flux CONGRESS

The International Congress for Integrative Developmental Cognitive Neuroscience

Presented by the Flux Society

2nd Annual Congress | September 11-13, 2014

Hilton LA/Universal City Hotel, Hollywood CA, USA

www.fluxcongress.org

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About the Flux Congress

The aim of the congress is to provide a forum for developmental cognitive neuroscientists to share their findings on the development of brain processes that support cognition and motivation from an integrative neuroscience perspective. Thus, it provides an opportunity for scientists in the field to expand their knowledge base, and also be better informed of translational approaches.

Program Contents

Welcome
to the Second Flux Congress

Welcome to our second meeting of Flux, the International Congress for Integrative Developmental Cognitive Neuroscience in Hollywood, California!

Our first meeting in Pittsburgh, PA was a resounding success and this one is building up to be another great accomplishment. Having a dedicated forum for us to share our research, get valuable feedback from fellow colleagues, meet new collaborators, and discuss important issues about the state of Developmental Cognitive Neuroscience is crucial for the continued growth of the field. This year we have an exciting program with a range of topics in our field keeping with our aims of understanding the brain basis of cognitive development and being informed regarding neural mechanisms.

The venue this year in the heart of Hollywood, California is the perfect location for our 2nd annual Flux gathering. The greater Los Angeles area is home to several prestigious institutions, such as the University of Southern California/Children's Hospital Los Angeles, and the University of California Los Angeles, among others, all of which have active programs of research in cognitive developmental neuroscience. In addition to being the entertainment capital of the world, Hollywood offers an array of exciting outdoor activities, gastronomic experiences and entertainment opportunities for our delegates and their families, all within close proximity to the conference. We hope that delegates and their guests will enjoy the option to join our Flux excursion to the historic Hollywood Bowl to hear the Orchestra's Finale show, "The Simpsons 25th Anniversary" including spectacular fireworks (don't forget to pack wine and cheese for your own picnic, or purchase food and beverages at the Bowl). For the more daring there is the iFly indoor skydiving experience guaranteed to exhaust your dopamine!

The program we have developed for this year's Congress encompasses the full spectrum of developmental cognitive neuroscience, from infancy to youth. In addition to the Huttenlocher Lecture, a symposium organized by the local hosts, and four keynote presentations, attendees will be able to participate in a series of ABC Tutorials aimed at providing conceptual background and practical tips in a number of areas relevant for our research. Finally, all of us will have a chance to discuss our current work during the meeting – whether by giving a talk (26 oral presentations), a poster (98 posters) or simply by exchanging experience and ideas during breaks and social events.

We also extend a warm welcome to the new members of the Flux Society. The aim of this society is "To advance the understanding of human brain development by serving as a forum for professional and student scientists, physicians, and educators to:

- exchange information and educate the next generation of developmental cognitive neuroscience researchers;
- make widely available scientific research findings on brain development;
- encourage translational research to clinical populations;
- promote public information by discussing implications on the fields of education, health, juvenile law, parenting, and mental health, and
- encourage further progress in the field of developmental cognitive neuroscience."

We are eager to attract more members to our important new scientific society, and hope that the Flux Society conference will continue to grow in the coming years. We are looking forward to this great meeting and interacting with attendees. We are confident that you will leave with greater understanding, new friends, and enhanced creativity in your approach. We also invite you to start planning for the 3rd annual Flux meeting in Leiden, The Netherlands!

Beatriz Luna
President

Brad Schlaggar
Vice-President

Elizabeth Sowell
Chair, Flux 2 Local Organizing Committee

Tomas Paus
Chair, Flux 2 Scientific Program Committee

Flux Leadership

Society Executive Committee

Beatriz Luna, President	University of Pittsburgh, USA
Brad Schlaggar, Vice President	Washington University, St. Louis, USA
Silvia Bunge, Executive Secretary	University of California, Berkeley, USA
Bruce McCandliss, Executive Treasurer	Vanderbilt University, USA

Congress Local Organizing Committee

Elizabeth Sowell, Chair	Children's Hospital, University of Southern California
Ron Dahl	University of California, Berkeley
Adriana Galvan	University of California, Los Angeles

Congress Scientific Program Committee

Tomas Paus, Chair	University of Toronto, Canada
Sue Andersen	Harvard Medical School and McLean Hospital, USA
Raquel Gur	University of Pennsylvania, USA
Catherine Lebel	University of Calgary, Canada
Brad Peterson	Columbia University Medical Center, USA
Brad Schlaggar	Washington University, St. Louis, USA
Elizabeth Sowell	Children's Hospital, University of Southern California, USA
Linda Spear	Binghamton University, USA
Nim Tottenham	University of California, Los Angeles, USA

flux CONGRESS

The International Congress for Integrative Developmental Cognitive Neuroscience

Flux Society Management

Podium Conference Specialists

Marischal De Armond

Caitlin Mooney

We are pleased to announce that the **3rd Flux Congress** will take place in Leiden, The Nertherlands, from September 17 to 19, 2015.

Conference Chairs:
Eveline Crone, Leiden University
Sarah-Jayne Blakemore, University College London

Abstract Submission and Registration will open March, 2015

For further information visit www.fluxcongress.org

General Congress Information

Meeting Venue

Hilton LA / Universal City Hotel
555 Universal Hollywood Drive
Universal City, CA 91608
All conference sessions will take place in this location.

Registration

Congress registration fees include access to all sessions including the welcome reception, speaker presentations, continental breakfasts, coffee breaks, and poster lunch sessions.

Name Badges

Your name badge is your admission ticket to the conference sessions, reception, breakfast, lunch, and coffee breaks. Please wear it at all times. At the end of the conference we ask that you recycle your name badge at one of the name badge recycling stations that will be set out, or leave it at the Registration Desk.

Registration and Information Desk Hours

The Flux Registration and Information Desk will be open during the following dates and times:

Thursday, September 11	12:00 PM – 6:30 PM
Friday, September 12	6:30 AM – 5:00 PM
Saturday, September 13	6:30 AM – 5:00 PM

If you need assistance during the meeting, please visit the Registration Desk.

Staff

Flux Congress staff from **Podium Conference Specialists** can be identified by ribbons on their name badges. Feel free to ask anyone of our staff for assistance. For immediate assistance, please visit us at the Registration Desk.

Poster Information

Set-Up / Removal

There are two Poster Sessions during the Congress. All posters must be set up on Thursday, September 11 between 11:00 AM and 6:30 PM, and all posters are to remain up for the duration of the Congress. Posters must be removed by the end of the second break at 3:30 PM on Saturday, September 13. Any posters not removed will be taken down by congress staff and will be held at the registration desk until 5:00 PM.

Poster Session 1: Friday, September 12
Mandatory Hours: 12:00 – 2:00 PM

Poster Session 2: Saturday, September 13
Mandatory Hours: 12:00 – 2:00 PM

Odd numbered posters will be presented during Poster Session 1, and **even numbered posters** will be presented during Poster Session 2.

Information on Poster Authors, Poster Numbers and Poster Titles begins on page 18. Visit the Flux website, **www.fluxcongress.org**, for a complete list of all poster abstracts.

An easy reference **Poster Floor Plan** for each session can also be found on page 20 of this program.

Flux Social Functions

Opening Reception

The Flux Congress Opening Reception will take place from 7:00 – 9:00 PM on Thursday, September 11 at the **Saddle Ranch Chop House**, at the City Walk, 1000 Universal Studios Boulevard.

To get to this venue, go to Lobby, exit the entrance and turn right. Walk around the hotel until it ends at the Ballroom (near fountain), and continue walking down the street to the right until you reach the corner. Turn right, walk up the hill until you get to the light – Hotel Drive – and cross, continue to the bridge and you will see the Saddle Ranch Chop House.

Excursions

Please visit the registration desk if you are interested in signing up for either/both of the following excursions:

Hollywood Bowl

Join us for this year's Flux Excursion at the Hollywood Bowl on Friday, September 12! The theme of the 2014 Hollywood Bowl season finale is "The Simpsons' 25th Anniversary." The orchestra will accompany your favorite scenes on the big screen and there will be plenty of special guests and a fireworks finale! Tickets for this excursion are $30, and transportation is included in the price.

We will meet in the hotel lobby at 6:45 PM and depart the hotel at 7:00 PM. The show runs from 8 PM – 10 PM.

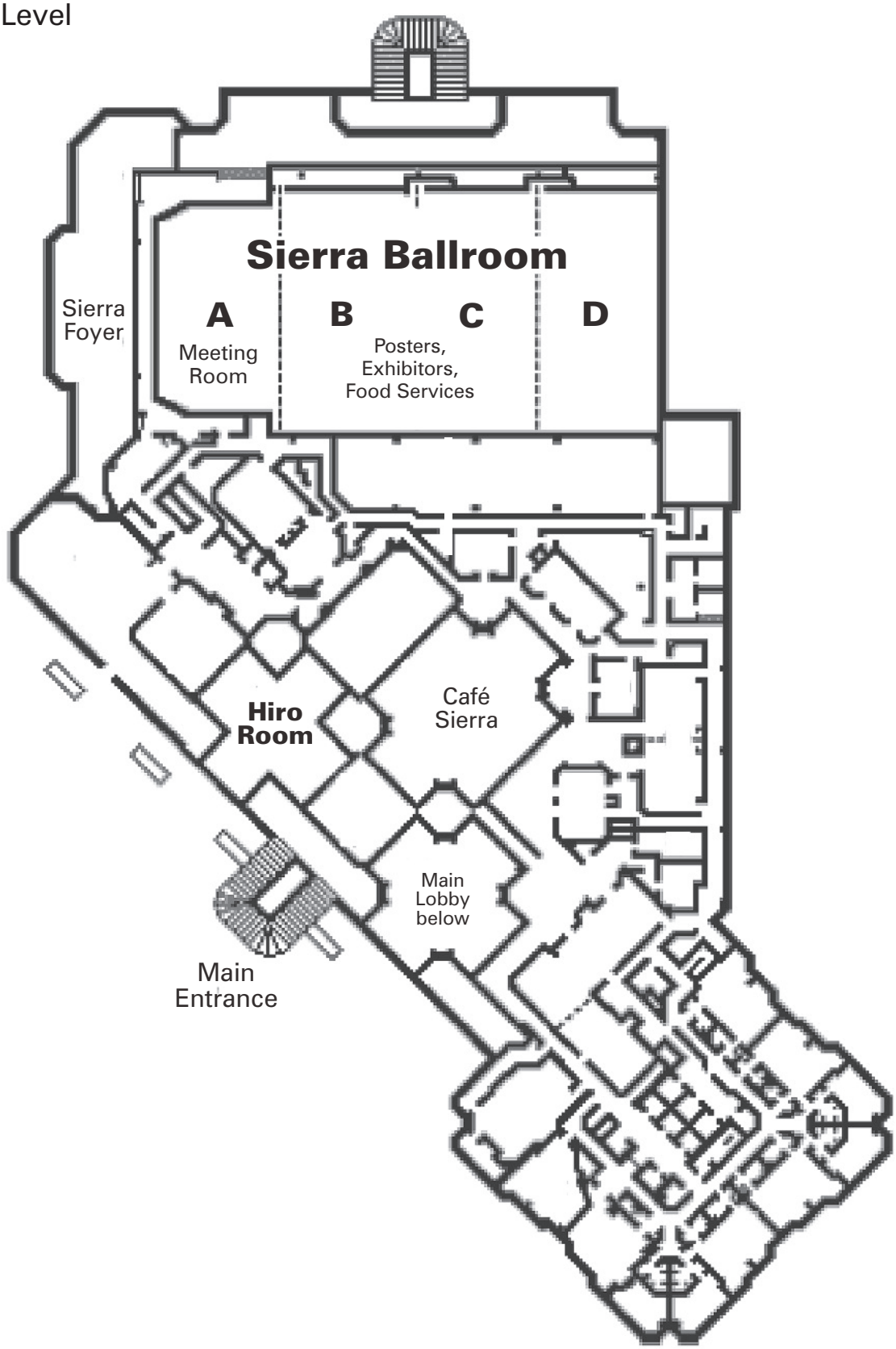
IFly Indoor Skydiving

Flux delegates will be extended a group rate of $45 per person for the IFly indoor skydiving experience. This activity will take about 2 hours and each person can take 2 flights.

Thursday, September 11, 8:30 PM – 10:00 PM, directly after the opening reception (5-10 minute walk from the Saddle Ranch Chop House).

Congress Venue Floor Plan

Ballroom Level



Flux Congress Program Schedule

Day 1 Thursday, September 11

Pre-Congress Workshop

1:00 – 3:00 PM **Developmental Cognitive Neuroscience publishing workshop** – *Sierra Ballroom A*

This is an introductory workshop aimed at early career researchers looking at how to get published in journals, how to review a paper, publishing ethics and open access.

Opening of Flux Congress

3:30 – 4:00 PM **Welcome Comments** – *Sierra Ballroom A (all oral sessions in this room)*

Elizabeth Sowell, University of Southern California, USA

Beatriz Luna, University of Pittsburgh, USA

Brad Schlaggar, University of Washington, St Louis, USA

Tomas Paus, University of Toronto, Canada

4:00 – 5:00 PM

Huttenlocher Lecture

Toward an integrative science of the developing human mind and brain

Terry Jernigan, University of California, San Diego, USA

5:00 – 6:30 PM

Local Organizing Committee Symposium

Integrative Developmental Cognitive Neuroscience: a focus on motivation

Chair: Ron Dahl, University of California, Berkeley, USA

Linda Wilbrecht, University of California, Berkeley, USA
Wouter Van den Bos, Max Planck Institute, Germany

Discussion Panel:
Jennifer Pfeifer, University of Oregon, USA
Adriana Galvan, University of California, Los Angeles, USA
Ron Dahl, University of California, Berkeley, USA

7:00 – 9:00 PM **Welcome Reception** – *The Saddle Ranch Chop House*
1000 Universal Studios Boulevard, Universal City

Day 2 Friday, September 12

7:00 – 8:00 AM **ABC Tutorial 1** – *Hiro Room*
Tools for the assessment of mental health and substance use in teenager
Patricia Conrod, King's College London, UK

ABC Tutorial 2 – *Sierra Ballroom A*
From humans to rodents and back: how animal models complement human work on brain development
Susan Andersen, Harvard Medical School and McLean Hospital, USA

7:30 – 8:30 AM **Continental Breakfast** – *Sierra Ballroom B & C*

8:30 – 9:00 AM

Keynote Address

Interventions, programs, and approaches that appear promising for improving executive functions and those that, despite much hype, do not
Adele Diamond, University of British Columbia, Canada

9:00 – 10:00 AM **Oral Session 1: Intervention/Executive Function – Preschooler (Part 1)**

Chair: Kerstin Konrad, RWTH Aachen University Hospital, Germany

O.1.1 *The development of emotion regulation and mood pathology*
Deanna Barch, Washington University in St. Louis, USA

O.1.2 *Manipulation of cue switching variables in children and adult*
Jessie-Raye Bauer, University of Texas at Austin, USA

O.1.3 *Fronto-parietal network reconfiguration supports the development of reasoning ability*
Carter Wendelk, University of California, Berkeley, USA

10:00 – 10:20 AM **Break** – *Sierra Ballroom B & C*

10:20 AM – 12:00 PM **Oral Session 1: Intervention / Executive Function – Preschooler (Part 2)**

O.1.4 *Neurobiological mechanisms of positive affect in preschool age children: an fMRI study*
Michael Gaffrey, Washington University School of Medicine, USA

O.1.5 *Apples or oranges? Advancing developmental decision neuroscience using a food choice paradigm*
Amanda Bruce, University of Missouri-Kansas City, USA

O.1.6 *Increased delay discounting in children with ADHD is associated with orbitofrontal cortex morphology*
Keri Rosch, The Kennedy Kreiger Institute, USA

O.1.7 *Experiential learning outweighs instruction early in development*
Johannes Decker, Weill Cornell Medical College, USA

O.1.8 *Neural correlates of developmental differences in mnemonic flexibility*
Christine Coughlin, University of California, Davis, USA

12:00 – 2:00 PM **Poster Session 1 / Lunch** – *Sierra Ballroom B & C*

2:00 – 2:30 PM **Keynote Address**

Neuroimaging findings in young drinkers: does teenage drinking harm the brain?
Susan Tapert, University of California, San Diego, USA

2:30-3:10 PM **Oral Session 2: Substance Use / Addiction – Youth (Part 1)**

Chair: Monique Ernst, National Institute of Mental Health, USA

O.2.1 *Striatal activation mediates the relationship between acute craving and smoking urges in adolescent smokers*
Kathy Do, University of California, Los Angeles, USA

O.2.2 *Peer feedback enhances food craving more for adolescents than adults*
Rebecca Martin, Columbia University, USA

3:10 – 3:30 PM **Break** – *Sierra Ballroom B & C*

3:30 – 4:30 PM **Oral Session 2: Substance Use / Addiction – Youth (Part 2)**

O.2.3 *Adolescent brain development and effects of alcohol use*
Monica Luciana, University of Minnesota, USA

Day 2 Friday, September 12 *Continued*

O.2.4 *Fundamental competencies predict the neural bases of emotion regulation in youth*
Peter Franz, Columbia University, USA

O.2.5 *Neural foundations of appetitive and affective reactivity and regulation across adolescence*
Jennifer Pfeifer, University of Oregon, USA

4:30 – 4:50 PM **NIDA Presentation**

A national longitudinal study of neurodevelopmental consequences of substance use: progress and prospects
Steve Grant, National Institute on Drug Abuse, USA

7:00 – 10:00 PM **Flux Excursion: Hollywood Bowl Season Finale**
Tickets are $30 each, and can be purchased at the Registration Desk (transport included).
Meet in hotel lobby at 6:45 PM to walk to shuttle pick up location.

Day 3 Saturday, September 13

7:00 – 8:00 AM **ABC Tutorial 3** – *Hiro Room*
Infants, toddlers, preschoolers in the scanner: practical tips on how to succeed
Nadine Gaab, Boston Children's Hospital / Harvard Medical School, USA

ABC Tutorial 4 – *Sierra Ballroom A*
Epigenetics and the brain: why and how
Timothy Bredy, University of California, Irvine

7:30 – 8:30 AM **Continental Breakfast** – *Sierra Ballroom B & C*

8:30 – 9:00 AM **Keynote Address**

Attention and memory in typical and atypical development
Dima Amso, Brown University, USA

9:00 – 10:00 AM **Oral Session 3: Infant / Toddler Cognition (Part 1)**

Chair: Silvia Bunge, University of California, Berkeley, USA

O.3.1 *Family Stress during the pre- to early postnatal period is associated with infants' brain connectivity and emotionality*
Alice Graham, Oregon Health and Science University, USA

O.3.2 *A novel maturational index for cross-sectional characterization of white matter ontology in early life*
Jerod Rasmussen, University of California, Irvine, USA

O.3.3 *Working memory deficits in adult Rhesus macaques (Macaca mulatta) with neonatal perirhinal cortex lesions*
Alison Weiss, Emory University, USA

10:00 – 10:20 AM **Break** – *Sierra Ballroom B & C*

10:20 – 12:00 PM

Oral Session 3: Infant / Toddler Cognition (Part 2)

O.3.4 *A mouse model to study the impact of early-life adversity on decision-making*
Natalia Caporale, University of California, Berkeley, USA

O.3.5 *Longitudinal changes in neural pattern similarity predict individual gains in arithmetic problem solving skills*
Sandhya Prathap, Stanford University, USA

O.3.6 *The early emergence of hierarchical rule learning and generalization*
Denise Werchan, Brown University, USA

O.3.7 *Neural correlates of early mother-child interaction*
Kerstin Konrad, RTWH Aachen University, Germany

O.3.8 *Mixed benefits of sleep versus wake across early development: How similar outcomes can be supported by different neural processes*
Rebecca Gomez, The University of Arizona, USA

12:00 – 2:00 PM

Poster Session 2 / Lunch – *Sierra Ballroom B & C*

2:00 – 2:30 PM

Keynote Address

Age of opportunity: lessons from the new science of adolescence
Laurence Steinberg, Temple University, USA

2:30 – 3:10 PM

Oral Session 4: Adolescence (Part 1)

Chair: Marie Banich, University of Colorado, USA

O.4.1 *Developmental change in amygdala reactivity during adolescence: effects of family history for depression, gender, and stressful life events*
Johanna Swartz, University of North Carolina, Chapel Hill, USA

O.4.2 *Fronto-striatal white matter integrity predicts adolescent development in delay of gratification: A longitudinal study*
Anna van Duijvenvoorde, Leiden University, The Netherlands

3:10 – 3:30 PM

Break – *Sierra Ballroom B & C*

3:30 – 4:30 PM

Oral Session 4: Adolescence (Part 2)

O.4.3 *Childhood cognitive development as a skill*
Torkel Klingberg, Karolinska Institutet, Sweden

O.4.4 *Adolescent cognitive control unaffected by presence of peers*
Gail Rosenbaum, Temple University, USA

O.4.5 *Neuroendocrine mechanisms underlying adolescent maturation of social reward and proficiency*
Cheryl Sisk, Michigan State University, USA

4:30 – 4:50 PM

Summary and Closing

Beatriz Luna, University of Pittsburgh, USA
Brad Schlaggar, University of Washington, St Louis, USA

Notes

Oral Presentations

Thursday, September 11

HUTTENLOCHER LECTURE

Terry Jernigan, University of California, San Diego

Toward an integrative science of the developing human mind and brain

This talk will describe a vision of a more integrative science of the developing human mind and brain. Arguments will be made for a new research paradigm that may help to create this integration. A simple conceptual model for guiding the new paradigm, how it all might work, and some critical elements it should have to be fruitful, will be described. A few results highlighting the need for higher dimensional, more information-rich data repositories will be presented from PING – the Pediatric Imaging, Neurocognition and Genetics Study - an example of one of several recent projects that are small steps in the proposed direction.

LOCAL ORGANIZING SYMPOSIUM

Integrative Developmental Cognitive Neuroscience: A Focus on Motivation

Linda Wilbrecht, University of California, Berkeley

Uncertainty, sensitive periods, and the motivation to explore

Our lab studies developmental changes in decision-making and the neurobiological processes that underlie the experience-dependent development of decision-making circuits in mouse models. Decision-making often involves a balance between the exploitation of current knowledge and the exploration of the unknown. During transition to independence, humans and other mammals possess relatively little specific knowledge to exploit. Our data from mice suggests, that rather than viewing their decision-making as impaired, we might better understand it as weighted toward exploration, especially under conditions of uncertainty. We also hypothesize that individual differences in decision-making may be biased by the particular conditions encountered in early exploration of the world, potentially in a sensitive period when the brain is more plastic. Synaptic level imaging studies in living mice show that neurons in the developing brain also go through a process of exploration, testing out a wide variety of potential connections at a rate that declines through adolescence. We find that experience—particularly exploratory experience—alters the rate of turnover and the identity of connections made in frontal cortical circuits, potentially underlying lasting changes in their function.

Wouter van den Bos, Max-Planck-Institute for Human Development

The interplay between motivation and cognition in adolescent impulsive decision-making

Reward based decisions rely on the integrity of the striatum and on interactions between the striatum and other cortical and subcortical networks. The dominant model of neurocognitive development of reward related behavior in adolescence emphasizes the developmental discrepancy between the early developing striatum and the delayed development of the prefrontal cortex (Somerville & Casey, 2010). However, there are numerous different loops between the prefrontal cortex and striatum that are thought to have different functions (Haber & Knutson, 2010). It is currently unclear precisely how the development of these different striatal loops contribute to the development of impulsive behavior. In this study we investigate how the development of anatomical and functional striatal connections underlie different aspects of impulsive behavior in a group of participants ages 8 and 25. Connectivity analyses revealed that developmental differences in temporal discounting are related to the structural integrity and functional connectivity of separable cortico-striatal and subcortical-striatal white matter tracts.

Discussion Panel:
Jennifer Pfeifer, University of Oregon
Adriana Galvan, University of California, Los Angeles
Ron Dahl, University of California, Berkeley

Friday, September 12

KEYNOTE ADDRESS

Adele Diamond, University of British Columbia

Interventions, programs, and approaches that appear promising for improving executive functions and those that, despite much hype, do not

The 'Executive Functions' (EFs) of inhibitory control, working memory, and cognitive flexibility enable us to think before we act, resist temptations, stay focused, mentally play with ideas, reason, problem-solve, and meet novel, unanticipated challenges.

EFs can be improved at any age through training and practice, much as physical exercise hones physical fitness. However, beware of inaccurate or exaggerated claims. Physical activity alone appears not to improve EFs (though it improves memory). Despite claims by commercial computerized training programs wide transfer does not occur (where it's been reported, replication attempts have failed). For example, working memory training does not improve intelligence or inhibitory control. People only improve on what they practice (though that transfers to other contexts where those same skills are needed). To see widespread benefits, diverse skills must be practiced.

Our ability to reason, exercise self-control, and flexibly adapt to change (i.e., our EFs) are better when we've had enough sleep and exercise, are not stressed, and feel emotionally and socially nourished. Conversely, EFs suffer most and first if we're sad, stressed, lonely, or not physically fit. I predict that those activities that will be found to most successfully improve EFs not only train and challenge diverse EFs but also indirectly support EFs by working to reduce things that impair EFs and working to enhance things that support EFs. The most effective way to improve EFs is probably not to focus narrowly on EF skills alone, but to address social, emotional, and physical needs as well.

ORAL SESSION 1: Intervention/Executive Function – Preschooler

Deanna Barch, Washington University in St. Louis

The development of emotion regulation and mood pathology

A body of research has identified structural and functional alterations in emotion processing systems that are present in depression. However, it is not yet clear whether these reflect manifest illness or whether they precede illness onset and potentially predict risk. Thus, we examined structural and functional brain integrity in children with no prior history of depression who were scanned in childhood (n=60; 8-12 years) and then followed longitudinally (n=48). At baseline, we examined brain activity to sad faces in a network of regions involved

in emotion processing (e.g., amygdala, hippocampus, parahippocmpal gyrus) and in a network of dorsal frontal and parietal regions associated with emotion regulation. We also examined the volumes of amygdala, hippocampus and anterior insula. At baseline, both reduced hippocampal volume and increased functional brain responses in emotion processing regions predicted higher self-reports of depression. Reduced amygdala and insula volumes, as well as increased activity in emotion processing regions, predicted reduced self-reports of emotion regulation. More importantly, these measures also predicted self-reports of depression and emotion regulation at follow-up. For emotion regulation, the brain measures predicted over and above baseline emotion regulation, indicating that they predicted changes over development. These data are consistent with the hypothesis that the structure and function of brain regions involved in emotion processing and emotion regulation may be potentially useful biomarkers of risk for mood pathology.

Jessie-Raye Bauer, University of Texas at Austin

Manipulation of cue switching variables in children and adults

To study cue-switching abilities in both children and adults, we created a task with two goals in mind. First, we aimed to reduce differences in adult and child performance, thus reducing performance confounds observed in previous imaging studies. Second, we wanted to measure relative learning within the task as a function of age. We collected behavioral data from 60 children aged 6-16 years and 60 adults aged 18-27 years. The computer-based task consisted of nine runs of increasing difficulty via manipulations of response mapping consistency, number of cued tasks, and number of possible responses. To quantify learning, we added a tenth run identical in difficulty to the easiest first run. With respect to our first goal, our attempts to reduce differences in adult and child performance were largely unsuccessful; children were consistently slower, less accurate, and more affected by the task-level manipulations than adults. However, we found a critical transition within our child age group where participants as young as 12 years displayed more adult-like responses in both response time and accuracy measures. We also found an interesting interaction between switch costs and response mapping manipulations. Relevant to our second goal, we found similar amounts of behavioral improvement in both response time and accuracy for both age groups, despite the high starting level of performance in adults. This result is evidence of an approach to temporarily train and improve task-switching abilities in children and adults within a single session via increasing task demand.

Carter Wendelken, University of California, Berkeley

Fronto-parietal network reconfiguration supports the development of reasoning ability

Reasoning is among the most complex and late-developing of human cognitive operations. Prior research has demonstrated the importance of the lateral fronto-parietal network for reasoning performance. The goal of this study was to test whether developmental improvements in reasoning ability can be explained by changes in functional connectivity between specific nodes in this network. With behavioral and fMRI data for 132 children and adolescents aged 6-18 years, including data from a second longitudinal timepoint for 56 of these participants, we examined functional connectivity within the lateral fronto-parietal network and its relation to reasoning ability. First, we observed a robust pattern of increases and decreases across this network, with maximal changes occurring between the ages of 10 and 12. Next, we observed a strong positive relation between reasoning ability and functional connectivity between rostrolateral prefrontal cortex (RLPFC) and the inferior parietal lobe (IPL), but only in older children and adolescents (12-18 years old). For a middle age group (9-11 years), it was not fronto-parietal connectivity but rather bilateral connectivity of left and right RLPFC that was strongly related to reasoning ability. Neither of these RLPFC connections was related to reasoning ability in the youngest group (6-8 years). We conclude that different connections best support reasoning at different points in development, and in particular that functional connectivity between RLPFC and IPL becomes increasingly important for successful reasoning as children get older.

Michael Gaffrey, Washington University School of Medicine

Neurobiological mechanisms of positive affect in preschool age children: an fMRI study

Neuroimaging data suggest that positive affect is associated with brain function in regions sensitive to reward. However, little is known about the neural correlates of positive affect in preschool-age children. Given that positive affect significantly shapes this developmental period and considerably influences later outcomes, this information is critical for informing normative patterns of positive affect development and treatment efforts targeting disruptions to them. Nevertheless, few neuroimaging paradigms appropriate for examining reward processing in preschoolers exist. Thus, the present study tested whether a novel adaptation of a common fMRI 'guessing game' task previously used in older age groups to study reward processing would be appropriate for similar use in preschoolers (N=25). Outcomes included gain, loss, and neutral. Robust activation in reward-related brain regions including the caudate, anterior cingulate cortex, and insula was found across all outcomes. Dissociable patterns of activity were also noted, with greater pregenual cingulate (pgACC) activity for gain trials and increased amygdala activity following gain and loss trials. pgACC reactivity and parent-reported reward sensitivity were also significantly related. Results suggest that cortical-striatal regions identified in older groups are also active during reward processing in preschoolers, validating the current paradigm as a means for studying the early neurobiological development of reward processing as well as potential disruptions to it.

Amanda Bruce, University of Missouri, Kansas City

Apples or oranges? Advancing developmental decision neuroscience using a food choice paradigm

Health-related decisions made by youth, such as eating, exercise, and drugs, are of great importance, and can set up lifelong patterns of behavior. We focus on food-related choices in this study, as childhood obesity poses such significant physical, psychological, and economic consequences. The objectives of this project are to determine the computational and neural mechanisms underlying food decision-making processes in children by administering behavioral choice tasks and functional magnetic resonance imaging (fMRI) scans. Eighteen healthy children between the ages of 8-14 (9 females) underwent a series of behavioral choice tasks and self-report measures. Participants were then scanned using an event-related fMRI paradigm, using 60 single food images. fMRI data were analyzed using the AFNI software. Preliminary results suggest that when making food choices based on their own preferences, children activate ventromedial prefrontal cortex (PFC). When projecting what they believe which foods their mother would choose for them, orbitofrontal cortex and dorsolateral PFC activate. The application of decision-making theory to improving health behavior choices holds substantial promise. Our ultimate goal is to use neuroscience findings to improve youth decision-making and to design health behavior interventions accordingly.

Keri Rosch, The Kennedy Kreiger Institute

Increased delay discounting in children with adhd is associated with orbitofrontal cortex morphology

Children with ADHD often display greater delay discounting, defined as a strong preference for smaller, immediate rewards over larger, delayed rewards, relative to typically developing (TD) children. Although behavioral evidence of greater discounting of delayed

rewards in children with ADHD is mounting, there is limited research on the neural correlates of this preference. The orbitofrontal cortex (OFC) is thought to be involved in encoding reward value and comparing reward options to guide action selection. The current study examined associations among OFC morphology and delay discounting in 8-12 year-old children with ADHD (n=59) compared to TD children (n=37). Participants completed a real-reward discounting task, that involved choices about receiving money immediately or after a delay of 1-90 days, and a real-time discounting task, that involved choices about playing a preferred game either immediately or after a delay of 25-100 seconds. A 3T MPRAGE was also obtained on 87 of these participants and the frontal lobe was segmented into functionally distinct regions. Children with ADHD showed greater delay discounting on the real-time task (Diagnosis x Delay, p=.049), but not on the real-reward task (p=.962). Among children with ADHD, greater delay discounting (lower area under the curve) on the real-time task was associated with less OFC surface area (r=.362, p=.008), whereas OFC morphology was uncorrelated with delay discounting in TD children. These findings provide further evidence of OFC involvement in reward-based decision-making and the pathophysiology of ADHD.

Johannes Decker, Weill Cornell Medical College

Experiential learning outweighs instruction early in development

Throughout our lives, we face the important task of distinguishing rewarding actions from those that are best avoided. Importantly, there are multiple means by which we acquire this information. Through trial and error, we use experiential feedback to evaluate our actions. We also learn which actions are advantageous through explicit instruction from others. Here, we examined whether the efficacy of these two forms of learning changes across development by placing instruction and experience in competition in a probabilistic learning task, adapted for use across development. 31 children (ages 6-12), 31 adolescents (ages 13-17), and 26 adults (ages 18-34) learned through trial and error to select the most rewarded option for each of three pairs of stimuli. One lower-valued stimulus was falsely instructed as being a good choice. After this learning phase, participants chose between all 15 possible stimulus pairings without feedback, enabling evaluation of the degree to which participants' learned the true value of each stimulus, or whether instruction biased this learning. Preliminary data suggest that whereas inaccurate instruction markedly biased adults' value estimation, children and adolescents relied chiefly on their experience. Instructional control of learning is thought to recruit corticostriatal brain circuitry, which continues to mature into adulthood. These behavioral data suggest that this protracted neurocognitive maturation may bias children and adolescents to learn less effectively from explicit instructions than they do their own previous experience.

Christine Coughlin, University of California, Davis

Neural correlates of developmental differences in mnemonic flexibility

Although individuals tend to demonstrate better episodic memory retrieval when the original encoding context is reinstated (Tulving & Thomson, 1973), an exact match between encoding and retrieval contexts may be especially advantageous for children (Ackerman, 1982). It is therefore possible that age-related improvements in episodic memory may be attributed to decreased dependence on contextual matches with age (Shing et al., 2010). We address this possibility by examining age-related differences in the contribution of the medial temporal lobes (MTL) to mnemonic flexibility during encoding and retrieval. Participants (8- to 11-year-olds and adults; N=60) participated in a functional magnetic resonance imaging (fMRI) task in which they made comparisons about pairs of pictures at encoding. At retrieval, they were shown picture pairs and asked whether each was old or new. Old pairs were presented in either the same location as encoding (exact retrieval condition) or in new locations (flexible retrieval condition). Rearranged pairs were also presented. Successful flexible retrieval was associated with activation in anterior hippocampal regions for adults but not children, who engaged this region more for exact reinstatement. Age-related differences were also observed in the posterior parahippocampal gyrus and posterior parietal cortex. Additional analyses will examine whether age-related differences in MTL activation at encoding are also associated with developments in flexible memory retrieval. Together, data further characterize episodic memory development during childhood.

KEYNOTE ADDRESS

Susan Tapert, University of California, San Diego

Neuroimaging findings in young drinkers: does teenage drinking harm the brain?

Alcohol use is common in adolescence, and rates of binge drinking are high. Neuropsychological and brain imaging studies have shown that the brain continues to develop into young adulthood, and may be more vulnerable to the effects of heavy doses of alcohol at this developmental phase. This lecture will discuss how a healthy brain progresses through adolescence and young adulthood. We will explore data showing that binge drinking appears to affect the brain, and is linked to changes in thinking abilities over time. We will examine the role of the media in alcohol use decisions of young people and discuss implications for prevention.

ORAL SESSION 2: Substance Use / Addiction – Youth

Kathy Do, University of California, Los Angeles

Striatal activation mediates the relationship between acute craving and smoking urges in adolescent smokers

Smoking initiation occurs at uniquely high rates during adolescence, despite widespread knowledge of health-compromising and long-term consequences of cigarette smoking. Although psychosocial factors influence the likelihood that youth will engage in nicotine use, no previous research has examined the role of the developing brain in this deleterious behavior. In the current study, 39 adolescent and 39 adult smokers and nonsmokers viewed video clips of youth smoking a cigarette and rated craving following each clip while undergoing functional magnetic resonance imaging (fMRI). Compared with nonsmokers, smokers exhibited decreased dorsolateral prefrontal cortex (DLPFC) activation. Compared to adult smokers, adolescent smokers exhibited increased ventral striatal (VS) activation, which mediated the relationship between video-induced craving and smoking urges following the experiment. Furthermore, greater functional connectivity between the VS and frontoparietal circuitry previously implicated in action representation was associated with acute craving to the smoking cues in adolescent smokers only. These results demonstrate that adolescent smokers may be more behaviorally and neurobiologically susceptible to smoking stimuli, perhaps due to the dynamic ontogenetic changes in frontostriatal circuitry that occur during this highly sensitive developmental window.

Rebecca Martin, Columbia University

Peer feedback enhances food craving more for adolescents than adults

Adolescence is a developmental period characterized by increased sensitivity to social information. While the influence such information can exert over adolescent behavior has been studied with respect to rejection and risk-taking, few studies have looked at how it might serve to regulate one's affective responses to primary rewards such as food.

Adolescent (ages 10-14) and adult (ages 18-22) participants viewed images of food and rated how much they wanted to eat the pictured items. After making their rating, participants were shown what they believed to be a group rating for that same food from a normative sample of approximately 100 peers their age, or they received no feedback. After a break, participants rated the images a second time, this time without peer feedback. We assessed social influence by comparing the degree to which participant ratings changed as a function of the peer ratings. Both adolescents and adults showed a strong main effect of peer feedback ($p<.0001$), however, adolescents more strongly conformed to their peers when peers rated foods more positively ($p=.006$). This finding replicates prior work showing that certain types of social information may be especially salient to adolescents, and extends such work by showing that peer influence may more strongly impact approach-related behaviors in adolescents compared to adults. This paradigm provides a model for studying how social influence can enhance or regulate one's reactivity to food cues, and could inform education or public health interventions aimed at improving health behaviors.

Monica Luciana, University of Minnesota

Adolescent brain development and effects of alcohol use

Alcohol use in adolescence is associated with alterations in regional brain volumes and neurocognitive deficits. Cross-sectional comparisons and other confounds introduce interpretive challenges regarding how substance use impacts the developing adolescent brain. In this prospective study, a low-risk sample of adolescents ages 9 to 23 completed baseline MRI scans and neurobehavioral testing prior to any experience with alcohol. Subsequently, participants completed three additional assessment waves, each two years apart. During the retest interval, many participants transitioned into regular alcohol use. Trajectories of brain and behavioral development were examined as a function of use initiation and characteristics. Alcohol use initiation is associated with anomalous patterns of cortical thinning in middle frontal regions and with disruptions in white matter development and connectivity, particularly in periventricular regions as well as in fiber tracts interconnecting the frontal lobe with posterior cortical regions. Baseline status of the nucleus accumbens predicts use initiation. Individual differences in reward sensitivity predict use patterns; measures of executive control are disrupted after establishment of regular use. These findings suggest disruptions in neural development as a function of alcohol use initiation, consistent with neurotoxic effects of alcohol that have been observed during other periods of the lifespan. Policy implications will be discussed.

Peter Franz, Columbia University

Fundamental competencies predict the neural bases of emotion regulation in youth

Childhood and adolescence are times of considerable change, as individuals must balance an increasing number of interests and responsibilities and the emotions that accompany them. How can one succeed at this balancing act? One key factor may be the capacity for adaptive emotion regulation, which is known to be essential for mental and physical health. Here we asked whether the ability to cognitively regulate emotion is associated with basic competencies in youth, such as earning high grades in school and maintaining close friendships. To answer this question, we tested 77 healthy individuals (45 female; ages 6-17) on a well-established fMRI paradigm in which participants viewed appetizing food images. On half of trials, participants regulated their craving using a cognitive distancing strategy ("far" trials) and on the other half of trials, they responded in an unregulated manner ("close" trials). To assess real-world competency, participants' parents completed a questionnaire designed to measure competency in three important domains: extracurricular activities, social relationships, and school performance. We found that on average, participants reported less food craving on far trials than close trials. The degree to which participants reported less craving on far versus close trials, termed "regulatory success", was associated with greater overall competence and differential activation in medial prefrontal regions. These results provide novel evidence that competency in youth is related to emotion regulation ability on a behavioral and neural level.

Jennifer Pfeifer, University of Oregon

Neural foundations of appetitive and affective reactivity and regulation across adolescence

Dominant biological models of adolescent development emphasize the neural foundations of certain trends in teenage behavior that are of significant parental and societal concern. These models focus on an imbalance between prefrontal systems for cognitive control and subcortical systems implicated in affective processing and approach/avoidance motivation. This has provided a critical framework for advancing discovery in the field, but there is a growing initiative to refine these models to account for new evidence and inconsistencies in the literature. This talk describes one such effort, a large fMRI study examining appetitive and affective reactivity and regulation in 60 girls aged 10-22 years. Two fMRI tasks extended prior approaches by assessing understudied aspects of affect, motivation, and control: labeling dynamic peer emotional displays, and reappraising craved foods. Across fMRI tasks, results demonstrated consistency in regions used for incidental and intentional regulation (including lateral prefrontal cortex), but variability in regions recruited during appetitive and affective reactivity (including ventral striatum and amygdala). Non-linear and linear trajectories associated with pubertal development and age were observed in both prefrontal and subcortical regions. Finally, half the sample completed a daily diary study tapping real-world affective and regulatory tendencies, which is currently being related to the neuroimaging data.

Saturday, September 13

KEYNOTE ADDRESS

Dima Amso, Brown University, USA

Attention and memory in typical and atypical development

Attention and memory processes are at the core of brain and cognitive development. I will discuss studies that detail the mechanisms and developmental course of visual attention beginning in infancy. I will then argue that this developmental profile supports the efficacy of memory systems, thereby elevating learning and memory more broadly. The implication of these data is that visual attention is critical to typical development and perhaps at the heart of atypical developmental trajectories. In support of this hypothesis, I will present data that suggests that atypical visual attention contributes to social and linguistic outcomes in children diagnosed with Autism.

ORAL SESSION 3: Infant / Toddler Cognition

Alice Graham, Oregon Health and Science University

Family stress during the pre- to early postnatal period is associated with infants' brain connectivity and emotionality

Extensive animal research has demonstrated the vulnerability of the brain to stressors during the pre- and early postnatal periods with consequences for emotional development and mental health. However, the influences of pre- and postnatal stress, and in particular

pre- and postnatal stress interactions, on early human brain development are not well understood. Resting state functional connectivity MRI (rs-fcMRI) allows for characterizing specific brain systems beginning in infancy. We examined the default mode network (DMN) due to its well characterized developmental trajectory and implications for mental health. DMN strength was examined in 23 infants (6-12-months) in the context of interparental conflict, a common source of early life stress (ELS) that frequently increases from the pre- to postnatal environment. We further tested DMN strength as a mediator between change in interparental conflict and infants' negative emotionality. Greater increase in conflict from pre- to postnatal was associated with stronger connectivity between two core DMN regions, the posterior cingulate cortex (PCC) and the anterior medial prefrontal cortex (aMPFC). Connectivity between the PCC and the amygdala was also increased. Stronger PCC-aMPFC connectivity mediated between increase in conflict and higher maternal report of negative infant emotionality (99% CI: .099, 1.49). Change in a common form of ELS from pre- to postnatal appears to be relevant for functional brain development. The developing DMN may be an important marker for effects of ELS with relevance for emotional development.

Jerod Rasmussen, University of California, Irvine

A novel maturational index for cross-sectional characterization of white matter ontology in early life

Early postnatal life is a period of rapid brain development, which has been characterized extensively using MRI. As an extension of current models we propose expressing the predictive power of gestational age at birth (GA) and postnatal scan age (SA) as a novel Maturation Index (MI). DTI was performed on 47 healthy neonates at full term (GA=39.0±1.5wk, SA=25.5±12.1days, 59% male) resulting in tract-based measures of Fractional Anisotropy (FA), Radial (RD), Axial (AD), and Mean Diffusivity (MD). Using an ANOVA model, co-varying for brain volume and sex, the index described here projects the variance explained (EV) by GA and SA onto an interval between -1 and 1 (MI=[EV(GA)-EV(SA)]/[EV(GA)+EV(SA)]). MI values describe a rate-of-change during two unique time intervals (GA and SA), capturing distinct phases of fiber tract ontology. Three central tenets were examined using MI values: 1) RD/AD/MD maturation precedes FA maturation, 2) fiber tracts develop in the order commissural, projection, associative, and 3) tract development occurs in a central-to-peripheral manner. Using this methodology, we were able to show AD/RD/MD preceding FA ($p<10^{-4}$) globally and regionally. Fiber groups were seen developing in the following order ($p<10^{-3}$): commissural, associative, projection. Projection fibers demonstrated the central-to-peripheral progression hypothesized and central regions of the projection fibers were observed to develop prior to associative fibers. This work validates MI as a useful tool for quantifying early life brain development.

Alison Weiss, Emory University

Working memory deficits in adult Rhesus macaques (Macaca mulatta) with neonatal perirhinal cortex lesions

The lateral prefrontal cortex (lPFC) is known to mediate working memory (WM) processes in both humans and animals. Yet, recent studies indicate that medial temporal lobe structures are also recruited during WM tasks, more importantly, the perirhinal cortex (PRh) has extensive anatomical interactions with the lPFC. The goal of this study was to characterize the nature of WM deficits in monkeys that had received neonatal perirhinal lesions (Neo-PRh) as compared to sham-operated controls (Neo-C). As adults, monkeys were tested in object-based (non-spatial) WM tasks that tapped different WM processing domains, e.g. maintenance only (Session-unique Delayed-nonmatching-to Sample, SU-DNMS), and maintenance and monitoring (Object-Self-Order, Obj-SO). Neo-PRh lesions transiently impaired learning SU-DNMS at a short (5-sec) delay, but this mild impairment was absent when the animals were re-tested with a longer delay (30-sec). In contrast, the same neonatal lesions severely impacted acquisition of Obj-SO. These results indicate that neonatal perirhinal lesions had a greater impact on WM tasks requiring monitoring than those requiring only maintenance processes. Thus, the WM deficits indicate either that PRh participates actively in WM processes or that the lack of PRh inputs to the lPFC early in infancy may have altered the normal maturation of the lPFC. Supported by grants from NIMH (MH-58846 and T32-HD071845-01A1).

Natalia Caporale, University of California, Berkeley

A mouse model to study the impact of early-life adversity on decision-making

Every year, approximately 1 in 10 children in Western society experiences emotional maltreatment. Mental health issues created by early life adversity may enhance vulnerability to further physical health problems. Human epidemiological data suggest a link between childhood trauma and abuse and depression, anxiety disorders, bipolar disorder and schizophrenia as well as substance use. In addition, early life adversity has also been associated with greater rates of obesity, cardiovascular disease and diabetes, all diseases with behavioral management challenges. We are interested in studying the neural mechanisms that mediate the impact of early life adversity on the development of executive control and decision making. Here we show that brief maternal separation in the first ten days of life, a model of early life adversity in rodents, decreases cognitive flexibility in a reversal learning task in juvenile mice. This reversal task is known to rely on the orbitrofrontal and dorsomedial prefrontal cortex in mice and is comparable to the Wisconsin card sorting task commonly used to test prefrontal function in humans. We are currently using this mouse model of adversity to measure the impact of maternal separation on frontal cortical circuit development using in vivo imaging tools.

Sandhya Prathap, Stanford University School of Medicine

Longitudinal changes in neural pattern similarity predict individual gains in arithmetic problem solving skills

The medial temporal lobe (MTL) is important for learning and memory, yet its role in knowledge and cognitive skill acquisition in childhood is largely unknown. Here we investigate the neurodevelopmental basis of individual gains during math learning in primary-grade school children. We conducted a longitudinal fMRI study in 30 children (aged 7-9) at two time points spanning a period of 1.2 years. During the fMRI-scan, participants solved a set of single-digit addition problems with addition (i.e., 5 9=14) and control (i.e., 5 1=6) conditions. The behavioral results indicated that children became significantly faster when solving addition problems ($p=.004$), and more efficient (i.e., reaction time /accuracy; $p<.05$) at Time-2 vs. Time-1. Multivoxel pattern similarity analysis revealed that brain activation patterns between addition and control conditions become less similar from Time-1 to Time-2 in prefrontal and parietal cortices; specifically in the bilateral MTL, angular gyrus, and the medial prefrontal cortex (mPFC). Thus, neural representations of these two types of problems become more distinct with development. Critically, longitudinal changes in multivoxel pattern similarity in the bilateral MTL, angular gyrus, and the mPFC were negatively correlated with individual gains in behavioral efficiency. Thus, children whose performance improved the most showed more distinct neural representation patterns over time. Our findings provide new insights into the role of the MTL, prefrontal, and parietal representations in children's arithmetic learning and knowledge acquisition.

Denise Werchan, Brown University

The early emergence of hierarchical rule learning and generalization

The ability to extract and generalize abstract rules from experience helps guide learning in new environments. Evidence from adults suggests that abstract or hierarchical rule learning is supported by interactions between the prefrontal cortex and striatum via dopaminergic pathways (Collins and Frank, 2013; Collins, Cavanagh, and Frank, 2014). Yet, little is known about how these processes occur in infants. Here we examined whether young infants could infer hierarchical rules and generalize learned information to novel contexts. We presented twenty 7-9 month infants (M = 8.5, SD = 1.22) with stimulus-reward location pairs. These pairs were constructed such that an implicit hierarchical order could be inferred, with some features acting as higher-order contexts indicative of a task set and other features acting as lower-order stimuli indicative of the reward location given the task set. We found that infants inferred the hierarchical structure and abstracted two task sets from the input. Moreover, infants were able to generalize one of these task sets to support learning in a novel context. Blink rate--a known proxy for central dopamine activity (Karson, 1982)--during learning of the task sets also predicted generalization at test. These findings suggest that infants may infer abstract rule representations during learning, affording generalization in new contexts. This research provides novel insight into the early emergence of hierarchical rule abstraction and learning in infancy.

Kerstin Konrad, RTWH Aachen University

Neural correlates of early mother-child interaction

Interactive behaviors between infants and their mothers represent the primary basis by which infants prepare for social activities. However, still little is known about the neural mechanism associated with the quality of mother-child interactions in the mother's and infant's brain and how maternal sensitivity and child responsiveness are related to each other. Thus, in the current presentation we will explore the hypothesis that synchrony between mother's and child's neural activity during naturalistic interactions predicts the quality of mother-child relationships. Findings from a series of neuroimaging studies will be presented in which (1) mothers' neural responses to infant cues were investigated with fMRI or (2) mothers and children were simultaneously investigated with NIRS in a social interaction situation. Our data suggest that in the mother's brain not only neural activity in limbic brain structures but in particular activity in and connectivity with areas implicated in the regulation of maternal emotions, such as the prefrontal cortex, was associated with better maternal sensitivity. In the infant's brain activation of prefrontal areas during positive mother-child interactions was associated with higher child responsiveness. Synchrony between mother's and infant's neural activation patterns will be further explored. Finally, the question whether brain imaging can broaden our understanding of mother-child interactions and clinical implications will be discussed.

Rebecca Gomez, The University of Arizona

Mixed benefits of sleep versus wake across early development: how similar outcomes can be supported by different neural processes

Generalization requires learners to extract redundant cues across training instances while ignoring less redundant, irrelevant ones. We investigate memory in young children who are unable to generalize immediately after learning, but who generalize after a delay. Children were exposed to stimuli with redundant cues relevant to a generalization and weakly supported irrelevant variations. A daytime nap in 12 month olds resulted in integration of unique sets of learning exemplars and subsequent generalization compared to a group who stayed awake. In 2.5 year olds, wake led to better generalization than sleep. That is, a daytime nap permitted generalization in infants and retarded generalization in toddlers who performed better after a wake delay. Although these results would seem to contradict, we argue that the differences observed across age in sleep/wake outcomes stem from developmental changes in learning and memory systems. Early in development an immature trisynaptic circuit precludes hippocampal sharp wave ripples and neural replay, favoring an explanation based on cortical encoding and forgetting during sleep that retains stronger, more redundant memories over weaker, less redundant ones. Later in development when hippocampal connectivity can begin to support neural replay, high levels of slow wave sleep may act to consolidate weaker, less redundant memories along with stronger ones, leaving children unable to extract the relevant generalization. In contrast, forgetting during wake allows 2.5 year olds to forget less redundant memories, permitting generalization.

KEYNOTE ADDRESS

Laurence Steinberg, Temple University

Age of opportunity: lessons from the new science of adolescence

This lecture examines two intersecting sets of changes that together have profound implications for how we view adolescence. The first concerns the lengthening of the period. In 1950, modern adolescence lasted around seven years. Today, because of the decline in the age of puberty and the delay in entering adult roles, adolescence lasts twice as long. The second set of changes concern our understanding of adolescent brain development. Adolescence is a second period of especially heightened plasticity, perhaps the last such period in development. Because adolescence is both longer and the adolescent brain more plastic, it is a stage of tremendous vulnerability but tremendous opportunity.

ORAL SESSION 4: Adolescence

Johnna Swartz, University of North Carolina, Chapel Hill

Developmental change in amygdala reactivity during adolescence: effects of family history for depression, gender, and stressful life events

Heightened amygdala reactivity to threat, which is consistently observed in patients with major depressive disorder (MDD), may represent a trait marker for the eventual development of the disorder. However, little is understood about how and when this neural phenotype emerges. The objective of this prospective, longitudinal study was to evaluate developmental change in threat-related amygdala reactivity in adolescents at high or low risk for MDD based on family history. 331 adolescents (initially aged 11-15 years) completed an fMRI paradigm that elicited threat-related amygdala reactivity at baseline and 2 years later. After quality control, data from 120 adolescents with a positive and 117 with a negative family history of MDD were available for analyses. Change in amygdala reactivity was assessed as a function of family history of MDD, gender, and recent stressful life events. We found that threat-related amygdala reactivity significantly increased with age in those with a positive family history, whereas it remained stable in those with a negative family history. Boys with a positive family history evidenced the greatest increases in amygdala reactivity over time. Stressful life events predicted increased amygdala reactivity with age in those with a negative family history of MDD. In conclusion, increase in threat-related amygdala reactivity during adolescence may represent a common developmental pathway through which two independent risk factors, namely positive family history and stressful life events, increase risk for the development of MDD.

Jiska Peper, Leiden University

Fronto-striatal white matter integrity predicts adolescent development in delay of gratification: A longitudinal study

The ability to delay gratification increases considerably across adolescence. It has been suggested that this impulse-regulation capacity is driven by increased regulatory control of the prefrontal cortex over reward-related striatal areas. Whether the integrity of fronto-striatal white matter tracts can predict development of impulse regulation during adolescence remains unknown. 225 healthy volunteers between 8 and 25 years completed a delay-discounting task at time-point 1 (T1) and two years later (T2) to measure individual development of impulsive decision-making. Using DTI, FA along fronto-striatal (FS) fibre tracts was quantified at T1. Regression analyses were performed, to determine 1) the interplay between age, delay discounting performance and FA of FS-tracts, and 2) whether FS-integrity predicts delay-discounting performance 2 years later. Cross-sectional results showed that delay-discounting decreases with age together with an increase in FS-tract integrity ($\beta=.46$, $p<.0001$). Importantly, longitudinal data showed that above and beyond delay discounting performance at T1, FS-integrity added unique variance in delay discounting performance at T2 ($\beta=.19$; $p=.004$). The results show that the integrity of white matter connections between prefrontal and striatal brain regions predicts individual differences in the ability to delay gratification. Next to behavioural ratings, studying white matter pathways between regulatory control brain systems and reward-related brain areas provide unique insights into the functional neuroanatomy of impulsivity across adolescence.

Torkel Klingberg, Karolinska Institutet

Childhood cognitive development as a skill

Two main theories view childhood development as either driven by structural maturation of the brain or as a result of skill learning. It is unclear where development of executive functions falls. Research now consistently show that WM training can improve WM capacity. The neural correlates of WM training have been explored with neurophysiology in monkeys, and in human studies with genetics, fMRI, PET, TMS and EEG. Here we compare the litterature on development and training and put forward the hypothesis that cognitive development is partly (but not exclusively) driven by training effects in the environment and that the neural mechanism underlying training induced plasticity are partly identical to those underlying childhood development. In particular, the connectivity of a fronto-parietal network is suggested to be associated with WM capacity. The striatum and corticostriatal white matter tracts, on the other hand, seems more important for plasticity, that is, the ability to change capacity with training. In this view, development of cognitive capacity during childhood can be viewed as the learning of a skill.

Gail Rosenbaum, Temple University

Adolescent cognitive control unaffected by presence of peers

Adolescence is known as a period of heightened risk-taking, and research has shown that teens take more risks in the presence of peers than alone. This effect is thought to arise due to the selective impact of peers on sensitivity to the rewarding aspects of risk-taking, while cognitive control is unaffected. In fact, prior work in our lab supports the idea that the presence of peers increases adolescents' behavioral reward sensitivity and brain activity in reward regions during risk-taking laboratory tasks. However, whether peers directly impact cognitive control activity remains unknown. To explore this possibility more directly, adolescents (N=38, ages 13-17) were asked to complete a Go/NoGo task in the fMRI scanner. Half of the participants believed they were being observed by an anonymous peer; the other half completed the task alone. Go/NoGo behavior, measured by accuracy, false alarm rate, and response time, did not differ by social context, as we might expect if peers influenced cognitive control. Critically, there were also no observed differences between participants in the peer and alone conditions in engagement of cognitive control regions thought to support Go/NoGo performance. In contrast, peers did significantly impact behavior and reward-related brain activity in a risk-taking task conducted in the same cohort. These combined results support the notion that peers influence adolescent behavior by increasing reward sensitivity rather than decreasing adolescents' ability to engage cognitive control circuitry.

Cheryl Sisk, Michigan State University

Neuroendocrine mechanisms underlying adolescent maturation of social reward and proficiency

Adolescent development includes maturation of social cognition, which involves the perception of social cues and selection of a context-appropriate behavioral response. Social reward and the incentive salience of social cues are necessarily revised during adolescence as the social hub switches from family to peers. Social proficiency is acquired via behavioral adaptations to social experience. Using male Syrian hamsters to study underlying neuroendocrine mechanisms, we found that adult, but not juvenile, males form a conditioned place preference (CPP) to female chemosensory stimuli, indicating that this social cue is not rewarding prior to puberty. Testosterone-treated juvenile males do form a CPP to female odors, and this CPP is prevented by the dopamine receptor antagonist haloperidol. We next identified an example of social proficiency in adult hamsters, i.e., a decrease in misdirected mounts with repeated sexual experience. Male hamsters deprived of testosterone during adolescence do not show this behavioral adaptation, even after testosterone replacement in adulthood. Over-expression of the transcription factor ΔFosB into the ventral prefrontal cortex of these males restores the ability to reduce misdirected mounts with sexual experience. Our studies thus show that 1) the perception of female odors as rewarding is activated during puberty by testosterone via a dopamine receptor-dependent mechanism, and 2) the ability to acquire social proficiency is organized by pubertal testosterone, likely involving structural reorganization of the prefrontal cortex.

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Poster Session 1
Friday, September 12 (presentation hours: 12:00 PM – 2:00 PM)

Poster Session 2
Saturday, September 13 (presentation hours: 12:00 PM – 2:00 PM)

Posters in bold represent first author

Poster board numbers work in the following way:
Poster – Poster Session – Board Number (Eg. P-1-57)

Odd numbered posters will be presented during Poster Session 1, and **even numbered posters** will be presented during Poster Session 2.

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All posters must be put up between 11:00 AM and 6:30 PM on Thursday, September 11, and removed by 3:30 PM on Saturday, September 13. Posters not removed by this time will be held at the Registration Desk until 5:00 PM.

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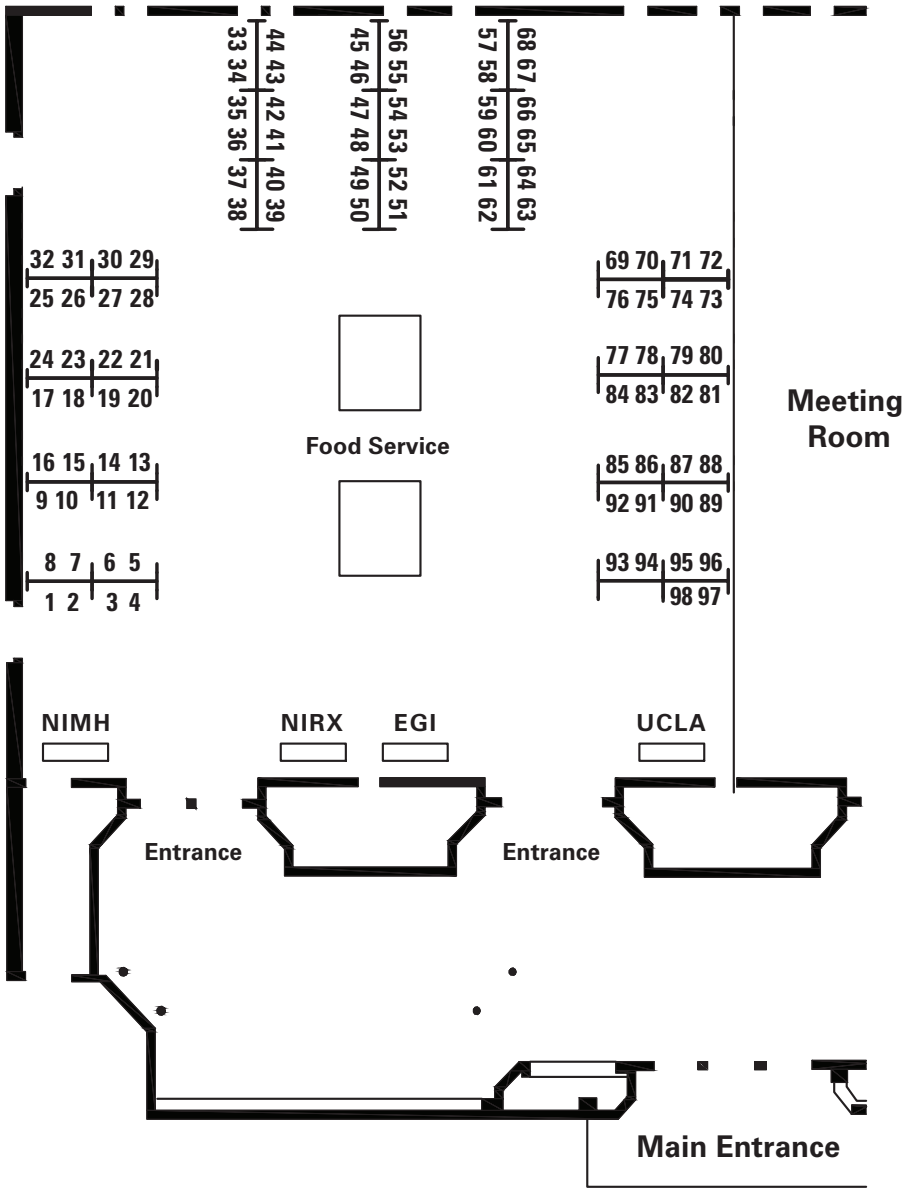

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P-1-1 How therapist language influences the developing brain: a look at adolescent binge drinkers

Sarah Feldstein-Ewing[1], Jon Houck[1], Uma Yezhuvath[2], Hollis Karoly[3], Francesca Filbey[4]

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P-2-2 Compliments and insults: neurobiological and behavioral responses to social prediction error in adolescence

Kaitlyn Breiner[1], Adriana Galván[1]

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P-2-4 Altered reward processing in adolescent binge drinkers relates to largest number of drinks recently consumed: a longitudinal fMRI study

Anita Cservenka[1], Karen Hudson[1], Bonnie Nagel[1]

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P-1-5 Developmental sex differences in resting state functional connectivity with sub-regions of the amygdala

Gabriela Alarcon[1], Anita Cservenka[1], Marc Rudolph[1], Damien Fair[1], Bonnie Nagel[1]

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P-2-6 What has neuroimaging taught us about adolescent social development?

Eric Nelson[1]

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P-1-7 Child trauma and cortical structure

Katie McLaughlin[1], Margaret Sheridan[2]

[1]University of Washington, [2]Boston Children's Hospital/Harvard Medical School

P-2-8 Peer reputation influences brain function during social evaluation in youth at risk for social anxiety

Johanna Jarcho[1], Megan Davis[1], Nathan Fox[2], Ellen Leibenluft[1], Daniel Pine[1], Eric Nelson[1]

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P-1-9 Different prefrontal-subcortical circuits support chronic and strategic emotion regulation across adolescence

Jennifer Silvers[1], Catherine Insel[2], Alisa Powers[3], Peter Franz[1], Jochen Weber[1], Walter Mischel[1], B.J. Casey[4], Kevin Ochsner[1]

[1]Columbia University, [2]Harvard University, [3]Long Island University, [4]Weill Cornell Medical College

P-2-10 Disrupted functional connectivity of working memory in adolencent-onset phychosis

Ariel Schvarcz[1], Katherine Karlsgodt[2], Peter Bachman[1], Maria Jalbrzikowski[1], Theo G. van Erp[3], Tyrone Cannon[4], Carrie Bearden[1]

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P-1-11 Ambiguity aversion is absent in 8-year-old children

Rosa Li[1], Elizabeth Brannon[1], Scott Huettel[1]

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P-2-12 Maternal history of depression impacts neural responses to emotional stimuli in school-age children

David Pagliaccio[1], Katherine Luking[1], Joan Luby[1], Deanna Barch[1]

[1]Washington University in St. Louis

P-1-13 Long-term alterations in prefrontal structural and functional brain development in adolescents born moderately preterm

Amanda Hodel[1], Sara Van Den Heuvel[1], Ruskin Hunt[1], Heather Sesma[1], Kathleen Thomas[1] [1]University of Minnesota

P-2-14 Effects of depression risk and current depressive symptoms on striatal response to incentives in healthy children

Katherine Luking[1], David Pagliaccio[2], Joan Luby[2], Deanna Barch[2]

[1]Washington University in St. Louis, [2]Washington University

P-1-15 Structural brain correlates of executive engagement in children's working memory.

Sandrine Rossi[1], Amélie Lubin[2], Grégory Simon[3], Céline Lanoë[3], Nicolas Poirel[2], Arnaud Cachia[2], Arlette Pineau[3], Olivier Houdé[2]

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P-2-16 Are there sensitive periods for learning in adolescence?

Ashok Sakhardande[1], Delia Fuhrmann[1], Lisa Knoll[1], Maarten Speekenbrink[2], Sarah-Jayne Blakemore[1]

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P-1-17 Qualitative but not quantitative structural characteristics of the anterior cingulate cortex predict inhibitory control during childhood: A longitudinal study

Gregoire Borst[1], Arnaud Cachia[1], Julie Vidal[1], Grégory Simon[1], Clara Fischer[2], Arlette Pineau[1], Nicolas Poirel[1], Jean-François Mangin[2], Olivier Houdé[1]

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P-2-18 Interactions between anxiety and cognition in adolescents and adults

Monique Ernst[1], Nilam Patel[1], Christian Grillon[1], Daniel Pine[1]

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P-1-19 The role of non-numerical stimulus features in the development of the number sense

Ariel Starr[1], Nicholas DeWind[1], Elizabeth Brannon[1]

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P-2-20 Adolescent binge-drinkers show atypical brain activity during risky decision-making

Scott Jones[1], Anita Cservenka[1], Gabriela Alarcon[1], Bonnie Nagel[1]

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P-1-21 Sex differences in the development of brain activity during inhibitory control

Megan Herting[1], Chris Nuñez[2], Christina Chen[2], Prapti Gautam[2], Elizabeth Sowell[2]

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P-2-22 Limbic hyper-reactivity to threatening social stimuli following early life deprivation

Kelly Jedd[1], Ruskin Hunt[1], Megan Gunnar[1], Kathleen Thomas[1]

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P-1-23 Numerical performances in schoolchildren is associated with grey-matter differences: A voxel-based morphometry study

Amélie Lubin[1], Sandrine Rossi[2], Gregory Simon[2], Céline Lanoë[2], Nicolas Poirel[2], Arlette Pineau[2], Olivier Houdé[2]

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P-2-24 Sex differences in intrinsic brain organization in children with ADHD

Jessica Cohen[1], Anita Barber[2], Stewart Mostofsky[2]

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P-1-25 The association between condom use and the developing adolescent brain

Sephira Ryman[1], Angela Bryan[2], Josef Ling[3], Andrew Mayer[3], Jon Houck[3], Sarah Feldstein Ewing[1]

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P-2-26 Developmental neuroanatomic endophenotypes of executive function in 22q11.2 Deletion Syndrome

Rachel Jonas[1], Maria Jalbrzikowski[1], Arati Patel[1], Leila Kushan[1], Caroline Montojo[1], Carrie Bearden[1]

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P-1-27 Longitudinal imaging of long range axon dynamics at the synaptic level across development in mice.

Linda Wilbrecht[1], Carolyn Johnson[2], Alexandra Loucks[2]

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P-2-28 Anonymous peers increase engagement of reward processing regions during adolescent risk-taking

Ashley Smith[1], Laurence Steinberg[1], Jason Chein[1]

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P-1-29 The unity and diversity framework of executive functions in childhood

Laura Engelhardt[1], Daniel Briley[1], Frank Mann[1], Jessica Church[1], K. Paige Harden[1], Elliot Tucker-Drob[1]

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P-2-30 Changes in cortical thickness in 6-year-old children open their mind to a global vision of the world

Nicolas Poirel[1], Elise Leroux[2], Arlette Pineau[3], Olivier Houdé[3], Grégory Simon[3]

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P-1-31 Medial temporal lobe structure relates to individual differences in memory and reasoning ability across development

Margaret Schlichting[1], Katharine Guarino[1], Alison Preston[1]

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P-2-32 Impaired executive control and reward functioning in pediatric obesity

Alaina Pearce[1], Maciej Kietlinski[1], Eleanor Mackey[2], Evan Nadler[3], Chandan Vaidya[4]

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P-1-33 Cortical anatomical correlates of developing language performance in relation to socioeconomic and genetic factors: A cautionary tale

Tim Brown[1], Hauke Bartsch[1], Natacha Akshoomoff[2], Erik Newman[2], Joshua Kuperman[1], Cinnamon Bloss[3], Elizabeth Sowell[4], Anders Dale[1], Terry Jernigan[2]

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Anna van Duijvenvoorde[1], Michelle Achterberg[1], Barbara Braams[1], Sabine Peters[1], Eveline Crone[1]

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P-1-35 Brain development of irritability: a fNIRS study of executive function in preschool children

Susan Perlman[1], Brianna Jones[1], Beatriz Luna[1], Theodore Huppert[1]

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P-2-36 Functional differences in stroop response for alcohol- and marijuana-using high-risk youth

Rachel Thayer[1], Sarah Feldstein Ewing[2], Andy Mayer[3], Andrew Dodd[3], Josef Ling[3], Angela Bryan[1]

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P-1-37 Sex differences in the relation between socioeconomic status and longitudinal trajectories of brain function

Sarah Ordaz[1], Daniel Hackman[2], Scott Rosenblum[3], Peter Gianaros[2], Beatriz Luna[2]

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P-2-38 Neural mediators of the intergenerational transmission of family conflict behavior

Darby Saxbe[1], Larissa Del Piero[1], Hannah Lyden[1], Gayla Margolin[1]

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Bhoomika Kar[1], Yagyima Nehabala[1]

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Wouter Weeda[1], Nikki Lee[1], Lydia Krabbendam[1], Mariette Huizinga[1]

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Lara Wierenga[1], Marieke Langen[1], Bob Oranje[1], Sarah Durston[1]

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Nikki Lee[1], Wouter Weeda[1], Catherine Insel[2], Melissa Versteeg[1], Leah Somerville[2], Lydia Krabbendam[1], Mariette Huizinga[1]

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Federico Nemmi[1], Torkel Klingberg[1]

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P-2-44 Adolescents show unique behavioral and neural responses to unpredictable positive cues

Catherine Insel[1], Alexandra Rodman[1], Alea Skwara[1], Stephanie Sasse[1], Erik Kastman[1], Leah Somerville[1]

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P-1-45 Temporal uncertainty differentially impacts concurrent task performance across development

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Deanna Greene[1], Jessica Church[2], Babatunde Adeyemo[1], Binyam Nardos[1], Kevin Black[1], Bradley Schlaggar[1]

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P-1-47 The neural systems predicting long-term outcomes in arithmetic development varies as a function of parental socioeconomic status

Ozlem Ece Demir[1], Jérôme Prado[2], James Booth[1]

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P-2-48 The association of cortical structure and cognition with classroom-based stress

Suzanne Houston[1], Elizabeth Sowell[1]

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P-1-49 Anxious children exhibit an altered pattern of cortical maturation

Erik Newman[1], Wesley Thompson[1], Hauke Bartsch[1], Donald Hagler[1], Chi-Hua Chen[1], Timothy Brown[1], Joshua Kuperman[1], Connor McCabe[2], Yoonho Chung[3], Natacha Akshoomoff[1], BJ Casey[4], Linda Chang[5], Elizabeth Sowell[6], Anders Dale[1], Terry Jernigan[1]

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Margaret Gullick[1], James Booth[2]

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P-1-51 Familial risk factors predict neural architectural differences in typically developing children and adolescents

Melanie Maddox[1], Erik Newman[1], Natacha Akshoomoff[1], Anders Dale[1], Terry Jernigan[1], for the Pediatric Imaging, Neurocognition, and Genetics Study[1]

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Linda Wilbrecht[1], Ezequiel Galarce[1], Wan Chen Lin[1], Michael McDannald[2]

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Lauren Murphy[1], Tami Feng[1], Jocelyne Bachevalier[1]

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Michelle Sandoval[1], Julia Leclerc[2], Rebecca Gomez[1]

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P-1-55 Deprivation and threat: the impact of socioeconomic status and community violence on working memory

Margaret Sheridan[1], Kate McLaughlin[2], Matt Peverill[3], Amy Finn[4]

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P-2-56 Funding priorities for developmental translational research at NIMH

Julia Zehr[1], Shelli Avenevoli[1], Ann Wagner[1], Kathleen Anderson[1]

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P-1-57 Creativity in the children's brain

Mathieu Cassotti [1], Grégoire Borst[2], Marine Agogué [3], Grégory Simon[4], Katell Mevel[2], Sonia Dollfus[5], Arlette Pineau[4], Olivier Houdé[2], Carole Peyrin[6], Nicolas Poirel[2]

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P-2-58 Using mouse models to investigate the effects of accelerated puberty onset on development of the prefrontal cortex

David Piekarski[1], Carolyn Johnson[2], Josiah Boivin[2], Angela Vandenberg[2], Linda Wilbrecht[3]

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P-1-59 Do we need inhibition to be creative? Evidence from a dual-task paradigm

Anaëlle Camarda[1], Marine Agogué[2], Marianne Habib[3], Olivier Houdé[1], Grégoire Borst[1], Mathieu Cassotti[1]

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Scott Marek[1], Kai Hwang[1], William Foran[1], Beatriz Luna[1]

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P-1-61 How peer's choices influence risk-taking in adolescence?

Anaïs Osmont[1], Grégory Simon[2], Sylvain Moutier[3], Olivier Houdé[4], Mathieu Cassotti[4]

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P-2-62 Cortical thickness and executive function relationships in adolescents with prenatal exposure to cocaine, alcohol and tobacco

Prapti Gautam[1], Tamara Warner[2], Eric Kan[2], Elizabeth Sowell[2]

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Katrina Poppert[1], Brad Cherry[2], Ric Steele[1], Laura Martin[3], Ann Davis[3], Cary Savage[3], Amanda Bruce[2]

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P-2-64 Computerized training of inhibitory control in children with ADHD

Rosario Santillana[1], Margaret Sheridan[2], Wesley Clapp[3], Brian Miller[3]

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Marie Banich[1], Harry Smolker[2], Hannah Snyder[3], Detre Godinez[2], Ben Hankin[3]

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Christian Beaulieu[1], Kaitlyn McLachlan[1], Carmen Rasmussen[1], Irene Vavasour[2], Alex MacKay[2], James Reynolds[3], Tim Oberlander[2], Christine Loock[2]

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Bonnie Goff[1], Nim Tottenham[1]

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Emily Barkley-Levenson[1], Adriana Galván[2]

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Lauren Sherman[1], Jeffrey Rudie[1], Jennifer Pfiefer[2], Kristin McNealy[1], Carrie Masten[1], Mirella Dapretto[1]

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Larissa Del Piero[1], Darby Saxbe[1], Hannah Lyden[1], Jonas Kaplan[1], Gayla Margolin[1]

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Michael Hallquist[1], Michael Frank[2], Kai Hwang[1], Alexandre Dombrovski[1], David Paulsen[1], Tae Kim[1], Beatriz Luna[1]

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P-2-72 Maternal interleukin-6 concentrations during pregnancy and newborn functional brain connectivity

Alice Graham[1], Damien Fair[1], Marc Rudolf[1], Jerod Rasmussen[2], Pathik Wadhwa[3], Sonja Entringer[4], Claudia Buss[5]

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Catherine Hartley[1], Hugo Decker[1], Ross Otto[2], Nathaniel Daw[2], BJ Casey[1]

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Jessica Lee[1], Eric Axelson[1], Peggy Nopoulos[1]

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Eric Murphy[1], Joan Luby[1], Deanna Barch[1], Andrew Belden[1]

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Charles Geier[1], David Lydon[1], Lawrence Lo[1], Nicole Roberts[1], Bea Luna[2]

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Katharine Newman-Smith[1], Denise Werchan[2], Rebecca Gomez[1]

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Nicole Roberts[1], David Lydon[1], Charles Geier[1]

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P-1-79 Age-related differences in dynamic whole-brain connectivity patterns

J. Bruce Morton[1], R. Matthew Hutchison[2]

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P-2-80 The Importance of knowing what you don't know: exploring the neural basis of individual differences in monitoring of episodic memory

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P-1-81 Electrophysiological oscillations and slowed cognitive processing speed as biomarkers of psychosis risk in adolescence

Peter Bachman[1], Chantelle Kinzel[1], Amira Ibrahim[2], Ariel Schvarcz[1], Maria Jalbrzikowski[1], Tyrone Cannon[3], Carrie Bearden[1]

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P-2-82 SIMPHONY: Studying the impact music practice has on neurodevelopment in youth

John Iversen[1]

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P-1-83 Age-associated abnormalities in white matter microstructure in 22q11.2 deletion syndrome

Maria Jalbrzikowski[1], Julio Villalon[2], Leila Kushan[1], Carrie Bearden[1]

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P-2-84 Integrating smoking beliefs into a neurobiological model of smoking-related decision-making

David Lydon[1], Nicole Roberts[1], Charles Geier[1]

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P-1-85 Are teens jetlagged? Variations in salivary cortisol as a function of week to weekend sleep in adolescents

*Natalie Rossi-Bryan*t[1], Richard Bootzin[1], Lynn Nadel[1], Rebecca Gomez[1]

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P-2-86 Multiple learning systems in adolescence

Juliet Davidow[1], Karin Foerde[2], Adriana Galván[3], Daphna Shohamy[1]

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P-1-87 Community detection & network topology during the first year of life - a resting-state functional connectivity study

Marc Rudolph[1], Robert Cary[1], Alice Graham[2], Pathik Wadhwa[3], Sonja Entringer[4], Jerod Rasmussen[3], Claudia Buss[4], Damien Fair[1]

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P-2-88 Early brain and cognitive development in children at risk for schizophrenia

Sarah Short[1], Barbara Goldman[1], Sandra Woolson[1], Rachel Steiner[1], J. Steven Reznick[1], Robert Hamer[1], Martin Styner[1], John Gilmore[1]

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P-1-89 Brain structure and function in children with non-verbal learning disability

Ian DeVolder[1], Thomasin Mccoy[1], Vincent Magnotta[1], Peg Nopoulos[1]

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P-2-90 On the development of brain systems for non-symbolic numerosity and the relationship to formal math academic achievement

Frank Haist[1], Jarnet Wazny[1], Elizabeth Toomarian[2], Maha Adamo[1]

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P-1-91 Using task-evoked pupillometry to predict children's short-term memory recall on a trial-by-trial basis

Jesse Niebaum[1], Alison Miller Singley[1], Silvia Bunge[1]

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P-2-92 Functional segmentation of the striatum in children and adults using resting state fMRI

Aarthi Padmanabhan[1], Srikanth Ryali[1], Kaustabh Supkar[1], Vinod Menon[1]

[1]Stanford University

P-1-93 Right insula response is decreased in boys carrying the MAOA-risk allele

Nicola Grossheinrich[1], Christine Firk[1], Martin Schulte-Ruether[1], Kerstin Konrad[1]

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P-2-94 Hemispheric asymmetry in white matter microstructure in adolescents with fetal alcohol spectrum disorder (FASD)

Kristina Uban[1], Prapti Gautam[1], Megan Herting[1], John Colby[1], Eric Kan[1], Colleen Adnams[2], Phillip May[3], Katherine Narr[4], Elizabeth Sowell[1]

[1]Children's Hospital Los Angeles, [2]University of Cape Town, [3]University of North Carolina Chapel Hill, [4]University of California Los Angeles

P-1-95 Prefrontal structural correlates of cognitive control during adolescent development: a 4-year longitudinal study

Nandita Vijayakumar[1], Sarah Whittle[1], Murat Yucel[2], Meg Dennison[1], Julian Simmons[1], Nicholas Allen[1]

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P-2-96 Protracted development of brain systems underlying working memory into early adulthood: a longitudinal fMRI study

Daniel Simmonds[1], Beatriz Luna[1]

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P-1-97 The development of cortico-ventral striatal resting-state functional connectivity over adolescence

Bart Larsen[1], Bea Luna[1]

[1]University of Pittsburgh

P-2-98 Assessing eye movements to investigate reading in children with and without dyslexia

Noor Al Dahhan[1], Donald Brien[1], John Kirby[1], Douglas Munoz[1]

[1]Queen's University

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Notes

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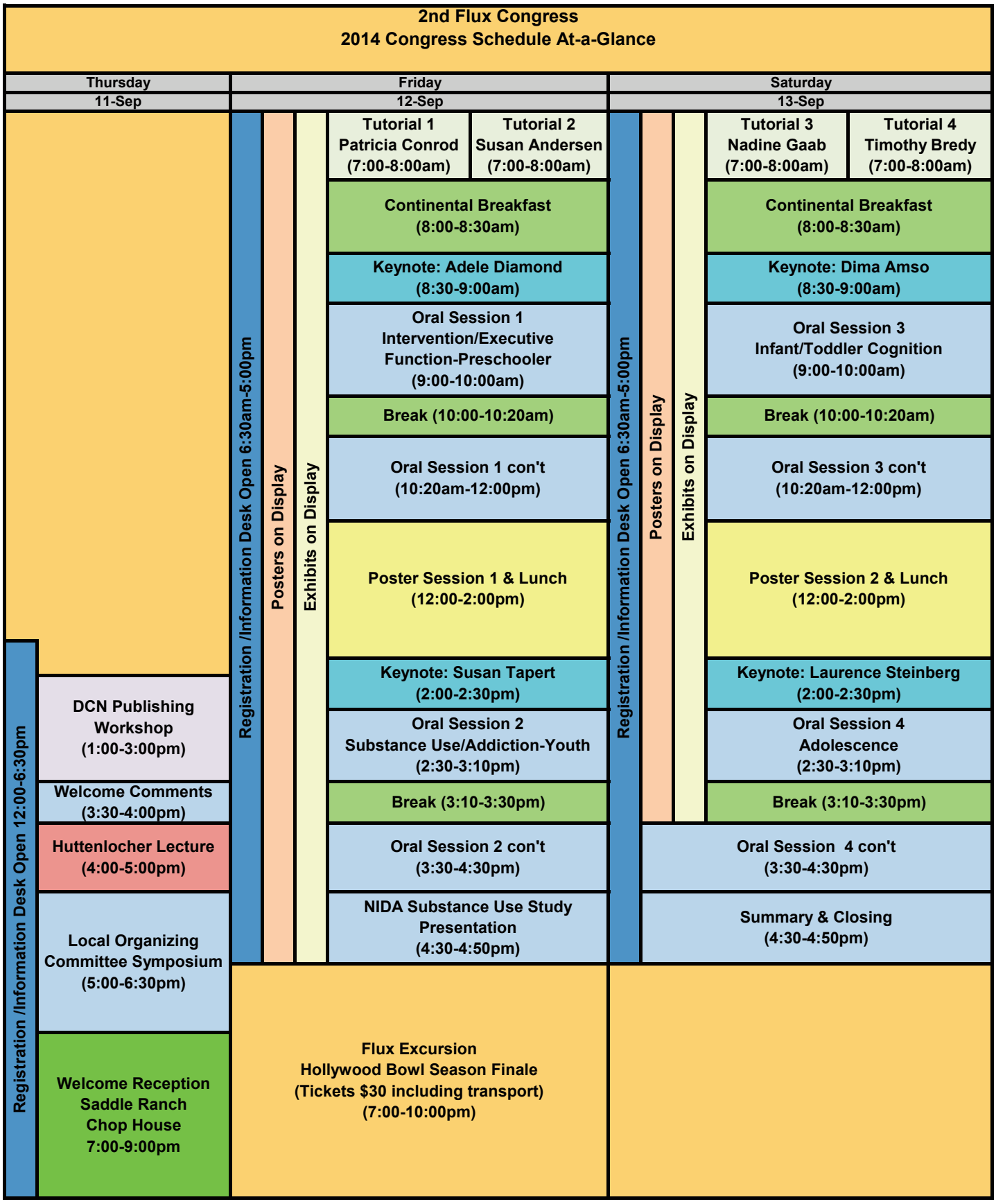

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