nigrosomes are primary subregions where dopaminergic cells are lost. Nigrosome 1 is the largest subgroup of the nigrosomes and is most affected in PD. We aimed to assess the magnitude of each genetic and environmental influence on the nigrosome1 region with MRI. This study included 33 monozygotic twin pairs and 13 dizygotic twin pairs who underwent susceptibility weighted imaging (SWI) on a 3T-MR imager. In all subjects, bilateral nigrosome1 regions were segmented manually by one observer as a region-of-interest analysis method. Signal-to-noise ratio (SNR) of the nigrosome1 region was calculated based on the background region. Twin analysis with a model involving phenotype variance components of additive genetic effects (A), common environmental effects (C), and unique environmental effects (E) was performed to assess the magnitude of each genetic and environmental influence on SNR. Additionally, correlation with age was assessed using Pearson's test, and laterality in bilateral regions and differences in sex were assessed using Wilcoxon ranking test. All parameters fit best with an AE model. Right (A: 59.4%) and Left (A: 74.3%) were highly heritable. No significant correlation with age was shown. There were no significant differences in laterality and sex. The present study indicated that the nigrosome1 region was highly heritable, which is consistent with the results of the previous twin brain study using MRI. We consider that the present study can provide useful information in evaluating PD. Nigrosome1 may be affected mainly by genetic factors. This study was approved by the ethics committee of our institution (approved number 696-7), and written informed consent was obtained from all subjects after they received an explanation of the purposes of the study and the possible consequences of participating in the study.

Oral-B2 *Japanese Only
Epigenetic Factors Affecting to Circulating Adiponectin Level in Monozygotic Twins

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Oral-B3
Association of Type II Diabetes With Both Sleep Duration and Depression: Analyses Using Polygenic Risk Scores for Type II Diabetes

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In Japan, the number of people with diabetes has been significantly increasing along with changes in the living environment and social lifestyles. As of 2017, it is estimated that there are 3.3 million patients with diabetes and approximately 17 million people living with prediabetes. The risk factors for developing diabetes are known to be genetic and environmental, that is, lifestyle related. However, the association between the genetic and environmental factors as well as the degree to which each risk contributes have yet to be well clarified. We have therefore analyzed the effects of type Ⅱ diabetes on sleep duration and depression using the polygenic risk scores (PRS) for type II diabetes in the Japanese population. Single nucleotide polymorphism (SNP) data and the results of blood tests from medical examinations collected since 2011 from volunteer adult twins enrolled in the Osaka University Twin Registry were examined. The PRS for type II diabetes were generated by utilizing data from a genomewide association study (GWAS) publicly released by the comprehensive research institute RIKEN for 36,614 cases of type Ⅱ diabetes and 155,150 control subjects. Moreover, glycated haemoglobin (HbA1c) levels from blood tests, analyses of age, gender, and BMI from biopsies collected during medical examinations, and sleep duration, amount of sleep debt (social jet lag), Center for Epidemiologic Studies Depression Scale (CES-D) scores, and smoking histories from self-administered questionnaire surveys (conducted in 2014, 2016, and 2019) were analyzed to obtain the phenotypes. In this study, standardized partial regression coefficients (β) were obtained by linear regression model analyses using the type II diabetes PRS generated to estimate their ability to predict CES-D, sleep duration, and sleep debt. No significant results were observed for the linear regression models with CES-D as the dependent variable. However, linear regression analyses with sleep duration as the dependent variable and HbAlc, age, and gender as the independent variables predicted a moderate effect in the relationship between sleep duration and HbAlc levels (β-0.1129, $p = .0962$). Moreover, in the linear regression models using sleep duration as the dependent variable and type II diabetes PRS, age, gender, and PC1～10 as the independent variables, a moderate effect could be predicted between sleep duration and type II diabetes PRS ($\beta = 0.1067$, $p = .0877$). In linear regression models using sleep duration as the dependent variable, the variables for both HbA1c and type Ⅱ diabetes PRS showed an association to sleep duration; however, at $p < .1$, these were considered suggestive. When CES-D or sleep debt was the dependent variable for the linear regression models, neither significant nor suggestive results could be obtained since the target sample was small and focused on the general population and not diabetic or depressive

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patients. Although the present results were not significant enough as evidence of pleiotropy between type II diabetes and sleep duration and depression, the fact that suggestive results could be obtained of an association between type II diabetes PRS and sleep duration indicates the possibility of a genetic correlation (pleiotropy) involving type II diabetes and sleep duration. Moreover, in analyses using HbAlc as the independent variable and type II diabetes PRS as the independent variable, the fact that we could confirm compatibility between the results of the phenotypic models and genotypic models demonstrates that type Ⅱ diabetes is a multifactorial genetic disease. In conclusion, there was no definite evidence that type Ⅱ diabetes PRS has a simultaneous influence on both sleep duration and depression since the analytical models did not show involvement between type Ⅱ diabetes and CES-D. However, moderate and suggestive association was observed for type II diabetes PRS and sleep duration as well as HbA1c and sleep duration, indicating that further investigations and case reports to accumulate data with larger target groups would contribute to a more comprehensive understanding of the phenotypic and genotypic factors involved between type II diabetes with sleep duration and depression, in turn, leading to optimal treatment strategies for these disorders. Documented consent was acquired from all research participants and all procedures in this research followed the ethical standards of the Research Ethics Review Board (Approval Number 696-7), the Interventional Study Ethics Review Board (Approval Number 10209-17), and the Observational Study Ethics Review Board (Approval Number 13581-6) of Osaka University.

Oral-C1
A Report on Multipregnancy Support in University Hospitals

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Multiple pregnancies are high-risk pregnancies with few options for childbirth facilities and methods, and postpartum childcare can lead to sleep deprivation and postpartum depression. In December 2019, we worked toward the construction of multiple birth support, considering that it is necessary to cooperate with the hospital and the community from the beginning of pregnancy in order to create a mechanism that does not isolate the multiple birth family. Currently, we are mainly conducting home visits after multiple births and online exchange meetings between mothers, but in some cases, home visits led to the misunderstanding that it is not necessary to receive newborn visits in the area. Therefore, it was necessary to gain an understanding of the difference between the support provided by the hospital and the community. In the future, the challenge is to expand the network with multiple birth support teams such as local governments and continue continuous support.

Oral-C2 *Japanese Only
Oral-C3
Consideration of the Enhancement of Multiples Care Support in Okinawa: Through the Life History of a Multiples Care Support Activist

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The reality of multiples' support in Okinawa has never been revealed until now. One reason for this may be the way families function in Okinawa. It has been thought that there is enough support for child-rearing, even for families with multiples, as parents have the support of family members nearby. However, a multiples group was newly established in 2021 by multiples' parents living in Okinawa, indicating that advancements in multiples support are desired. Therefore, the vision for multiples care support in Okinawa is considered by conducting a survey of the current condition of multiple child care and support activities in Okinawa. The life history method was used as a research method. The research subject is a mother of twins living in Okinawa. The 2-h interview survey, which was conducted in November 2021, covered the period of multiple pregnancies, birth, child-rearing, and the establishment of the group. Questions were asked in chronological order and the interviewee could express herself freely. Concerning this interview, it was confirmed that it may be published, there would be no disadvantages, and that it is in accord with the ethical code of the Japan Research Association for Community Development. Although the existence of the multiples group in Okinawa had never been known until now, it had actually been established approximately 20 years ago. The interviewee had decided to start it after being influenced by a derived group representative. It could be inferred that the interviewee was able to put her desire to support others into action as she is a professional and was part of an empowering work environment. The establishment of the multiples group, which is a space where parents of multiples can sympathize with others, was promoted as it did not exist in the community and because there was a case of multiples' abuse death in the past. On the other hand, the matter of increasing difficulty in obtaining child-rearing support due to the shallow relationships with nearby communities caused by the nuclearization of families could not be determined from the interview. However, it is evident that the current enhancement of multiples care support in Japan has served as a tailwind for Okinawa. As Okinawa already has various social issues including high percentages of poor/single-mother/multiple households, having multiple care support closely related to regional governments and specialists as well as the people concerned may lead to additional support activities in addition to multiples care support.

Oral-D1 *Japanese Only
Oral-D2 *Japanese Only
A Study on Twins' Experience: How Young Adult Twins Felt About Their Parents Trying to Take Care Of Them Equally

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Oral-D3
Literature Research on the Grief Caused by the Loss of a Twin

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Grief support for those who have experienced perinatal loss, including miscarriages, stillbirths, and neonatal deaths, has received

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a great amount of attention in recent years. The perinatal loss rate for a multiple pregnancy is five times higher than that of a single pregnancy, and there is also a possibility of a perinatal loss of one (or more) in a multiple pregnancy. However, currently, the issue of twin loss has been untouched in Japan and grief care (bereavement care) for multiple-birth families has become an important issue. In this research, the grief and care for parents/family who have lost one twin (multiple) in the perinatal stage as well as that of the twin survivor are outlined by means of a survey of foreign literature and the necessity of grief care that meets the needs of multiple-birth families is considered. A keyword search was conducted using PubMed for the bibliographic search. The target period was set as 1968~November 2021, and the search keywords and formula were (grief) AND ((bereavement) OR (perinatal loss) OR (twin loss) OR (Stillbirth) OR (Miscarriage) OR (Neonatal death) OR (Pregnancy loss) OR (Neonatal loss) OR (deceased twin) OR (bereaved twins)) AND ((Twin Pregnancy) OR (twins) OR (triplets) OR (multiplets)). Sixty-two items were found as a results. After excluding 29 literature items including literature on multifetal reduction, literature in German or French, case reports, literature not related to twin loss (e.g., research on separated twins), and literature with no abstracts (searched for MeSH terms), the remaining 33 items were used. Moreover, regarding the extraction of literature to be analyzed, consideration was given in order to avoid taking away from the main thesis or contextual meaning. Regarding situations where the survival of one child is prioritized due to complications during a multiple pregnancy, there were reports on cases where parents felt that they were not provided with the appropriate information. Additionally, while there are reports that indicate no difference between the grief of parents who have experienced twin loss and parents who have experienced perinatal loss in a single pregnancy, there were reports that showed that some parents felt that their grief concerning the perinatal loss of one child was interrupted or minimized as it would be pointed out that they had a surviving child. It was reported that mothers especially experienced an intense struggle when faced with looking after their newborn/infant while dealing with the grief of twin loss. Some parents experience complicated feelings when seeing other multiples and some parents tend to be happy when a surviving child of twin loss is treated like a multiple. On the other hand, regarding the grief of the survivor, it was reported that the genetic and/or environmental factors could affect the survivors' mental health condition even when experiencing bereavement at birth. In addition, medical staff also feel unprepared to deal with twin loss. Regarding twin loss, parents face a serious struggle when dealing with perinatal loss and care of the surviving child at the same time. It is necessary to provide families who have experienced twin loss with care that is different to what is provided for single-birth families. Additionally, while parents are generally closest related to their children, as identical multiples are genetically closest to their cotwin, their grief may be extremely great. Regardless of whether the bereavement is before or after birth, it is indicated that continuous support may be required as it can have a persistent effect on the mental condition of the survivor.

Oral-E1 *Japanese Only
Activity Report of the Online Preparatory Class for Parenting Multiple-Birth Children in COVID-19

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Oral-E2
Challenges of Support Classes for Postpartum Multiple Birth in the Time of COVID-19

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This study aimed to identify the challenges of postpartum multiple birth support classes in the Corona pandemic. A postpartum class was held in February 2021 using the web version of the conference system (ZOOM). A web-based, anonymous, self-administered questionnaire survey was administered to six classroom participants who consented to the study. Data were collected using a Google Form, including attributes, program satisfaction (5-point scale), and free text. Satisfaction was assessed for each program (infant accidents and handling, breastfeeding twins, and social gatherings), and descriptive statistics were performed. The free descriptions regarding the reasons for this were compared with the results of a survey conducted in the previous year with the same program in a face-to-face setting by organizing the items by semantic content. The issues were extracted after confirming the characteristics of the Corona pandemic. This study was approved by the Ethics Committee for Human Subjects at the institution to which the researchers are affiliated. (Approval number 1910-3). The participants were three primiparas raising twins from 1 month to 3 years old, one prenatal woman, and two husbands of primiparas; one of the primiparas was a pregnant woman. Six respondents (response rate: 86%) were nonpregnant women. Many of the participants were from other prefectures and cities, all families were nuclear families, and all the women were working women. When the class was held face to face, 70% of the respondents in the fiscal year 2019 stated that regarding childcare supporters, it was their biological mother, while in the fiscal year 2020, 50% of the respondents indicated that their main childcare supporters were their husbands, friends, and biological mothers. The satisfaction results showed that 88% of the respondents were 'satisfied' or 'somewhat satisfied' with the postpartum social events. All subjects responded that they 'fully understood' or 'understood' infant accident and response. Regarding multiple breastfeeding, 67% of the respondents were 'satisfied' or 'somewhat satisfied'. In the free comments, there were some comments such as, 'It was good to be able to interact with them since the childbirth preparation class at the nearby maternity hospital was canceled due to the prevention of the spread of the new coronavirus infection', 'It was good to hear the unique stories of twins', and 'It would be good to have some local information exchange'. Husbands stated that they were 'not good at going online', and in the scene where they are prompted to speak, they acted as if they were hiding from the online world to take care of the twins, so they did not speak actively. In the web-based version of the class held in fiscal year 2021, the main childcare supporters were husbands because it may have been difficult for biological mothers to travel to the Kanto area to provide childcare support, where the number of COVID-19 infected people was high. Also, the area where the participants live may be extensive, making it difficult to exchange information closely related to the community. It is necessary to identify certain areas to recruit participants and provide information about the local area that will be useful after birth. In addition, it is becoming more difficult for

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women with multiple pregnancies to interact during the Corona pandemic, and there are fewer opportunities to obtain information on child-rearing specific to multiple pregnancies. The study showed that the main issue is to organize classes where husbands can actively participate, make friends, and get information from older mothers who have experienced multiple pregnancies.

EDUCATIONAL SESSIONS
Educational 1-1 *Japanese Only
Supportive Measures for Twins and High-Order Multiples and Their Families: Recent Policy Trends in Japan

Hideyuki Kobayashi

Maternal and Child Health Division, Ministry of Health, Labor and Welfare, Government of Japan (Previous position)

Educational 1-2 *Japanese Only
On the Support for Families with Multiples in Aichi Prefecture

Naomi Kato and Tomomi Kamiya

Health Promotion Division, Health and Medical Affairs Department, Bureau of Health and Medical Care, Aichi Prefectural Government

Educational 1-3 *Japanese Only
Educational 2
Loss of a Baby From a Multiple Pregnancy: The Butterfly Project

Nicholas Embleton

Neonatal Medicine, Newcastle University & Newcastle Hospitals NHS Trust, United Kingdom

We are an academic collaboration and have conducted >10 years research with parents of multiple pregnancies where one or more babies died and where at least one baby survived. We conducted interviews, thematic analysis, and worked with many parents and health professionals to identify the key themes. We then worked with families to create a unique film project which is available as www.neonatalbutterflyproject.org. The website has short films with parents and staff talking about their feelings and experiences, and also discusses practical and learning aspects for the different themes. The course covers aspects of miscarriage, stillbirth, and baby loss in relation to loss of one baby or more, and focuses on the importance of communication, empathy and understanding especially in health-care environments. We have developed a unique 4-h online learning course that is accredited for CME/CPD by the Royal College of Paediatrics and Child Health (RCPCH), Royal College of Nursing (RCN) and the Institute of Health visiting (iHV). The course has been endorsed by more than 20 advocacy organizations worldwide. The course is aimed at health professionals working with affected families, including obstetrics, NICU, fetal medicine, nursing, midwifery, and pediatrics. It will also be of relevance to students, counselors, psychology, and family practice, and of interest to families and friends when offering support to grieving parents. The course is free to join and view, and the CME certificate can be downloaded by those who upgrade and complete. The course attracted >250 learners from more than 50 countries in the first month. Learners can interact with peers from around the world through the moderated conversations with the educating team. The website includes numerous downloads including parent stories, advice for families, and friends, initiating conversations and memory making, and guidelines for hospitals translated into more than 10 languages including Japanese.

Educational 3
Twin Studies on the Heritability of Intelligence

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Intelligence is the best and longest researched psychological construct and one of the best predictors for individuals' life outcome; for example, school (marks, attainment) and job performance (hiring, income, promotions). It has also been part of genetic and heritability research since the 19th century, by the father of twin studies Sir Francis Galton. In my talk, first I would like to give a short introduction to intelligence, its definitions, and basic theories, the distinction between intelligence and IQ, how IQ is measured and the importance of intelligence and IQ in a person's life. This first part would also include some explanations of statistics and methods that are intended to help laypeople understand. In the second part, I want to give a survey about basic facts and results of two large twin studies on intelligence: (1) The Minnesota Study of Twins Reared Apart, conducted in the USA from 1979 onward and (2) the Keio Twin Project from Japan. Monozygotic twins are far more similar to each other in a huge variety of psychological traits, including intelligence, than dizygotic twins, even if they were reared apart, and the differences between two monozygotic twins, separated after birth and reared apart, are not significantly bigger than the differences between two testings of the same individual. Hereby, it should be communicated that intelligence is a trait heritable to a similar extent like physiological traits; for example, height and weight. In addition, I also want to make a little digression into the history and to a controversy called 'Burt-Affair', which damaged the reputation of twin research unjustifiably, before finally looking to the future.

Educational 4-1
Management and Outcome in Twins Anemia Polycythemia Sequence

Enrico Lopriore[1] and Jeanine van Klink[2]

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Twin anemia polycythemia sequence (TAPS) is a severe complication in monochorionic twin pregnancies caused by unbalanced feto-fetal transfusion through placental anastomoses leading to anemia in the donor twin and polycythemia in the recipient twin. Robyr at al. (2006) were the first to describe the iatrogenic form of TAPS in a cohort of twins treated with laser surgery for twin-to-twin transfusion syndrome. Shortly thereafter, our research group reported the same condition to occur spontaneously in three cases of monochorionic twins which had no amniotic fluid discordances during pregnancy (Lopriore et al., 2007). To clearly demarcate this new form of unbalanced feto-fetal transfusion from the well-known twin–twin transfusion syndrome (TTTS), we introduced the term 'twin anemia polycythemia sequence' and its acronym TAPS. We were also the first to unravel the pathophysiology based on the typical presence of only minuscule (diameter <1 mm) anastomoses, detected through color-dye injection of the placental vessels.

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Although this idea was first encountered with disbelief, in the years that followed more and more evidence emerged reporting on other cases with similar presentations, leading to increased attention and awareness for this new condition. Now, almost 15 years later, TAPS has become a distinct entity in monochorionic twinning, with its own characteristic pathogenesis, diagnostic criteria, classification systems and outcome. Through extensive international collaboration on the TAPS Registry, we were able to report on the outcome of large group of TAPS twins. We found that outcome in both spontaneous and post-laser TAPS was poor. In spontaneous TAPS, mortality occurred in 1 in 10 fetuses: in post-laser TAPS in 1 in 4. Donors had a three- to four-fold increased risk for mortality, highlighting the profound impact of anemia on fetal survival. Severe neonatal morbidity was seen in approximately 30% of spontaneous TAPS twins and in 40% of postlaser TAPS twins and was strongly predicted by gestational age at birth. Despite the increased risk for demise in the donor antenatally, donors and recipients had comparable rates of severe neonatal morbidity. This could be a reflection of the big impact of prematurity (which is comparable for donors and recipients), but might also be due to the fact that the most severely ill donors already demised in utero. If all donors would have survived, the neonatal morbidity rate might have been higher in donors. Notably, postlaser TAPS twins showed a far worse outcome than spontaneous TAPS twins, which could be explained by preceding TTTS, a different placental angioarchitecture (less compensating blood flow in postlaser TAPS), and the type of management (postlaser TAPS was frequently managed expectantly or with IUT (with PET), which might have allowed the condition to progress).

Educational 4-2
Long-Term Neurodevelopmental Outcome Twin Anemia Polycythemia Sequence

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In 2021, we published the first study into long-term neurodevelopmental and behavioral outcome in spontaneous TAPS twins. Overall neurodevelopmental impairment (mild and severe) was detected in 30% of our cohort of TAPS twins. Moreover, we found that TAPS donors do not only have increased risk antenatally but also show poorer outcome later in life. TAPS donors had significantly higher rates of overall neurodevelopmental impairment than recipients (44% vs. 18%) and demonstrated a high prevalence of bilateral deafness (15% vs. 0%), in all cases based on auditory neuropathy spectrum disorder (ANSD). Notably, this high rate of deafness is not reported in TTTS survivors nor in children that suffered from anemia based on erythrocyte alloimmunization. Moreover, the prevalence of hearing problems in TAPS donors is substantially higher than in NICU infants (1–3%). We hypothesize that the chronic anemic state of the donor might have led to a hypoxic environment, gradually damaging the developing brain and auditory nerve system. To investigate this hypothesis, future research should be aimed at comparing umbilical cord pH and lactate values between donors and recipients. According to our theory, TAPS donors might present with lower pH values and higher lactate values on day 1 after birth. Additionally, evaluation of cerebral magnetic resonance images of the donors with hearing problems might shine more light on the exact cause of ANSD in these children.

Symposium
(Symposium 2-1) *Japanese Only
(Symposium 2-2) *Japanese Only
(Symposium 2-3) *Japanese Only
Invited Workshops
Workshop 1-1
The TAPS Support Foundation: A New Approach to Twin Advocacy

Stephanie Ernst

The Founder of TAPS Support Foundation

The TAPS Support Foundation was established to raise awareness of Twin Anemia Polycythemia Sequence, a rare disease affecting just 3–5% of monochorionic twins, born out of one mother's determination to change screening protocols to include TAPS in routine checks for monochorionic twins. This foundation works with leading researchers to create safe, accessible information about TAPS, and advocate for change in the world of twins. In this section, Stephanie will talk about what TAPS is and share her story and the role her daughters have played in creating not only changes in the scientific world, but also inspiring the start of the TAPS Support Foundation. (1) An overview (layman's terms) of twin anemia polycythemia sequence. (2) Stephanie introduces the story of her daughters Emilie and Mathilde, and how they became to be known as the TAPS twins in scientific circles, as well as the role they play in her passion for advocating for TAPS awareness. (3) Why a foundation specifically for TAPS? Stephanie will go over the inspiration for the foundation. *The challenges of a TAPS diagnosis:* This section will cover the specific issues faced by TAPS patients, from diagnosis to delivery and beyond. Stephanie will discuss the lack of established screening protocols, the difficulties of pre- and postnatal screening, and the lack of awareness about a TAPS diagnosis short- and long-term impact on parents and TAPS Twins. This will be presented from the patient's point of view, not a medical perspective. (1) The importance of not calling TAPS a form of TTTS as this dilutes the urgency of changing screening protocols. What differentiates it from TTTS, and a summary of issues. (2) Prenatal screening issues — Inconsistencies in guidelines, as well as myths and misinformation about Twin Anemia Polycythemia Sequence before birth. It includes a discussion of routine MCA doppler screening and other signs of TAPS on ultrasound. (3) Diagnostic criteria after birth and the need to include screening for TAPS after birth even without obvious prenatal signs (between 40% and 63% of TAPS cases go undiagnosed until birth). (4) Short- and long-term effects of both types of TAPS, and the impact this has on families, including the impact of perinatal mortality on parents, as well as long-term effects and why it is difficult for families, especially when seeking later diagnoses for their children. *About the Foundation:* How the TAPS Support Foundation is working towards making these changes, and our future plans as well as our history and achievements. (1) The early days of the foundation, and how it started from a patient group, and why there was a need to formalize it. (2) What the mission, vision, and values of the foundation are, and about our five fundamental pillars to REACH our goals of standardized testing for twins and TAPS education. (3) Creating the community — why it is important that doctors, patients, and researchers connect on common ground to raise awareness of mutual issues. (4) Projects we have been involved in, how we are raising awareness, resources, and tools we have created for families. (5) Funding TAPS research — rare disease research has little to no

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funding. (6) Our future plans, how we plan to work with researchers and hospitals, as well as patients to help with a worldwide change in perspectives towards TAPS. Where to find resources, where to find us, how you can request a financial grant for research from us. Also, resources and researchers available worldwide who can talk with you about TAPS and where to find clinical trials and information.

W1-2 *Japanese Only
Diagnosis and Prenatal Management of Twin Amniotic Fluid Discordance and Selective Intrauterine Growth Restriction

Katsusuke Ozawa

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Twin-twin transfusion syndrome (TTTS) occurs in approximately 10% of monochorionic diamniotic (MD) twins. In TTTS, a recipient twin has polyhydramnios and cardiac failure, and a donor twin has oligohydramnios and growth restriction due to unbalanced blood distribution through vascular anastomoses in a shared placenta. Fetoscopic laser photocoagulation (FLP) is used in the management of TTTS with polyhydramnios (maximum vertical pocket (MVP) >8 cm at a gestational age (GA) of 16–25 weeks or MVP >10 cm at a GA of 26–27 weeks) in a recipient twin and oligohydramnios (MVP <2 cm) in a donor twin between a GA of 16–27 weeks. On the other hand, twin amniotic fluid discordance (TAFD) is defined as discordance in amniotic fluid volume (MVP >7 cm and MVP <3 cm) but cases that do not meet the criteria for FLP above. The outcome of some cases of TAFD is poor. In a retrospective study, 48/84 (57%) cases of TAFD progressed to TTTS. The outcomes of cases of TAFD that did not progress to TTTS were death (17%) and neurological impairment (10%). In TAFD with abnormal Doppler imaging findings (absent or reverse end-diastolic velocity [AREDV] in the umbilical artery [UA] or reverse velocity in the ductus venosus), the mortality rate was as high as 35%, and 9% of cases had neurological impairment. We conducted a prospective study that aimed to improve the outcome of TAFD and we performed FLP in cases of TAFD with abnormal Doppler imaging findings. The results showed that the survival rates of the donor and recipient twins were 27.3% (3/11) and 100% (11/11), respectively. None of the surviving donor twins and two of the 11 recipient twins had hemiplegia at 6 months of age. Another recipient twin had developmental delay at 3 years of age. FLP for TAFD was feasible but did not improve the outcome of the fetuses; therefore, FLP is currently not performed in cases of TAFD alone. Selective intrauterine growth restriction (sIUGR) is defined as growth restriction (<-1.5 *SD*) in one fetus of an MD set of twins. In sIUGR, an unbalanced area of shared placenta is strongly associated with the pathophysiology, in addition to unbalanced blood distribution. One of the problems in sIUGR is high mortality and morbidity caused by hypovolemic shock in the surviving twin after intrauterine fetal death of the co-twin due to acute blood transfusion through vascular anastomoses. We performed FLP for a case of sIUGR with oligohydramnios and AREDV in the UA in one fetus because this case represents an extremely high-risk condition for adverse pregnancy outcomes. MD twins with both TAFD and sIUGR are not rare; therefore, some cases of sIUGR where FLP is indicated also include TAFD. In conclusion, some cases of TAFD or sIUGR with poly- or oligohydramnios who do not meet the criteria for TTTS in MD twins are clinically challenging and require selective care for the best outcome.

W2-1 *Japanese Only
Four-Dimensional Ultrasound to Clarify Twin Fetal Brain Development and Maturation

Emiko Nitta[1], Kenji Kanenishi[1] and Toshiyuki Hata[1,2]

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W2-2
Classroom Placement of Multiples Within the School

Monica Rankin, J Susan Griffith and Carolyn Lister

International Council of Multiple Birth Organizations (ICOMBO)

In recent years, there has been an increase in the birthrate of twins and multiples due to improved maternal health, improved neonatal care, fertility treatments, and women who delay their childbearing until they are in their thirties. This means that it is quite usual for schools to have several sets of twins or multiples in their classrooms each year. Placement of multiples in the school classroom is a common issue across the world. Parents of multiples are often told by the school authorities that the children will be together or not, without regard for the needs of the children or their parents. There are many stressors for parents and children when the children begin their school life. The stresses are increased substantially for multiple birth families as they consider whether the multiples should be placed in the same classroom or separate classrooms. Many schools have policies, some written and some unwritten, that enforce the separation of multiples into different classrooms. Many reasons are cited, such as 'It is too hard for the teacher to tell the twins apart', 'It always works best this way'. The reasons are generally not backed up by scientific studies. Several studies on classroom placement have previously been conducted in various countries. ICOMBO undertook this study internationally to examine trends in private and government schools, looking at similarities between countries. The objective was to ascertain if parents had any involvement in the decision making regarding classroom placement of their multiples; to investigate similarities and differences between countries; to determine what information and resources assists parents and educators in the decision-making process; and to produce new resources for use in all countries.

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