FIT'NG
Fetal, Infant, & Toddler Neuroimaging Group

Program

2nd Annual

Fetal, Infant, & Toddler Neuroimaging Group Conference

September 10-11, 2023
Hyatt Regency Sonoma Wine Country
Santa Rosa, CA, United States

fitng.org

@FIT_NGIn
www.fitng.org
#fitng2023

Program At-A-Glance

2023 Annual FIT'NG Conference (Santa Rosa)
Program-at-a-Glance
Program is subject to change

Timing	Sunday, Sep 10	Monday, Sep 11
8:00 AM	Registration /Information Desk Open 8:00 am - 6:30 pm	Registration /Information Desk Open 8:30 am - 6:30 pm
8:15 AM		
8:30 AM		
8:45 AM	FIT'NG Welcome& Intro	
9:00 AM	**Session 1** Characterizing the rapidly developing brain from the fetal period through infancy *Featuring Dr. Lorenzo Fabrizi*	**Session 3** Effects of Early Adversity on Neurodevelopment *Featuring Dr. Chiara Bulgarelli*
9:15 AM		
9:30 AM		
9:45 AM		
10:00 AM		
10:15 AM		
10:30 AM	*Break 10:30am - 10:45am*	*Break 10:30am - 10:45am*
10:45 AM	**Session 2** Neural Correlates of Early Cognitive and Emotional Development *Featuring Dr. Santiago Morales*	**Session 4** Sensitive Periods & Brain Plasticity *Featuring Dr. Rebecca Reh*
11:00 AM		
11:15 AM		
11:30 AM		
11:45 AM		
12:00 PM		
12:15 PM	**Lunch Break** *on your own* 12:15pm - 1:45pm	**Lunch Break** *on your own* 12:15pm - 1:45pm
12:30 PM		
12:45 PM		
1:00 PM		
1:15 PM		
1:30 PM		
1:45 PM	**Keynote** *Dr. Rebecca Saxe*	**Think Tank: Elephants in the Room for Developmental Neuroimaging** *Featuring a variety of discussants*
2:00 PM		
2:15 PM		
2:30 PM		
2:45 PM		
3:00 PM	*Break 3:00pm - 3:15pm*	*Break 3:00pm - 3:15pm*
3:15 PM	**Panel: Developmental Neuroimaging and Prevention of Psychiatric Disorders** *Featuring a variety of speakers*	**Session 5** Early Neural Predictors of Psychiatric Risk *Featuring Dr. Jessica Girault*
3:30 PM		
3:45 PM		
4:00 PM		
4:15 PM		
4:30 PM	**Sponsor Tech Time**	
4:45 PM		FIT'NG Society Updates
5:00 PM	Flash Talks	Flash Talks
5:15 PM		
5:30 PM		
5:40 PM		
5:45 PM	**Poster Session # 1**	**Poster Session #2**
6:00 PM		
6:15 PM		
6:30 PM		
6:45 PM		
7:00 PM		
7:15 PM		
7:30 PM		
7:45 PM		
8:00 PM		
8:15 PM	**Trainee Committee Social Event** Details TBA	
8:30 PM		
8:45 PM		
9:00 PM		
9:15 PM		
9:30 PM		

About FIT'NG

The Fetal, Infant, & Toddler Neuroimaging Group (FIT'NG) was founded in the Fall of 2018 by Drs. Marisa Spann (CUIMC), Dustin Scheinost (Yale), Alice Graham (OHSU), and Lilla Zöllei (MGH/HMS). It is composed of interdisciplinary scientists and clinicians who have an interest in elucidating neurodevelopmental processes, the role of the preconceptional, prenatal and postnatal influences on the developing brain, and linkages between early neural phenotypes and subsequent behaviors and health outcomes.

The network provides a forum for that supports this goal through bringing together scientists and clinicians across multiple disciplines (e.g. neuroscience, computer science, biomedical engineering, psychology, psychiatry, and public health), career stages, and geographic regions to encourage collaboration and innovation.

We have three core focus areas: methodological development, education/training advancement, and data sharing and integration. A primary objective spanning these areas is to encourage the establishment and dissemination of guidelines to support best practices for methods used to study the developing brain, including EEG, fNIRS, MRI, MEG, OCT, histology, DOT, ultrasound, and others. These methods are rapidly evolving and present unique challenges when applied to the study of fetal, infant and toddler brains.

FIT'NG Vision

Advancing understanding of early brain development represents an imperative for basic science and for improving capacity to support lifelong health and prevention neuropsychiatric disorders. As there are unique challenges associated with studying early brain development, we believe the FIT'NG network provides an optimal setting for interdisciplinary efforts to solidify the field and methods garnering a sound position in within the larger scientific and medical community.

Program Contents

1 FIT'NG Conference 2023 Program-at-a-Glance

2 About FIT'NG

3 Welcome Letter

7 FIT'NG Leadership & Committees

8 2023 FIT'NG Young Investigator Award Winners

9 General Conference Information

10 Local Restaurant Options

13 Conference Event Floor Plan

14 Conference Bingo

15 Annual Conference Schedule

19 Oral Abstracts

28 Flash Talk Abstracts

31 Poster Sessions

31 Poster Abstracts

83 Conference Exhibitors

84 Sponsor Thank You

Welcome!

To our growing FIT'NG Community,

Welcome to the 2nd Annual Conference for the The Fetal, Infant, and Toddler Neuroimaging Group (FIT'NG). We are thrilled to have you join us in the Sonoma California region for this exciting event. Like the focus of our collective scientific endeavors, we are a young, dynamic, and rapidly growing group. Having launched in 2018, we have not only weathered the ups and downs of the pandemic but have made enormous gains towards fulfilling our mission of bringing together our interdisciplinary community who are working together towards the common goal of understanding early brain development and behavior. We have hosted multiple successful workshops, trainings and events, and been overwhelmed by the enthusiasm and support for our offerings. We are particularly proud of our expansion to truly represent all developmental neuroimaging techniques, and the extent to which our efforts have been fueled by trainees and facilitated connections between people at all career levels. We see more clearly now than ever that our society has a critical role to fill amongst those who are committed to advancing understanding of early brain development. You are all integral to the success of the FIT'NG community and we cannot thank you enough!

Our inaugural meeting in Paris, France marked a significant time in FIT'NGs' development. Our society membership, which only launched in April 2022 is now up to over 235 individuals with 24 countries represented. FIT'NG is also changing the face of our field within a few short years, publishing two papers and two commentaries. These papers provide the history of the FIT MRI field (Pollatou et al., 2022), a reference that addresses common concerns mentioned by grant and manuscript reviewers (Korom et al., 2022), and a commentary related to the art of FIT scanning (Spann, Wisnowski, HBCD Phase I Scanning Young Populations Working Group, Smyser, FIT'NG, Howell, and Dean 3rd, 2023), and collaborative science opportunities in our field (FIT'NG et al., 2023). These achievements are all of ours to share and we look forward to continuing as a prolific, collaborative society.

OUR KEYNOTE

We are honored and excited to have Rebecca Saxe as our keynote speaker at this year's conference. Over the last 10 years, Rebecca has been at the forefront of advancing our understanding of how the infant brain develops the ability to understand and interact with the social world around it. Unpacking such a complex yet fundamental facet of human brain function would only have been possible through her imaginative experiments which combine innovative methodology, cutting edge imaging, behavioral testing, and basic neuroscience. We are enormously grateful to Rebecca for accepting the invitation to deliver the keynote and cannot wait to hear what we are certain will be a truly inspirational and insightful lecture.

OUR AWARDEES

We would like to highlight the Young Investigator Award Winners, listed later in this brochure. The Program Committee received a large number of amazing applications and had the difficult decision to select the final list of awardees. This year we were able to provide 22 awards. The awardees represent a microcosm of FIT'NG and include a diverse range of scholars with scientific projects spanning a wide range of techniques, methods, and biological and clinical topics. Congratulations to you all!

OUR COMMITTEES

The commitment and collaborative nature of our society shines brightly from our committee members. Many of you volunteered your time from the beginning, as the first FIT'NG workshop mobilized our community. We wanted more scientific content for us and by us. Your efforts over the past few years continue to make this idea a reality.

We would like to express our deep gratitude to our wonderful Program Co-Chairs, Chad Sylvester and Tomoki Arichi. Drs. Sylvester and Arichi worked closely with Dr. Alice Graham and Michelle Smith (Podium) to craft a program that spans a wide range of methodologies, age ranges, and scope. The committee has put together content that covers the amazing work

being done to answer the current key questions in our field using cutting edge methods across the entire spectrum of neuroimaging modalities and behavioral assessments. We are confident that attendees will thoroughly enjoy the invited expert speakers, poster sessions, trainee meetings, and breakout sessions. We are also indebted to the Scientific Program Committee, whose members' names are listed later in this brochure. The Program Committee worked tirelessly to review abstracts, select abstracts for poster and oral presentations, and make initial decisions on FIT'NG awards.

Our Communications Committee, led by Drs. Kelly Vaughn and Claudia Lugo-Candelas (Co-chairs), has continued to expand our membership and reach this year. They engaged with members each week on Twitter @FIT_NGIn to promote key FIT'NG events. Highlights include #FITNGTogether trainee events, the new #FITNGfNIRS virtual workshop series, the developmental #EEG workshop series, and, of course, #fitng2023. Thanks to all of your engagement and support, our Twitter account has gained 500 new followers since our 2022 conference. Please continue to engage with us on Twitter for up-to-date information about the conference and the society: @FIT_NGIn #fitng2023. In addition, we also have a mailing list that you should sign up for https://groups.io/g/fitng in order to be able to engage in further communication with our community.

We are so proud of our exceptional Trainee Committee led by co-Chairs Aiden Ford and Halie Olson with active members Cat Camacho, Marta Korom, Abigail Fiske, Parvaneh Adibpour, Ola Dopierala, Genesis Flores, and María José Castro-Gómez. This year they expanded the success of FIT'NG Together, a publicly available and free programming series for pediatric neuroimaging trainees across the world, by launching events focused on prevalent methodological and conceptual challenges in FIT imaging ("Elephants in the Room", continued in the Think Tank event at this conference!), and introducing the various modalities at the core of FIT neuroimaging to new audiences ("Basics Of"). In total, they hosted 11 FIT'NG Together events, also including journal clubs and software tutorials ("Diffusion Fall"), that reached nearly 700 participants. Trainee Committee members also contributed to society publications, including an upcoming book chapter. Building on efforts to foster mentorship networks and promote trainee-focused conference programming, this year's conference will feature three events organized by the Trainee Committee, in addition to initiatives designed to advance the professional development of FIT'NG trainees. These efforts have fostered a broader sense of community and connections across universities contributing to our goals of bringing together scientists and clinicians from across FIT disciplines and connecting trainees to resources and potential mentors. FIT'NG thanks the many experts who donated their time to mentor and teach the trainees in our field as part of FIT'NG Together: Martin Styner, Jason Yeatman, Reinhard Grassl, Chiara Maffei, Salomé Kurth, Rebecca Spencer, Kimberly Whitehead, Karen Spruyt, Topun Austin, Louisa Gossé, Fabrice Wallois, Tomoki Arichi, Lorenzo Fabrizi, Nadège Roche-Labarbe, Julie Uchitel, Tristan Yates, Scott Marek, Judit Gervain, Sean Deoni, Jessica Gemignani, Alice Graham, M.J. Heise, Brendan Ostlund, Morgan Forgarty. Their efforts have been invaluable for building our community and working towards our goal of creating shared resources and best practices for FIT'NG research.

The Vision & Visibility (V&V) Committee was established in 2022 as a presidential initiative to ensure diverse perspectives and imaging modalities were adequately represented within the society. The V&V Committee continues to identify community needs and address them in ways that enhance FIT neuroscience and training. This committee is chaired by Courtney Filippi & Jerod Rasmussen and includes exceptional EEG and fNIRS faculty from across the globe including Lindsay Bowman, Sam Wass, Sobana Wijeakumar, Sam McCann, and Laura Pirazzoli. Brittany Howell serves as the committee's board representative. This year, the V&V committee hosted EEG and ffNIRS workshops attended by hundreds of researchers across Asia, Europe, the Middle East, and North and South America. Attendees represented a wide range of career stages from students and research assistants to full-time faculty. These workshops and other engagement initiatives illustrate FIT'NG's deep commitment to supporting and training researchers studying the developing brain. In the coming year we anticipate additional workshops and other opportunities to connect with the FIT'NG community. We are always looking to add to our already multifaceted group and encourage all to reach out if you would like to join us and/or have ideas for initiatives that further support diversity in the society!

OUR SPONSORS AND PARTNERS

FIT'NG continues to grow in a supportive incubator! FIT'NG garnered sponsor support from our first pre-conference workshop at the Flux: Developmental Cognitive Neuroscience meeting in 2019 and the number of sponsors is growing strong. To our universities and their affiliates: Yale University School of Medicine (Magnetic Resonance Research Center and BioImage Suite), Virginia Tech (Fralin Biomedical Research Institute at VTC), Mass General Brigham (Radiology Department), A.A. Martinos Center for Biomedical Imaging and Columbia University (Department of Psychiatry), and Nathaniel Wharton Fund, your belief in us and provision of support necessary to move our vision forward is invaluable! To our new and ongoing sponsors, thank you for ensuring that our meeting this year was possible. Bringing together researchers of the young brain truly does ensure a better future for humankind. They are listed in the program book and on our website, but we also want to acknowledge them here: NIRx, BrainVision, MindWare Technologies, TracInnovations, Turing. We will continue to grow and are so glad to have you with us from the beginning!

In order for this society to flourish we knew ongoing and continued support of our scientific mission would be essential. The National Institutes of Health is providing multi-year support through a NIH Support for Conferences and Scientific Meetings grant (R13 HD108938) titled, "Fetal, Infant, Toddler Neuroimaging Group (FIT'NG): Uniting Clinical, Computational, Engineering, and Neuroscience to advance discoveries for the young child". We are primarily supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) and co-supported by the National Institute of Drug Abuse (NIDA). The grant allows us to provide a forum for investigators to disseminate novel methods to support better understanding of neural mechanisms disrupted due to prenatal and early childhood traumas, present the most cutting-edge science that will shift and shape our understanding of the developing brain, sensitive periods of prevention and intervention, and novel mechanism integral for healthy brain development. It also primarily supports awards to support young and underrepresented minority investigators to participate in our meeting. A special thank you to Dr. James Griffin, our program officer!

To Bea Luna, Founder and Founding President of the Flux: Developmental Cognitive Neuroscience society and one of the first members of FIT'NG; and the Flux society we are so grateful for our collaboration. Our partnership has been invaluable and we know that our continued collaboration will further ensure that advances in our knowledge of the developing brain are supported.

We are so grateful to our sponsor and partner Podium Conference Specialists. From the beginning, Podium believed in our mission and wanted to ensure we had the skills to grow and develop into a viable and sustainable society. Their words of encouragement and advanced knowledge of society development and all of its phases has been invaluable to us. We thank Marischal De Armond, the President and Founder, for continuing to provide us with the resources to grow. To Michelle Smith, we thank you for seamlessly taking on this role as our conference manager with only a few months before the meeting. We knew we were in good hands! None of us could have imagined the knowledge necessary to move our society forward - this is a science in itself

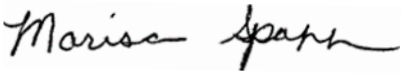
OUR MEMBERS

No person can build a society and a conference home without a strong foundation. It is YOU, our members and partners in forming this society that turned this idea into a reality. Year after year you have demonstrated FIT'NG's importance through your engagement and contributions. Your voices will continue to fuel the intellectual, social-community, and fiscal success of our society. You are sharing more of your work focused on the early developing brain! From 45 poster submissions in 2022 to over 140 poster submissions for this meeting. There is a role and opportunity for everyone in this community, all you have to do is reach out! Join a committee, propose a new white paper or commentary, and be an active member of this society so we can ensure our voices are heard in the sea of neuroimaging technologies that were not originally designed for, but that we are ensuring are reimagined for the small brain. Still in our infancy, we cannot wait to see where we take FIT'NG together.

Please tweet throughout the meeting at @FIT_NGIn using #fitng2023

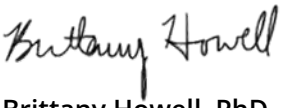
Sincerely,

Executive Board and Founders



Marisa Spann, PhD, MPH
President and Founding Member
Herbert Irving Associate Professor
Vagelos College of Physicians and Surgeons, Columbia University

Alice Graham, PhD
Incoming President and Founding Member
Assistant Professor
Oregon Health & Sciences University



Brittany Howell, PhD
Secretary
Assistant Professor
Virginia Technical Institute

Dustin Scheinost, PhD
Treasurer and Founding Member
Associate Professor
Yale University School of Medicine

Lilla Zollei, PhD
Bylaws Officer and Founding Member
Associate Professor
Massachusetts General Hospital/Harvard University

Program Committee

Chad Sylvester, MD, PhD
Program Committee Co-Chair
Associate Professor
Washington University School of Medicine

Tomoki Arichi MBChB FRCPCH FHEA PhD
Program Committee Co-Chair
Reader in Perinatal Imaging
King's College London

Communications Committee

Kelly Vaughn, PhD
Communications Committee Co-Chair
Assistant Professor
University of Texas Health Science Center at Houston

Claudia Lugo-Candelas, PhD
Communications Committee Co-Chair
Assistant Professor
Columbia University Irving Medical Center

Trainee Committee

Aiden Ford
Trainee Committee Co-Chair
PhD Candidate
Emory University, Neuroscience Program

FIT'NG Leadership & Committees

FIT'NG BOARD

Marisa N. Spann	President & Founding member, Columbia University
Alice Graham	Incoming President & Founding member, Oregon Health & Science University
Brittany Howell	Secretary, Virginia Tech
Dustin Scheinost	Treasurer & Founding member, Yale University
Lilla Zöllei	Bylaws Officer & Founding member, Massachusetts General Hospital / Harvard Medical School

VISION & VISIBILITY COMMITTEE

Courtney Filippi	(Chair), University of Maryland
Jerod M. Rasmussen	(Co-Chair), University Of California, Irvine, School Of Medicine
Lindsay Bowman	University Of California Davis
Sam Wass	University of East London
Sobana Wijeakumar	University of Nottingham
Sam McCann	King's College, London

COMMUNICATIONS COMMITTEE

Kelly Vaughn	(Chair), Children's Learning Institute, University of Texas Health Science Center at Houston
Claudia Lugo-Candelas	(Co-chair), Columbia University Irving Medical Center/New York State Psychiatric Institute
Roxane Licandro	Massachusetts General Hospital, Harvard Medical School And Medical University Of Vienna
Aiden Ford	Emory University & Marcus Autism Center
Elmo Pulli	Finnbrain Birth Cohort Study, University of Turku
Jetro Tuulari	Finnbrain Birth Cohort Study, University of Turku
Isabella Mariani Wigley	Finnbrain Birth Cohort Study, University of Turku

TRAINEE COMMITTEE

Aiden Ford	(Co-Chair), Emory University
Halie Olson	(Co-Chair), Massachusetts Institute of Technology
Parvanah Adibpour	INSERM
M. Catalina Camacho	Washington University in St. Louis
Ola Dopierala	University of British Columbia
Abigail Fiske	University of Oxford
Genesis Flores	University of Southern California
Maria José C Gómez	McGill University
Marta Korom	University of Delaware

ASSOCIATION SECRETARIAT & CONFERENCE MANAGEMENT

(fitng@podiumconferences.com)

Podium Conference Specialists

Michelle Smith

Marischal De Armond

Tori Lunden

2023 FIT'NG Young Investigator Award Winners

Congratulations to the FIT'NG Young Investigator Award winners! Look for them with the award winner ribbon on their name badge and congratulate them on their award.

Armen Bagdasarov	Duke University
M. Catalina Camacho	Washington University in St. Louis
Melisa Carrasco	University of Wisconsin
Áine Dineen	Trinity College Dublin
Kuaikuai Duan	Emory University
Nikita Ghodke	Ashoka University
Lanxin Ji	NYU Langone Health
Jessica Leov	University of Waikato
Kelsie Lopez	Northeastern University
Nora Moog	Charité - Universitätsmedizin Berlin, Berlin, Germany
Nicholas Murgueitio	University of North Carolina at Chapel Hill
Benazir Neree	American University
Ogoamaka Nwana	University of Texas Health Science Center
Sarvenaz Oloomi	University of British Columbia
Shinwon Park	IBS Center for Neuroscience Imaging Research, Sungkyunkwan University
Raimundo Rodriguez	Yale School of Medicine
Rebecca Schwarzlose	Washington University in St. Louis
Lichao Sun	University of Houston
Huili Sun	Yale University
Madeleine Wyburd	University of Oxford
Ran Xiao	Emory University

General Conference Information

Venue
Hyatt Regency Sonoma Wine Country Hotel
170 Railroad Street
Santa Rosa, CA 95401
United States of America

All conference sessions will take place at this location.

Registration
Conference registration fees include access to all sessions including, speaker presentations, coffee breaks, and poster sessions.

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

Registration & Information Desk Hours
The FIT'NG Registration and Information Desk, located in the Alexander Valley on the main conference floor, will be open during the following dates and times:

- Sunday, September 10, 2023 from 8:00am–6:45pm
- Monday, September 11, 2023 from 8:30am–6:45pm

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

Staff
FIT'NG staff from Podium Conference Specialists can be identified by orange 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.

Internet Services
Wireless Internet is available to delegates for no charge. Simply choose the **Hyatt Meeting** WiFi network, select Complimentary and agree to the terms and conditions, then select Connect Me. The password is **FITNG2023**. Kindly note, the WiFi strength is ideal for checking emails and websites but is not strong enough for streaming videos or heavy social media use.

If you are active on social media, make sure to hashtag #FITNG2023 @FIT_NGIn when referring to the meeting. We ask all FIT'NG delegates to respect no live tweeting of presentations without prior approval from the speakers/authors. We encourage social tweets about the conference and look forward to growing our online community.

If you require assistance, please visit the registration desk and we will endeavour to assist you.

Poster Information

- **Annual Meeting**

There are two Poster Sessions during the conference and posters have been allocated to either one of the sessions based on poster themes. Poster presenters must set-up and remove their posters during the following times.

- **Poster Session 1** – Sunday, September 10

Poster Set-up: Sunday, September 10 from 8:30am – 10:30am

Poster Hours: Sunday, September 10 from 5:15pm – 6:45pm

Removal of all posters by 6:45pm on September 10

- **Poster Session 2** – Monday, September 11

Poster Set-up: Monday, September 11 from 8:30am – 10:30am

Poster Hours: Monday, September 11 from 5:15pm – 6:45pm

Removal of all posters immediately following the poster session.

Any posters that are not taken down by the removal deadline will be held at the registration desk until the end of the Meeting. Any posters that remain unclaimed by the end of the conference will be disposed of.

Information on Poster Authors (Lead), Poster Numbers and Poster Titles begins on page 29.

Railroad Square Restaurants & Bars

Americana Classic Farm To Table
205 5th Street, Suite A, Santa Rosa
707-755-1548

Chevys Fresh Mex
24 4th Street, Santa Rosa
707-571-1085

Grossman's Noshery & Bar
308 1/2 Wilson Street, Santa Rosa
707-595-7707

Jackson's Bar & Oven
135 4th Street, Santa Rosa
707-545-6900

Khoom Lanna Thai Food
107 4th Street, Santa Rosa
707-545-8424

19TEN Bar & Provisions
115 4th Street, Santa Rosa
707-791-7494

La Gare French Restaurant
208 Wilson Street, Santa Rosa
707-528-4355

LoCoco's Cucina Rustica
117 4th Street, Santa Rosa
1707-523-2227

Paradise Sushi & Grill
119 4th Street, Santa Rosa
707-525-1690

Breakfast & Lunch

A'Roma Roasters - Coffee, Tea & More
95 5th Street, Santa Rosa
707-576-7765

The Branch Line
10 4th Street, Santa Rosa
707-595-1941
*Plant-Based Eatery & Mercantile

Omelette Express
112 4th Street, Santa Rosa
707-525-1690

Nimble & Finns
123 4th Street, Santa Rosa
707-666-9590

Wine Tasting Room

4th Street Cellars
127 4th Street, Santa Rosa
707-806-2779

Downtown Restaurants & Bars

Ausiello's 5th Street Bar & Grill
609 5th Street
(707) 579-9408

Beer Baron Bar & Kitchen
614 4th Street
(707) 757-9294

Belly Left Coast Kitchen & Tap Room
523 4th Street
(707) 526-5787

Carmen's Bistro & Bar
619 4th Street
(707) 843-5186

Eddie's Kitchen
409 Mendocino Avenue
(707) 293-9906

El Coqui Puerto Rican
400 Mendocino Avenue
(707) 542-8868

El Fogon Taco Shop
623 4th Street
(707) 575-0574

Fu Zhou Super Buffet Chinese
450 Mendocino Avenue
(707) 523-7000

Golden Bun Vietnamese Sandwiches
490 Mendocino Avenue
(707) 890-5678

Haku Sushi
518 7th Street
(707) 541-6359

Han Bul Korean BBQ 522 7th Street
(510) 206-3947

Jojo Sushi Restaurant & Sushi Bar
645 4th Street
(707) 569-8588

Kaial Restaurant
535 Ross Street
(707) 595-3311

Kancha Champagne Bar & Tapas
643 4th Street
(707) 623-9793

La Doña Mexican Cuisine & Bar
458 B Street
(707) 978-2869

La Rosa Tequileria & Grille
500 4th Street
(707) 523-3663

Mi Pueblo Santa Rosa
703 4th Street
(707) 843-7804

Aroma de Café
620 5th Street
(707) 293-9246

Miso Good Ramen
507 4th Street
(707) 545-7545

Perch + Plow
96 Old Courthouse Square
(707) 541-6896

Sushi Rosa
515 4th Street
(707) 843-5132

Thai House 525
4th Street
(707) 526-3939

The New Sizzling Tandoor
409 Mendocino Avenue
(707) 579-5999

Ting Hau Restaurant
717 4th Street
(707) 545-5204

Tipsy Taco & Cantina
505 Mendocino Avenue
(707) 890-5581

Warike Restobar
527 4th Street
(707) 536-9201

Wilibee's Wine & Spirits
700 3rd Street
(707) 978-3779

Breakfast & Lunch

4th Street Market &
300 Mendocino Avenue
(707) 573-9832

Grateful Bagel
631 4th Street
(707) 535-0570

Mac's Delicatessen
630 4th Street
(707) 545-3785

The Naked Pig
640 5th Street

Wine Tasting

Trecini Winery Tasting Room
684 7th Street
(707) 525-9400

Breweries & Beer

3 Disciples Brewing
501 Mendocino Avenue
(707) 978-2459

Civilization Brewing
104 Mendocino Avenue
(707) 523-3060

Flagship Taproom
446 B Street
(707) 541-6716

Russian River Brewing Co.
725 4th Street
(707) 545-2337

Shady Oak Barrel House
420 1st Street
(707)575-7687

Coffee, Tea & Treats

Cafe Des Croissants
85 Santa Rosa Avenue
(707) 570-2078

Crooks Coffee
404 Mendocino Avenue
(707) 791-3365

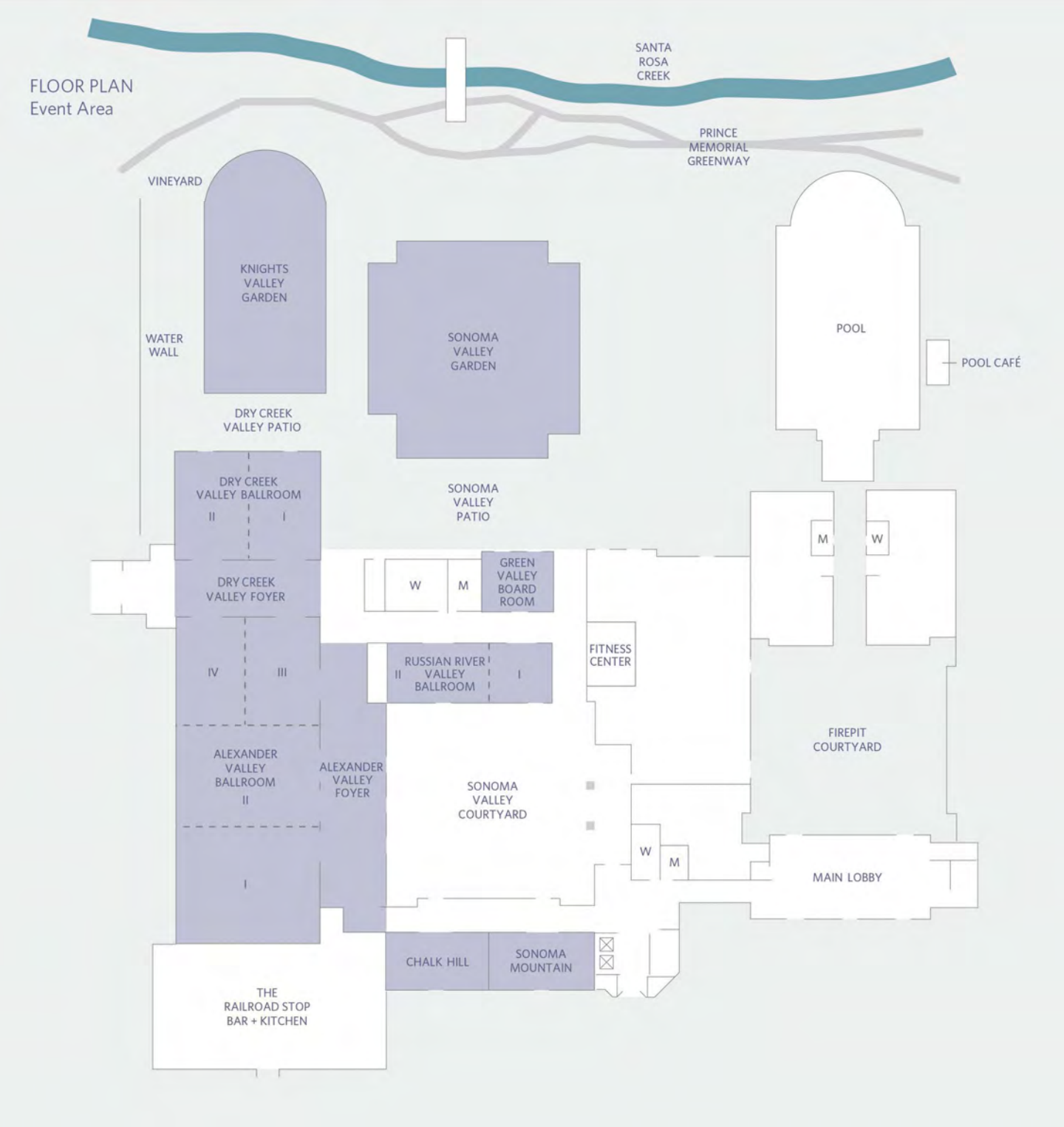
Land + Water Coffee
621 4th Street
(707) 527-3731

Noble Folk Ice Cream & Pie Bar
539 4th Street
(707) 978-3392

Sift Dessert Bar
404 Mendocino Avenue, Suite A
(707) 703-4228

Teaside Bubble Tea
519 4th Street
(707) 541-6297

Hyatt Regency Sonoma Wine Country Floor Plan



FIT'NG 2023

September 10-11, 2023
Santa Rosa, CA, USA

FIT'NG
Fetal, Infant, & Toddler Neuroimaging Group

CONFERENCE BINGO

Research and connect with attendees of interest	Take session notes and post your key insights	Ask a question during a session	Exchange contacts with an attendee from another institution	Share your top 3 favorite posters in a post
Join a Think Tank (Elephants in the Room)	Attend the Sponsor Tech Time	Attend a networking session or social event	Pick up your FIT'NG swag bag	Join a Trainee Event and participate
Attend a session outside your research field	Take a picture of a poster that inspired you		Post your conference plan: talks and posters you'll explore	Take a picture with a presenter
Introduce yourself to a new colleague	Post about a talk you attended	Engage with 5 poster presenters in conversation	Tag an exhibitor in a post	Plan a coffee chat with a fellow participant
Compliment a speaker on their talk	Learn about FITNG history at the Welcome Session	Come up with a new FIT'NG pun and tag in a post	Take part in a stimulating panel discussion	Connect over lunch with a fellow conference-goer

FIT'NG 2023: Annual Conference Detailed Daily Schedule

All sessions will be held in the Alexander Valley Ballroom, Hyatt Regency Sonoma Wine Country.

SUNDAY, SEPTEMBER 10, 2023

08:45 – 09:00 **FIT'NG Welcome & Introduction**

09:00 – 10:30 **Session #1: Characterizing the rapidly developing brain from the fetal period through infancy**

Chair: Aiden Ford, *Emory University*

Development of touch and pain processing in human preterm infants
Lorenzo Fabrizi, *University College London*

Segmenting through the shadows: extracting and characterising the fetal cortical plate in the second trimester from in-utero 3D ultrasound scans
Madeleine Wyburd, *University of Oxford*

A shifting role of thalamocortical connectivity in the emergence of large-scale functional brain organization across early lifespan development
Shinwon Park, *IBS Center for Neuroscience Imaging Research, Sungkyunkwan University*

Dynamics of infant white matter maturation from birth to 6 months
Sarah Schultz, *Emory University*

10:30 – 10:45 **Break**

10:45 – 12:15 **Session #2 - Neural correlates of early cognitive and emotional development**

Chair: Courtney Filippi, *University of Maryland*

EEG correlates of cognitive control development
Santiago Morales, *University of Southern California*

Studying the attentive infant brain across multiple time-scales
Sam Wass, *University of East London*

An innovative approach to measure infant object looking during play: combining head-mounted eye-tracking and electroencephalography (EEG)
Lichao Sun, *University of Houston*

Evaluating awake fMRI in one hundred 2 month-olds
Áine Dineen, *Trinity College Dublin*

12:15 – 13:45 **Lunch, on your own**

13:45 – 15:00 **Keynote – Are infant brains just little adult brains?**

Rebecca Saxe
Massachusetts Institute of Technology

Chair: Lilla Zollei, *Massachusetts General Hospital/Harvard Medical School*

In this talk, I will start with a surprising discovery from human infant neuroimaging: the functions of cortical regions are quite similar, between infants and adults. Indeed, as the methods in our field improve, some initial differences have disappeared, turning into similarities. I'll share some examples from my own lab's studies using awake fMRI with infants, e.g. to measure cortical responses to faces. But, these mounting similarities can't be the whole story: brains are machines for learning, and infants have a lot to learn to acquire adult minds. So, I will turn to speculation about why it is easier to confidently measure similarities than differences, and where we might look next for signatures of the difference between infants' and adults' brain functions.

15:00 – 15:15 **Break**

15:15 – 16:30 **Panel: Developmental neuroimaging and prevention of psychiatric disorders**

Chairs: Brittany Howell, *Virginia Tech* and Ola Dopierala, *University of British Columbia*

Hear from an esteemed panel of presenters:

- John Constantino, *Washington University School of Medicine*
- Joe Culver, *Washington University in St. Louis*
- Mary Dozier, *University of Delaware*
- Katherine MacDuffie, *University of Washington*
- Koraly Perez-Edgar, *The Pennsylvania State University*
- Rebecca Saxe, *Massachusetts Institute of Technology*

16:30 – 17:00 **Sponsor Tech Time**

Chair: Lilla Zöllei, *Massachusetts General Hospital/Harvard Medical School*

Learn about what's new from some of our sponsors! Thank you to all our sponsors for supporting FIT'NG.

17:00 – 17:15 **Flash Talks #1**

Chair: M. Catalina Camacho, *Washington University in St. Louis*

Optimizing data retention in awake infant fMRI: Lessons learned from over 300 scans
Lillian Behm, *Yale University*

Establishing high-density diffuse optical tomography for bedside neuromonitoring of cortical hemodynamics in pediatric patients on ECMO
Sophia Mcmorrow, *Washington University School of Medicine in St. Louis*

Proof-of-concept: Whole-head high-density diffuse optical tomography in infants
Liam Collins-Jones, *University College London*

17:15 – 18:45 **Poster Session #1**

20:00 – Onwards **FIT'NG Trainee Committee Social Event**

The Trainee Committee is very excited to meet you all at the 2nd annual FIT'NG conference. After a day of engaging conference talks, we invite all trainees and postdocs to bond at the Sonoma Valley Courtyard of the Hyatt Regency at 8pm on Sunday, September 10. Join us for a relaxing evening and camaraderie as we unwind by the inviting fire pit, toast marshmallows, and create delicious s'mores together. It's the perfect way to end the day and make lasting connections with fellow FIT'NG conference attendees!

MONDAY, SEPTEMBER 11, 2023

09:00 – 10:30 **Session #3 - Effects of early adversity on neurodevelopment**

Chair: Tomoki Arichi, *King's College London*

Understanding the impact of early adversity on neurodevelopment by using fNIRS in low-resource settings: The Brain Imaging for Global Health (BRIGHT) project in The Gambia
Chiara Bulgarelli, *Birkbeck, University of London*

The combined role of maternal childhood maltreatment and maternal depression during pregnancy for newborn global white matter microstructure
Nora Moog, *Charité – Universitätsmedizin Berlin, Berlin, Germany*

Impact of socioeconomic status on longitudinal changes in visual working memory function in children in rural India.
Sobana Wijeakumar, *University of Nottingham*

Auditory statistical learning in two-year-old Bangladeshi children: An fNIRS study
Eileen Sullivan, *Harvard University*

10:30 – 10:45 **Break**

10:45 – 12:15 **Session #4 - Sensitive periods & brain plasticity**

Chair: Kelly Vaughn, *Children's Learning Institute, University of Texas Health Science Center at Houston*

All in the timing: The alignment between brain maturation and expected experience
Rebecca Reh, *Cohen Veterans Bioscience*

Auditory sensitive period timing and language development in infants with prior GABA agonist drug exposure
Kelsie Lopez, *Northeastern University*

Sensorimotor EEG mu rhythm activity during action observation and execution in 6- to 9-week-olds: An individual differences analysis
Kelsey Davinson, *University of Connecticut*

Segmenting Hypothalamic Subunits in Human Newborn MRI
Jerod Rasmussen, *University of California, Irvine*

12:15 – 13:45 **Lunch, on your own**

13:45 – 15:00 **Think tank: Elephants in the room for developmental neuroimaging**

Chair: Halie Olson, *Massachusetts Institute of Technology*

Join us for small group discussions led by faculty in the field! Delegates have been pre-assigned to a topic group based on previously submitted rankings of interest.

- **Group 1: Measuring and interpreting individual differences in neurodevelopmental trajectories**
  Trainee Moderator: Cat Camacho
  Faculty Moderator: Kathrine Skak Madsen
- **Group 2: Sleep & sleep state during resting-state data collection**
  Trainee Moderator: Aiden Ford
  Faculty Moderator: Tom Arichi
- **Group 3: Causal mechanisms in brain-behavior relationships**
  Trainee Moderator: María José Castro Gómez
  Faculty Moderator: Lindsay Bowman

- **Group 4: Measuring and interpreting development as a construct in neuroimaging analyses**
  Trainee Moderator: Halie Olson
  Faculty Moderator: Laurie Bayet
- **Group 5: Leveraging windows of neuroplasticity and sensitive periods to optimize early interventions**
  Trainee Moderator: Marta Korom
  Faculty Moderator: Chad Sylvester

15:00 – 15:15 **Break**

15:15 – 16:45 **Session #5 - Early neural predicators of psychiatric risk**
Chair: Dustin Scheinost, *Yale University*

Atypical visual brain development during infancy in autism: Links to genetic liability and behavior
Jessica Girault, *University of North Carolina*

Maternal postnatal depression is associated with older brain age in infants and worse toddler cognitive performance
Huili Sun, *Yale University*

Characterizing task-dependent and task-independent brain states in sleeping neonates at risk for anxiety
M. Catalina Camacho, *Washington University in St. Louis*

Infant Late Positive Potential is Associated with maternal Emotion Characteristics
Rebecca Brooker, *Texas A&M University*

16:45 – 17:00 **FIT'NG Society Updates**
Learn more about the society and the future.

17:00 – 17:15 **Flash Talks #2**
Chair: M. Catalina Camacho, *Washington University in St. Louis*

Predicting fMEG manifestations of fetal spontaneous neural activity using premature EEG
Alban Gallard, *Université de Picardie Jules Verne*

Development of infant brain iron couples with resting-state neural activity during the first 150 days of life
Lanxin Ji, *NYU Langone Health*

EEGWISE: an EEG Workflow Improvement and Signal Enhancement toolbox for infant data
Ran Xiao, *Emory University*

17:15 – 18:45 **Poster Session #2**

FIT'NG Conference Oral Abstracts

SESSION #1: CHARACTERIZING THE RAPIDLY DEVELOPING BRAIN FROM THE FETAL PERIOD THROUGH INFANCY

Chair: Aiden Ford, Emory University

INVITED SPEAKER

Development of touch and pain processing in human preterm infants

Lorenzo Fabrizi, *University College London*

During the third trimester of gestation, the human brain undergoes a series of rapid maturational changes. Thalamocortical projections synapse onto layer IV neurons, and inter-hemispheric callosal and intra-hemispheric cortico-cortical associative connections begin to develop. Following premature birth (before 37 weeks of gestation), neonates are exposed to handling and, in some cases, necessary invasive clinical interventions, while these processes are still ongoing. This means that the way the preterm brain handles, and is affected by, these early sensory inputs varies considerably depending on its maturational stage and is completely different from that of a full-term infant. In this talk, I will present what we have learned about how the preterm brain processes touch and pain using electroencephalography and near-infrared spectroscopy and about the development of the cortical infrastructures that allow for this maturation.

CONTRIBUTED TALKS

O1.1 Segmenting through the shadows: extracting and characterising the fetal cortical plate in the second trimester from in-utero 3D ultrasound scans

Madeleine Wyburd[1], Ana Namburete[1], Mark Jenkinson[1]

[1]*University of Oxford*

Normal development of the human brain can be characterised by precisely timed growth and folding of the cortical plate (CP), with deviations often associated with poor cognitive outcomes. Therefore, monitoring the development of the fetal CP has the potential to serve as an early biomarker for neurodevelopmental impairment. To date, three-dimensional (3D) characterisation of the complex CP has only been performed from MRI scans, despite ultrasound being the modality of choice in routine prenatal care. In this study, we propose an automated deep learning-based pipeline to extract and characterise the CP from 3D ultrasound scans (fig. 1). We validate our pipeline by comparing the derived CP properties to previous MRI studies. To measure the CP properties, it must first be delineated. However, in ultrasound volumes, large shadows often obstruct regions of the CP. These can lead to holes within the extracted surface shown in fig. 1, thereby making further analysis extremely difficult. To overcome this, we used a topology-preserving segmentation network: TEDS-Net, which deforms a prior shape that closely resembles the CP (P) to produce a segmentation, anatomically guiding the segmentation in the regions of shadows. To train and evaluate the network, we used n = 643 transabdominal ultrasound volumes between 18 and 26 gestational weeks (GW) collected as part of the INTERGROWTH-21st study (IG). The trained network was then applied to n = 2,188 unseen IG volumes, and both global and local properties were measured from the topologically-correct CP surfaces. As the chosen P closely resembles the CP at 22 GW, it was possible to parcellate the volume into 5 lobes (fig 3) by aligning it to the MRI-derived Computational Radiology Labâ€™s (CRL) fetal brain parcellation map. Using the learnt fields in TEDS-Net, the prior parcellation map was non-rigidly registered to each CP segmentation, enabling regional measures of local features. Moreover, as these fields are invertible, the CP properties can be propagated back onto P, facilitating a direct comparison between individuals and gestational weeks.
Our network achieved 100% topologically accurate segmentation with a Dice overlap of 80% compared to the manual labels, shown in fig. 2, with the performance found not to correlate significantly with gestational age (p=0.57). Volume, surface area, and 3D Sylvian Fissure (SF) depth were measured and found to have a high overlap with previous MRI studies and a 2D ultrasound study (fig 3) spanning 5-55 cm3, 40-150 cm2, and 5-12 mm, respectively. The average cortical depth, thickness, and volume for each lobe are shown in fig. 3, with the insula found to deepen and thicken at the fastest rate, which is expected for this gestational period due to SF opercularization. The volumes of the frontal, parietal and temporal lobes are found to have the greatest increase, closely aligning with previous MRI growth curves. Figure 4 shows the local properties averaged across the subsets and projected onto the prior geometry, allowing direct comparison between GWs. In summary, we have designed the first automated pipeline to extract and analyse the CP in 3D from challenging ultrasound scans. The chosen approach allows for efficient volumetric parcellation and group-wise comparisons and was found to have a high overlap with previous MRI results. This pipeline has the potential to detect cortical malformations in routine pregnancy care.

O1.2 A shifting role of thalamocortical connectivity in the emergence of large-scale functional brain organization across early lifespan development

Shinwon Park[1], Koen Haak[2], Han Byul Cho[3], Kyoungseob Byeon[3], Bo-Yong Park[4], Phoebe Thomson[1], Haitao Chen[5], Wei Gao[6], Ting Xu[1], Sofie Valk[7], Michael Milham[1], Boris Bernhardt[8], Adriana Di Martino[1], Seok Jun Hong[3]

[1]*Child Mind Institute,* [2]*Radboud University Medical Center,* [3]*Sungkyunkwan University,* [4]*Inha University,* [5]*University of California, Los Angeles,* [6]*Cedars-Sinai Medical Center,* [7]*Max Planck Institute for Human Cognitive and Brain Science,* [8]*McGill University*

How does the brain acquire specific functions across different areas and organize major processing architectures such as cortical hierarchy, across development? While the interplay between intrinsic (i.e., genetic patterning) and extrinsic (i.e., sensory experiences relayed via thalamus) mechanisms has been considered critical for such developmental processes in embryonic period, our understanding of the postnatal brain development is still limited. Given its role in sensory processing, thalamocortical circuitry may play a critical role in shaping functional organization after birth. Accordingly, we examined the developmental effects of thalamocortical connectivity on large-scale functional brain organization across infancy, childhood, adolescence, and young adulthood. We employed

connectopic mapping to comprehensively chart the gradually changing functional relationship between the thalamus and neocortex in two developmental cohorts: 1) developing Human Connectome Project (HCP) consisting of 195 infants (39.7 Â± 3.0 weeks), and 2) HCP Development comprising 603 participants (14.8 Â± 3.9 years). We then employed mechanistic approaches to interpret the developmental changes. Through thalamus-centered (e.g., core and matrix genes) and whole-brain (i.e., Allen Human Brain Atlas) genetic transcriptomic association analyses, we delineated subcortical-cortical gene influences, and then leveraged generative network modeling to simulate brain development. Finally, perturbing the network simulations allowed us to identify the age window significantly contributing to the emergence of large-scale cortical hierarchies. We found that development of thalamocortical connectivity showed diverging patterns across age, indicating a change in the relationship between thalamus and macroscale cortical functional organization. During infancy, thalamocortical connectome topology provided the basis for development of cortical hierarchy and significant associations with cortical genes involved in developmental processes. However, during childhood/young adulthood, these thalamic projections undertook a unique role of differentiating between internally- and externally-oriented functional processes, suggesting the emergence of mature functional systems. Specifically, the salience network formed a stable anchor that differentiates between external-oriented networks (i.e., dorsal attention, visual and sensorimotor) and the default mode network. Moreover, this reflected the distinct patterns of underlying thalamic projections based on the relative density of core and matrix cells. Using generative network modeling, we demonstrated that the thalamocortical connectivity is a major player scaffolding the emergence of a continuous internal-external functional gradient and modular structures. Specifically, our perturbation analysis revealed its highest influence in later age groups (i.e., above 12 yrs), particularly in the development of internal processing areas such as the default mode network. Our findings provide compelling evidence of the active role of thalamocortical connectivity in shaping large-scale functional brain organization, emphasizing its significant impact across the early developmental stages. These results may provide new insights into developmental neuroscience, as well as clinical conditions that are related to atypical interaction between intrinsic and extrinsic mechanisms, such as autism and schizophrenia.

O1.3 Dynamics of infant white matter maturation from birth to 6 months

Longchuan Li[1], Benjamin Risk[1], Sarah Shultz[1], Warren Jones[1]

[1]*Emory University*

Background: During infancy, white matter tracts undergo rapid myelination, establishing the structural foundation for functionally organized brain networks. As white matter tracts mature rapidly and asynchronously, the consequences of disruptions to these pathways are likely to be dynamic and temporally specific. Longitudinal, temporally-precise quantification of trajectories of white matter pathways during infancy is therefore a necessary first step toward understanding how deviations from typical trajectories can lead to disability. Here we present results from what is to our knowledge the largest longitudinal study to date (129 time points from 79 typically developing infants) of white matter development from birth to 6 months. **Objectives:** 1) to model growth and change rate trajectories of major white matter tracts; and 2) to examine the impacts of sex and gestational age at birth on the dynamics of white matter development. **Methods:** Participants were 79 typically-developing infants (mean(SD) gestational age = 38.7(1.8) weeks, 31 female). Data were collected from each infant at up to 3 randomized time points between birth and 6 months. Eleven white matter tracts were identified using probabilistic tractography (Figure 1A). Generalized additive mixed models (GAMMs) were used to model growth and change rate trajectories of fractional anisotropy (FA), medial diffusivity (MD), axial diffusivity (AD), and radial diffusivity (RD). **Results:** Most tracts had their maximum change rates at birth, with rate of growth beginning to stabilize around month 5 (Figure 1). Some tracts exhibited large changes in growth rates over time (e.g., CCb), while a few tracts exhibited smaller dynamics (e.g., Fx). Despite most participants being full-term or early-term births, gestational age had a significant effect on whole-brain white matter growth trajectories ($p<1e-05$ for FA, MD, AD, and RD), with longer gestation associated with higher FA and lower diffusivity measures (MD, AD, and RD). Additionally, there was a significant interaction between gestational age at birth and chronological age for FA ($p=0.005$), resulting in growth curves that were closer together as age increased, indicating a possible catching-up effect among infants born at younger gestational age (Figure 2). FA was initially higher in females than males, and then became nearly equal, while MD, AD, and RD tended to be higher in males than females throughout the first six months (main effect uncorrected $p=0.03$, $p=0.01$, $p=0.04$, respectively) although the 95% simultaneous confidence bands were broadly overlapping (Figure 2). **Conclusions:** We show that the dynamics of white matter maturation are time-varying, asynchronous, and linked to infant gestational age at birth and sex. Our results reinforce growing evidence that the impact of gestational age on brain development exists on a continuum, even across the spectrum of early-term and full-term births, and provide the first-ever demonstration of the effect of gestational age on change rates of white matter development during the first 6 postnatal months. Future work should examine whether accelerated maturational trajectories associated with shorter gestation are adaptive and serve a compensatory role, or whether they represent an adverse response to stress associated with premature exposure to the ex-utero environment.

SESSION #2: NEURAL CORRELATES OF EARLY COGNITIVE AND EMOTIONAL DEVELOPMENT

Chair: Courtney Fillipi, University of Maryland

INVITED SPEAKER

EEG correlates of cognitive control development

Santiago Morales, *University of Southern California*

Cognitive control plays an important role in children's development, including their well-being and risk for psychopathology. Cognitive control is comprised of multiple components including detection and control processes. Previous studies examining the electrophysiological correlates of the development of cognitive control have mostly relied on event related potentials (ERPs). Although ERPs have been a fruitful measure, they ignore potentially important information contained in the EEG data (e.g., non-phase-locked signals). Time-frequency analyses can better characterize the oscillations contained in the EEG data. In this talk, I will show the EEG

correlates of the development of cognitive control in early childhood using time-frequency analyses in a large sample of children. Importantly, most of these developmental differences are not observable with ERPs, highlighting the unique contributions of time-frequency approaches to studying the development of cognitive control. I will also show preliminary evidence utilizing time-frequency approaches to study the emergence of detection components of cognitive control in infancy. Finally, I will present preliminary data showing how early contextual factors such as prenatal maternal SES longitudinally predict these time-frequency measures of cognitive control. Altogether, this talk will demonstrate the contributions of time-frequency approaches to studying neurocognitive development.

CONTRIBUTED TALKS

O2.1 Studying the attentive infant brain across multiple time-scales

Sam Wass[1], Emily Phillips[1], Marta Perapoch Amadó[1]

[1]University of East London

The capacity to choose what we pay attention to and what we ignore enables us to regulate perception and action, to guide behaviour in complex environments (Rueda et al., 2021). Atypical early attention is observed across multiple domains of psychopathology (Wass et al., 2012). Understanding how attention is instantiated in the developing brain is an essential aim for developmental neuroscience. Historically, most of what we know about the attentive infant brain comes from studies that used fMRI, fNIRS and EEG to record brain activity while children are alone, passively viewing material on-screen. We review this work, including foundational studies that examine how periodic (oscillatory) and random (stochastic) activity across multiple time-scales influence attention, and how these relationships change over developmental time (Robertson et al., 2013). We also discuss one limitation of this work, which is that much of the data in the world is latent as it is unrealized without some direct physical action (Karmazyn-Raz & Smith, 2023). In other words, attention is not a uni-directional process through which we passively consume information outside us. Rather, it is a bidirectional process through behaviours generate experiences (Smith & Gasser, 2005). We present new, state-of-the-art recordings from a 5-year European Research Council-funded study to address this challenge. These include a world-unique dataset of N=110 infants who attended sessions at 5, 10 and 15 months, who interacted with toys in a naturalistic setting while engaged both in solo play and joint play with their parent. We recorded combined dual fNIRS, EEG and physiological (ANS) recordings. Using machine learning analyses from video data, we coded micro-movements of head position, facial units, body movements, hand movement, vocalisations, vocal/facial affect, from both parent and infant (see Fig 1). Our analyses examine change across multiple timescales (see Fig 2), from slow-scale fluctuations measured in previous fMRI research, through medium-scale fluctuations with fNIRS and ANS to fast-scale fluctuations with EEG. We examine how periodic (oscillatory) and stochastic activity changes over development, and we examine the roles played by the parent during joint play, in using allostasis to help the infant maintain a critical brain state, intermediate position between under- and over-excitation. We also examine whether autonomic arousal and brain activity associate with changes in moment-by-moment attentional engagement, and whether they anticipate attention changes or follow on from them. Early on, slow-varying fluctuations in arousal forwards-predict attentional behaviours. Later on, fluctuations in theta power associate with changes in attention, but cortical changes follow, rather than precede, attention shifts. Together, our results suggest that attention control transitions from subcortical to cortical control through interactions between hierarchically nested systems operating across multiple time-scales. Even by later infancy, though, attention control is still reactive, with stochastic behavioural changes forwards-predicting subsequent brain changes. Finally, caregiver-driven mechanisms drive attention co-regulation via allostasis.

O2.2 An innovative approach to measure infant object looking during play: combining head-mounted eye-tracking and electroencephalography (EEG)

Lichao Sun[1], Ira Marriott Haresign[2], Sam Wass[2], Hanako Yoshida[1]

[1]University of Houston, [2]University of East London

The ability to engage in attention sharing with others during infancy predicts language and cognitive development in early childhood. For instance, the amount of joint attention (JA) with parents during the first two years was significantly associated with vocabulary growth (e.g., Morales et al., 2000; Yu et al., 2019). One line of developmental studies has used head-mounted cameras to capture infant's visual experiences from their egocentric view (Yoshida & Smith, 2008). This research has highlighted the importance of socially coordinated visual experience in promoting sustained attention and associated word learning (e.g., Suarez-Rivera et al., 2019; Sun & Yoshida, 2022). Another line of research has used electroencephalogram (EEG) recordings to demonstrate the associations between alpha and theta rhythms and JA (Mundy et al., 2003; Philips et al., 2021; Wass et al., 2018). However, the cognitive mechanisms underlying this socially coordinated attention are not fully understood. For example, does infants' neural activity differentiate between times when the infant is looking at the object with and without parent attention sharing? How does neural activity differ during sustained attention? The present study aims to develop and establish an innovative approach to combine head-mounted eye trackers with EEG recordings to use in the context of social interaction, in order to precisely capture infant's moment-to-moment gaze behaviors while tracking neural oscillatory activities at the same time. 25 parents and their infants aged from 6 to 12 months completed two 6-minute object play sessions at their visits. Infants wore a 32-channel EEG cap as well as head-mounted eye-tracking gear, while parents wore eye-tracking gear during play (Fig.1A&B). The EEG and eye-tracking input were synchronized by triggers received from the same source. Before the recording started, experimenters placed six familiar toy objects on the table and asked the parent to freely use objects and play with the infants. Both parent and infant gaze behaviors were annotated separately and synchronized by using the shared timestamp (Fig.1C). We examined the distribution of infant attention by measuring the proportion of time infants spent on objects as well as social components nearby (e.g., parent's hands or face). Then, we extracted the episodes of infant object looking for ERP-like EEG analyses. For instance, the time-frequency plot presents the infant's alpha and theta band activities (2-16 Hz) occurring 2000 ms after the onset of infant object look in the frontal-central regions (Fig.1D). Cluster-based permutation analyses will be conducted to further compare neural oscillatory activity in relation to different types of gaze behaviors - such as JA, infant attention toward the parent's face and/or hands, inattention, etc. The present study introduces a methodology integrating EEG and head-camera eye tracker recordings during parent-child interaction. We describe the procedures and discuss the significance and benefits of the combined method as well as its potential challenges. Further findings based on this approach can provide a more comprehensive understanding of the neural significance of early visual experiences and inform future neurodevelopmental research on the topic.

O2.3 Evaluating awake fMRI in one hundred 2 month-olds

Áine Dineen[1], Graham King[1], Cliona O'Doherty[1], Anna Truzzi[1], Enna-Louise D'arcy[1], Chiara Caldinelli[1], Anna Kravchenko[1], Jessica White[1], Claire Ambre[1], Anisha Wadhwa[1], Maebh Healy[1], Amy Burke[1], Sojo Joseph[1], Eleanor Molloy[2], Adrienne Foran[3], Ailbhe Tarrant[3], Angela Byrne[4], Rhodri Cusack[1]

[1]Trinity College Dublin, [2]The Coombe Hospital, Trinity College Dublin, [3]The Rotunda Hospital, Children's Health Ireland at Temple Street, [4]The Coombe Hospital, Children's Health Ireland at Crumlin

Introduction: Awake infant functional MRI (fMRI) has rich potential as a window into the early development of brain function. The Foundations of Cognition (FOUNDCOG) project is a longitudinal neurodevelopment study with awake fMRI at 2- and 9-months corrected age (CA), recruiting infants born 37-42 weeks gestational age, and infants that spent time in the neonatal intensive care unit (NICU). We present what we have learned from scanning the first 100 FOUNDCOG infants at 2-months CA. **Methods:** Stimulation comprised videos (6x 22.5s videos, 2 repetitions) and pictures (12 objects x3 instances, 2 repetitions). Awake fMRI was prioritised but if an infant fell asleep, resting-state fMRI and structural MRI were collected. A custom Psychopy (Peirce, 2019) stimulus delivery allowed a smooth transition to resting-state scans. Pink noise maximised the likelihood of a smooth transition from the noisy functional to quieter T2w structural sequence without waking the infant. Infants were scanned in a Siemens 3T MAGNETOM Prisma using the posterior coil of a 64-channel head coil and a flexi-coil on the forehead. fMRI was acquired with multiband EPI, TR=610ms, TE=32ms, 3mm isotropic, 64x64x36 voxels per volume, 485, 510 or 1,000 volumes for video, picture and resting-state runs respectively. Infants and caregivers attended a 2-hour appointment with a 4-member scan team, when the infant was 2-months CA. The set-up aimed to maximise comfort and minimise motion (Fig.1), inspired by Deen (2017) and Ellis (2020). Infants were placed on a bead-filled vacuum pillow wearing Optoacoustics OptoActive II ANC Headphones held by inflatable cushions lining the posterior head coil to ensure the earcups formed a seal providing hearing protection and allowing an audio stimulus. Visual stimuli were projected onto the bore of the scanner. A flexi-coil in lieu of an anterior head coil ensured infants could see the visual stimuli. An engaging home screen captured attention between scans. If an infant's eyes closed, the clinician sometimes administered a drop of sucrose to encourage eye opening. Infants wore a pacifier 40% of the time. A team member remained with the infant during the scan. An in-bore camera recorded the infant's face, allowing real-time monitoring from the control room, and retrospective tagging of attentive state. **Results:** Awake fMRI was acquired from 97 (24 NICU) of the first 100 FOUNDCOG infants (25 NICU), a total 436 runs (255 videos, 181 pictures), a median 20 minutes per infant (Fig.2). Asleep resting-state fMRI was acquired in 78 infants and a T2w structural in 70 infants. As expected, motion was higher for awake than resting-state (Fig.3) but 97% of awake runs had a median framewise displacement less than 2.5mm. Camera footage from 63 infants (268 awake runs) has been manually tagged to date (Fig.4). Infants were observed to be intere sted in and eye scanning the visual stimuli for 75%, and fussy for 15%, of awake scan time. 57 caregivers rated their experience on Likert scales, results indicate that they were satisfied with their infant's experience (4.7/5) and felt their infant was comfortable for the majority of the scan (4.4/5). **Conclusion:** A high proportion of 2-month-olds will engage with awake task-based fMRI, and will also complete resting-state and structural scans in the same 2-hour visit. Caregivers found the scans to be a positive experience. These methods may inform future studies using MRI in infants and other challenging cohorts.

KEYNOTE TALK

Are infant brains just little adult brains?

Rebecca Saxe, *Massachusetts Institute of Technology*

In this talk, I will start with a surprising discovery from human infant neuroimaging: the functions of cortical regions are quite similar, between infants and adults. Indeed, as the methods in our field improve, some initial differences have disappeared, turning into similarities. I'll share some examples from my own lab's studies using awake fMRI with infants, e.g. to measure cortical responses to faces. But, these mounting similarities can't be the whole story: brains are machines for learning, and infants have a lot to learn to acquire adult minds. So, I will turn to speculation about why it is easier to confidently measure similarities than differences, and where we might look next for signatures of the difference between infants' and adults' brain functions.

SESSION #3: EFFECTS OF EARLY ADVERSITY ON NEURODEVELOPMENT

Chair: Tomoki Arichi, King's College London

Understanding the impact of early adversity on neurodevelopment by using fNIRS in low-resource settings: the Brain Imaging for Global Health (BRIGHT) project in The Gambia

Chiara Bulgarelli, *Birkbeck, University of London*

1 in every 4 children worldwide are undernourished before they reach the age of 5, and 1 in every 2 children is thought to live in poverty. Although there is a large amount of research that highlights the detrimental impact of poverty and malnutrition on general infant development, not much is known about their consequences for neurodevelopment. The Brain Imaging for Global Health (BRIGHT) project aims to establish brain function-for-age curves of infants in The Gambia and in the UK, in order to gain an insight into the effects that malnutrition, social or environmental difficulties and increased risk of disease, related to living in a low-resource context, may have on infant development. In this talk, I will show how the BRIGHT team successfully set-up a complex and multimethodological study in a low-resource country, and the challenges we faced and tackled to perform the first ever brain imaging of infants in Africa using functional near infrared spectroscopy (fNIRS). fNIRS is portable and relatively low-cost, therefore has proven to be a valid tool to be used in The Gambia, where otherwise acquiring brain imaging data would have not been possible. I will also discuss recent findings about the longitudinal development of fNIRS-based functional connectivity in Gambian infants across the first two years of life. We related connectivity strength to pre-school cognitive outcomes and early growth measures. Using fNIRS-based functional connectivity as an indirect measure of brain maturation in low resource, previously hard to study in poor-resource settings, will help us understanding the consequences of early brain maturation differences and ultimately identify those most vulnerable to poorer developmental outcomes.

O3.1 The combined role of maternal childhood maltreatment and maternal depression during pregnancy for newborn global white matter microstructure

Nora Moog[1, 2], Khalid Al-Ali, Jerod Rasmussen[3], Martin Styner[4], Hyagriv Simhan[5], Pathik Wadhwa[3], Richard Miller, Emily Barrett, Sonja Entringer[1], Thomas O'connor[6], Claudia Buss[1]

[1]Charité - Universitätsmedizin Berlin, [2]Charité – Universtitätsmedizin Berlin, [3]University of California, Irvine, [4]University of North Carolina at Chapel Hill, [5]University of Pittsburgh, [6]University of Rochester Medical Center

Objective: Maternal depressive symptoms during pregnancy are highly prevalent and have consequences for offspring cognitive and social-emotional development. These effects are likely mediated by variation in gestational biology. However, gestational biological correlates of MDS may differ depending on the presence or absence of a history of childhood maltreatment (CM). We aim to investigate the independent and interactive associations of maternal depressive symptoms in pregnancy and maternal history of CM on newborn global brain microstructure. **Methods:** In a sample of N=90 mother-infant dyads from two cohorts, maternal depressive symptoms were assessed serially across pregnancy with the Edinburgh Postnatal Depression Scale. CM was assessed with the Childhood Trauma Questionnaire or the Adverse Childhood Experiences scale, respectively, and harmonized into one binary indicator variable of abuse and/or neglect exposure. Diffusion tensor imaging (DTI) was performed in the infants within 90 days of birth. Fiber profiles of fractional anisotropy (FA), axial diffusivity (AD), radial diffusivity (RD) and mean diffusivity (MD) were computed and for each DTI metric a global mean across the brain was computed for use in the statistical analyses. **Results:** After adjusting for age, sex, race and ethnicity, and study site, neither depressive symptoms nor CM were independently associated with global newborn white matter microstructure. There was a significant interaction effect of maternal depression and CM on newborn global FA (B=-.001, p=.026) and RD (B=5.94e-6, p=.012) but not MD (B=2.90e-6, p=.053) or AD (B=2.21e-6,p=.116). More specifically, in infants born to women with a history of CM, higher maternal depressive symptoms were associated with lower fractional anisotropy, and with higher radial diffusivity, a pattern suggesting lower microstructural integrity and myelination. In contrast, infants of women without CM exhibited the reverse pattern of associations between depressive symptoms and DTI metrics. **Conclusions:** The present findings suggest that maternal depressive symptoms during pregnancy may affect offspring brain development via different mechanisms depending on whether mothers were exposed to CM. Future studies should explore whether these different patterns in newborn brain microstructure associated with maternal depression and CM also translate into differences in cognitive and social-emotional developmental trajectories. These findings may inform future prevention strategies and highlight the importance of monitoring the psychosocial well-being of pregnant women.

O3.2 Impact of socioeconomic status on longitudinal changes in visual working memory function in children in rural India.

Sobana Wijeakumar[1], Samuel Forbes[2], Vincent Magnotta[3], Sean Deoni[4], Kiara Jackson[5], Vinay Singh[6], Madhuri Tiwari[6], Aarti Kumar[6], John Spencer[5]

[1]University of Nottingham, [2]Durham University, [3]University of Iowa, [4]Brown University, [5]University of East Anglia, [6]Community Empowerment Lab, Lucknow

Objective: Each year, 250 million children in low- and middle-income countries fail to reach their developmental potential. The impact of socioeconomic status on neurocognitive function in the first 1000 days of life is under-explored and unclear. In the current study, we inquired how VWM function might change from the first year to the second year of life in a first-ever large scale LMIC longitudinal neurocognition study. Second, we examined how SES might impact these developmental changes in VWM function in children in this population. **Methods:** Families with 223 6-month-old and 9-month-old infants from in and around Shivgarh, rural Uttar Pradesh, India took part in the study across two years. At the first time point, infants were 6 and 9 months of age, and at the second time-point, they were 18 and 21 months of age, respectively. VWM function was assessed at both time-points using a preferential looking task. In this task, two side-by-side blinking displays of colored squares were presented, with one side showing a change in colors, while the colors on the other side stayed constant. At the first time-point, VWM load was varied between 1 (low), 2 (medium), and 3 (high) load and for the second time-point, VWM load was varied between 2 (low), 4 (medium), and 6 (high) items. Portable eye-tracking and video recordings were used to extract looking behaviour and functional near-infrared spectroscopy was used to collect brain function while children engaged with the task. Change preference (CP) score was calculated by dividing the total time spent looking at the changing side divided by the total looking time. Image reconstruction techniques were used to transform channel-based neuroimaging data into the voxel space using segmented head volumes obtained from MRI scans. Linear mixed effects modelling was used to probe the association between behaviour and brain function. **Results and Conclusions:** Our behavioural results revealed that high SES children did not show any change in CP scores from the first to the second time-point. On the other hand, low SES children demonstrated lower CP scores compared to high SES children at the first time-point but showed a significant improvement in CP scores by the second time-point. Our brain imaging results revealed two significant effects. First, overall, a developmental increase in CP scores was associated with an increase in activation in the left anterior intraparietal sulcus, consistent with previous findings for a role in maintaining VWM representations. Second, both high SES and low SES children with high CP scores showed a comparable increase in activation in the right middle frontal gyrus, an area associated with executive attention, consistent with our behavioural results. However, while high SES children with low CP scores showed a small increase or similar activation from the first to the second time-point, low SES children with low SES scores showed a drop in activation in this region. Taken together, our findings contribute to the growing literature of the impact of socioeconomic status on developmental changes in neurocognition in LMIC countries.

O3.3 Auditory statistical learning in two-year-old Bangladeshi children: An fNIRS study

Eileen Sullivan[1, 2], Laura Pirazzoli[2], John Richards[3], Talat Shama[4], Alexandre Chaumette[5], Rashidul Haque[4], William Petri[6], Charles Nelson[2]

[1]Harvard University, [2]Boston Children's Hospital, [3]University of South Carolina, [4]ICDDR,B, [5]Harvard College, [6]University of Virginia

Introduction: Auditory statistical learning is thought to serve as one of the building blocks of language acquisition. Prior studies have uncovered behavioral and neural correlates of statistical learning, yet further research is needed to illuminate statistical learning processes in more diverse contexts, including low- and middle-income countries (LMICs). Further research is also needed to uncover whether neural correlates of statistical learning may relate to early environmental factors and language outcomes in LMICs.
Methods: In the current study, we used functional near-infrared spectroscopy (fNIRS) to investigate auditory statistical learning in 102 two-year-old children living in Dhaka, Bangladesh. We employed a statistical learning paradigm that included a four-minute

familiarization phase of auditory â€œtone wordsâ€ (sequences of three tones) with varying transition probabilities (TPs) and a four-minute test phase of blocks containing either high TP, low TP, or novel tone sequences (See Figure 1). A Gowerlabs NTS optical tomography system with 38 channels was used for fNIRS data collection (layout shown in Figure 2). We conducted coregistration and anatomical source localization at the individual level, with the superior temporal gyrus (STG) and inferior frontal gyrus (IFG) as regions of interest (ROIs). We also collected measures of early environmental exposures and language outcomes. **Results:** Timecourses of HbO2 and HbR responses are shown in Figure 3. Two-year-olds showed significantly higher oxygenated hemoglobin (HbO2) responses to the high TP (very predictable) condition compared to a silent baseline condition in the left and right STG, but not in the IFG. HbO2 responses to the low TP (somewhat predictable) condition and the novel condition were not significantly different than responses to baseline in the STG or IFG. Significant differentiation of responses was found between the high TP and novel conditions in the right STG only. The contrasts between the high TP and low TP conditions and between the low TP and novel conditions were not significant (Figure 4). We did not find that fNIRS correlates of statistical learning were correlated with any measures of the early environment or language outcomes. **Discussion:** Our findings suggest that two-year-olds in this context demonstrate a preference for familiar tonal patterns. The results indicate that participants were able to differentiate large contrasts of predictability but not smaller, more fine-tuned contrasts. The lack of associations found among fNIRS measures, early environment, and language outcomes may suggest that alternative statistical learning paradigms, such as those with linguistic stimuli, could be better suited to studying these potential relations. Overall, this study demonstrates the feasibility of using fNIRS to study the neural correlates of statistical learning in LMICs and highlights the potential for fNIRS to provide deeper understanding of the mechanisms underlying language acquisition.

SESSION #4: SENSITIVE PERIODS & BRAIN PLASTICITY

Chair: Kelly Vaughn, Children's Learning Institute, University of Texas Health Science Center at Houston

All in the timing: The alignment between brain maturation and expected experience

Rebecca Reh, *Cohen Veterans Bioscience*

Early life experience shapes our perception of the world. Brain circuits are fine-tuned during sensitive periods in development, when neural systems are uniquely malleable to environmental input. Over the past several decades, amazing strides have been made in identifying the cellular mechanisms that control the opening and closing of, and plasticity during, these windows. My work integrates advances from molecular and cellular neurobiology to further our understanding of how early experience shapes cognition. Using human language as a model system, in this talk I examine how experience is encoded in the brain during developmental sensitive periods. First, I investigate whether statistical learning, typically thought of as a domain general cognitive mechanism, remains effective in altering phoneme perception beyond the close of the sensitive period for native phonetic attunement. Using electroencephalography to measure neuronal responses to native phonemes in a cohort of 131 5-, 9- and 12-month-olds, I show that perceptual sensitivity to a brief familiarization of novel speech sounds declines with age. Second, I present recent findings on the long-term impact of SSRI exposure in utero on language development and lexical representations in 10-year-old children. Together, this work highlights the importance of timing alignment between brain maturation and environmental experience in perceptual and cognitive development.

O4.1 Auditory sensitive period timing and language development in infants with prior GABA agonist drug exposure

Kelsie Lopez[1], Ellen Underwood[2], Alice Tao[3], Isabelle Kim[4], Siobhan Coffman[4], Charles Nelson[4], Charles Berde[4], Laura Cornelissen[4], Takao Hensch[4], Laurel Gabard-Durnam[1]

[1]Northeastern University, [2]New York University, [3]Weill Cornell Medical College, [4]Boston Children's Hospital

200,000 infants receive GABA agonist drugs (GA) annually in the United States. Animal model research suggests that early GA exposure impacts development by accelerating sensitive periods in the brain. How GA exposure influences human sensitive periods remains an open question to inform fundamental developmental learning mechanisms. We address this question by focusing on an auditory sensitive period in infancy. We tested whether early prolonged GA exposure accelerates this sensitive period's timing by evaluating the EEG auditory-evoked potential (AEP) at 2 and 10 months (mean corrected age = 2.61 months and 10.40 months, respectively) in infants with (n = 29) and without (n = 50) early GA exposure. Participants in the GA group were exposed to GABA agonist drugs prior to 2.5 months for an average of 8.32 hours (range: 1.43 â€“ 45.22 hours) and with an average of 1.97 exposures (range: 1 - 12 exposures). The average age of first GA exposure was 0.45 days corrected age (range: -1.15 - 2.26 days). GA effects on language development were assessed with the Ages and Stages Questionnaire (ASQ) communication subscale at 10 months. Cumulative GA exposure and number of exposures negatively predicted ASQ scores at 10 months (b = -.031, p = .036; b = -.136, p = .033). Cumulative GA exposure and number of exposures both negatively predicted amplitude of the AEP P1 component at 2 months (b = -.087, p = .030; b = -.422, p = .011), consistent with a more mature auditory response profile in GA-exposed infants. We did not see significant group differences in AEP P1 amplitude at 10 months when the sensitive period closes, suggesting the AEP differences at 2 months indicate acceleration in the GA-exposed infants, rather than an overall different AEP response. These results inform how exposure to early GA can accelerate human sensitive period developmental timing and impact subsequent learning.

O4.2 Sensorimotor EEG mu rhythm activity during action observation and execution in 6- to 9-week-olds: An individual differences analysis

Kelsey Davinson[1], Kimberly Cuevas[1], Lauren Bryant[2]

[1]University of Connecticut, [2]College of the Holy Cross

The sensorimotor EEG mu rhythm's neural mirroring properties may provide insight into the neural foundations of action-perception integration. The EEG mu rhythm (adult: 8-13 Hz) desynchronizes (decrease in oscillatory activity relative to baseline) both when performing an action and observing another perform the same action. There is evidence of facial gestures eliciting neural mirroring in newborn macaque monkeys (5-6 Hz; Ferrari et al., 2012) and 9-month-old human infants (6-9 Hz; Rayson et al., 2017). The functional and spatial properties, as well as the frequency band range of the mu rhythm, have yet to be characterized in young infants. The present study aims to identify the frequency range of the mu rhythm at 6-9 weeks of age using facial gestures and determine whether there

is evidence of neural mirroring properties. Based on the existing literature, we hypothesized event-related desynchronization (ERD) in either the 3-4 or 5-6 Hz band at central sites during facial gesture production and perception. We anticipated that the perception of non-biological movement would not elicit central ERD. Twenty-nine infants observed a series of 20-s tongue protrusion (TP), mouth opening (MO), spinning disc, and baseline (still face or still disc) trials (Ferrari et al., 2012; Meltzoff & Moore, 1992). Spontaneous gesture executions were coded frame-by-frame from video recordings. The 3-4 Hz, 5-6 Hz, and 7-8 Hz frequency bands were candidates for defining the mu rhythm based on prior work with infants (Berchicci et al., 2011; Ferrari et al., 2012; Rayson et al., 2017). Analyses focused on central (C3/C4) and occipital (O1/O2) sites to determine if the sensorimotor mu rhythm is functionally distinct from the posterior alpha rhythm in each candidate band. Execution data were used to identify the EEG frequency range that functionally defines mu rhythm activity at 6-9 weeks. Unexpectedly, candidate mu frequency range differed as a function of gesture type. For TP execution (n = 10), the 3-4 Hz and 5-6 Hz bands exhibited significant ERD at central sites (ts > 2.3, ps < .05), with only the 3-4 Hz band demonstrating topographical specificity that did not extend to occipital regions. On the other hand, during MO execution, central ERD was right-lateralized in the 5-6 and 7-8 Hz frequency bands (ts > 2.8, ps â‰¤ .051). We expected to see the same pattern of activity during gesture observation trials (TP: n = 25, MO: n = 20), but surprisingly, there was not significant ERD at central sites (Fig. 1). As seen in Fig. 2, there were individual differences in central ERD during facial gesture perception. Previous research has indicated that variability in mu rhythm activity is related to early experience (Vanderwert et al., 2015). Follow-up analyses will include behavioral data to determine whether individual differences in facial gesture production or social contingency are related to variations in central ERD during the perception of facial gestures. In addition, non-biological control conditions and the scalp topography of the emerging mu rhythm will be further examined in the final presentation. As seen in Fig. 1, ERD may be broader at 6-9 weeks compared to later infancy. Our findings will be discussed in relation to the active intermodal mapping model of early perception-action learning, which theorizes that integrating representations of self and other contributes to social learning (Meltzoff & Marshall, 2018).

O4.3 Segmenting Hypothalamic Subunits in Human Newborn MRI

Jerod Rasmussen[1], Alice Graham[2], Damien Fair[3], Jonathan Posner[4], Yun Wang[4], Thomas O'connor[5], Hyagriv Simhan[6], Sonja Entringer[7], Pathik Wadhwa[1], Claudia Buss[8]

[1]University of California, Irvine, [2]Oregon Health & Science University, [3]University of Minnesota, [4]Duke University, [5]University of Rochester Medical Center, [6]University of Pittsburgh, [7]Charite, [8]Institut für Medizinische Psychologie

Introduction: Preclinical evidence suggests that inter-individual variation in the structure of the hypothalamus at birth is associated with variation in the intrauterine environment, with downstream implications for future disease susceptibility. However, scientific advance in humans is limited by a lack of validated methods for the automatic segmentation of the newborn hypothalamus. **Methods:** N=216 healthy full-term infants with paired T1-/T2-weighted MR images across four sites were considered for primary analyses (mean postmenstrual age=44.3Â±3.5 weeks, nmale/nfemale=110/106). The outputs of FreeSurfer's hypothalamic subunit segmentation tools designed for adults (segFS) were compared against a novel registration-based pipeline developed here (segATLAS), and against manually edited segmentations (segMAN) as reference. Comparisons were made using Dice Similarity Coefficients (DSCs) and through expected associations with postmenstrual age at scan. In addition, we aimed to demonstrate validity of the segATLAS pipeline by testing for the stability of inter-individual variation in hypothalamic volume across the first year of life (n=41 longitudinal datasets available). **Results:** SegFS and segATLAS segmentations demonstrated a wide spread in agreement (mean DSC=0.65Â±0.14 S.D.; range={0.03-0.80}). SegATLAS volumes were more highly correlated with postmenstrual age at scan than segFS volumes (n=216 infants; RsegATLAS2=65% vs. RsegFS2=40%) and segATLAS volumes demonstrated a higher degree of agreement with segMAN reference segmentations at the whole hypothalamus (segATLAS DSC=0.89Â±0.06 S.D.; segFS DSC=0.68Â±0.14 S.D.) and subunit levels (segATLAS DSC=0.80Â±0.16 S.D.; segFS DSC=0.40Â±0.26 S.D.). In addition, segATLAS (but not segFS) volumes demonstrated stability from near birth to ~1 years age (n=41; R2=25%; p<10-3). **Conclusion:** These findings highlight segATLAS as a valid pipeline for the segmentation of hypothalamic subunits within the human newborn. Because the hypothalamus is traditionally understudied due to a lack of high-quality segmentation tools during the early life period, and because the hypothalamus is of high biological relevance to human growth and development, this tool may stimulate developmental and clinical research by providing new insight into the unique role of the hypothalamus and its subunits in shaping trajectories of early life health and disease.

SESSION #5: EARLY NEURAL PREDICTORS OF PSYCHIATRIC RISK

Chair: Dustin Scheinost, Yale University

Atypical visual brain development during infancy in autism: Links to genetic liability and behavior

Jessica Girault, *University of North Carolina*

The first two years of life mark a rapid, dynamic period of postnatal brain development that coincides with the emergence of burgeoning cognitive abilities. It is during this same period that atypicalities in development associated with autism are first apparent. Initiating interventions during a period of heightened neuroplasticity is hypothesized to have the greatest long-term benefits for children, but such an approach relies heavily on the ability to detect at-risk infants early, before symptoms develop. Mounting evidence suggests that neural markers may serve as important predictors of individual variation in behavior and diagnostic outcomes in autism. Here I present a body of work demonstrating atypical development of cortical regions, fiber pathways, and functional networks involved in visual processing during infancy in autism. Individual variation in visual system development is linked to behavior, cognition, and family-level markers of genetic liability. Together this work suggests that genetic liability for autism shapes infant visual system development, setting off a cascade of brain-behavior changes that alter the way a child interacts with their world. Findings are discussed in light of their implications for early detection and intervention, focusing on strategies for incorporating child- and family-level predictors.

O5.1 Maternal postnatal depression is associated with older brain age in infants and worse toddler cognitive performance

Huili Sun [1, 2,] Dustin Scheinost[1, 2]

[1]Wayne State University, [2]Yale University

Maternal mental health plays a critical role in the early development of the infant brain, shaping the infant's future temperament, emotionality, and behavioral patterns. Postnatal depression is one of the most important maternal mental health measures. Previous research has indicated that maternal depression impacts offspring's brain and cognitive development. However, the effects of maternal health on human infant brain structure and subsequent cognitive outcomes are not fully understood. To address this gap in knowledge, we investigated how infant structural connectivity and future cognition performance are affected by maternal depression with 642 neonates from the developing Human Connectome Project. All neonates were scanned at birth (GA: 37.53 weeks; PMA:39.46 weeks), while 563 mothers completed the Edinburgh Postnatal Depression Scale (EPDS) screening to estimate their depression level. 503 neonates underwent cognitive testing (BSID-III) at 18 months old. Standard DWI preprocessing was performed. Structural connectivity for each subject was constructed with the 90-node infant atlas based on the quantitative anisotropy between any two nodes. We used Connectome-based Predictive Modeling (CPM) to predict the postmenstrual age for each infant based on their brain structural connectome. The difference between actual age and predicted brain ages was further used to understand the relationship among maternal depression, infant brain structure, and cognition performance in a late age. Prediction models controlled for sex, brain volume, and head motion. We first trained a 10-fold CPM model to predict the postmenstrual age for all the neonates based on their brain structural connectome features. The predicted brain age was significantly correlated with the true postmenstrual age for each infant (Pearson correlation: r=0.80, p=1.45e-142). This predicted brain age represents a potential individualized measure of brain maturation. We found that the more depressed the mother was at birth, the older their baby's brain was (Pearson correlation between EPDS scores and predicted brain age error: r=-0.15, p=5.56e-4), and that maternal depression level was negatively correlated with infant cognition and language performance at 18 months (cognition: r=-0.052,p=0.044; language: r=-0.13, p=0.0047). To examine how the structural alterations in the brain caused by maternal depression impacted infant cognitive performance, we performed mediation analyses. The structural connectivity strength of the depression-altered infant brain regions fully mediated the correlation between maternal depression and infant cognition performance and partially mediated the correlation between maternal depression and infant language performance at 18 months old. In summary, our study highlights the importance of maternal depression in promoting optimal brain development and cognitive outcomes in infancy and beyond, emphasizing the need for further research in this area to fully understand the impacts of maternal depression on infant brain structure and cognition performance.

O5.2 Characterizing task-dependent and task-independent brain states in sleeping neonates at risk for anxiety

M. Catalina Camacho[1], Alyssa Labonte[1], Julia Moser[2], Abby Hook[1], Natalie Huttner[1], Sanju Koirala[2], Rebecca Schwarzlose[1], Chad Sylvester[3]

[1]Washington University in St. Louis, [2]University of Minnesota, [3]Washington University

Background: Anxiety is associated with alterations in attention and saliency processing. Recent work suggests that these alterations may be present at birth, suggesting a prenatal origin to anxiety risk. Work from our lab has demonstrated that individual differences in neonatal activation to deviant sound stimuli (auditory oddball task) during natural sleep are associated with parental anxiety levels. There is also evidence that infants of anxious parents have poorer sleep quality. Taken together, it is possible that each the natural rhythms of neonatal brain activation during sleep (sleep stage) and attentional and saliency processing during the oddball task (attention network functioning) are associated with anxiety risk. Here, we seek to characterize individual brain states in a sample of neonates in relation to task stimuli and risk for anxiety. **Objective:** In this project we will 1) characterize shared brain states in a large sample of neonates; 2) relate state transitions and maintenance to task structure; and 3) test if state characteristics are related to anxiety risk factors. **Method:** Our sample size will be approximately 90 neonates (39-43 weeks gestational age) for final analysis with between two and eleven 6.7-minute runs of task data. Participants will be split into two datasets for discovery/training and replication/testing as appropriate for each analysis. Networks will be defined for the sample using the Infomap algorithm on a group-level connectivity matrix derived from the sample using a neonate-specific parcellation scheme. We will estimate brain states at the group level using hidden Markov modelling (HMM) on the network-averaged and temporally concatenated training data, fitting 2-20 states. Scree plots of testing data model fit will be used to determine the optimal number of states. The final model will then be applied to each infant's data separately to estimate shared brain states across the sample. Time spent in each state and moment-to-moment probability of being in each state will be extracted for further analysis. To identify which brain states are associated with the task, mean likelihood of being in each state (at the group level) will be examined in relation to Oddball onset. Finally, we will examine correlations among risk factors for anxiety (self-reported maternal anxiety symptoms, observed infant temperament at 4 months) and brain state characteristics. **Prediction:** We predict that the states detected will represent the intersection of sleep and task stage (early, middle, and late Oddball). We predict that states related to the task will differ in auditory, attention, and saliency processing network activation. In line with work in adults, we predict that states that vary as a function of sleep stage will differ in default mode network activation. We also predict that infants at higher risk for anxiety (higher maternal anxiety or more negative temperamental reactivity) will vary in the amount of time they spend in each state associated with the early and middle Oddball trials, spending more time in states with increased ventral attention network activation. **Discussion:** The results of this study will provide key insights into the pathophysiology of anxiety, infant cognitive processing, and the effects of sleep stage on fMRI measures of brain activation.

O5.3 Infant Late Positive Potential is Associated with maternal Emotion Characteristics

Rebecca Brooker[1], Elizabeth Kiel[2]

[1]Texas A&M University, [2]Miami University

The Late Positive Potential (LPP) is an event-related potential linked to the processing of affective stimuli (Cuthbert et al., 2000). In general, LPP amplitudes are enhanced for affective (vs. neutral) and more (vs. less) self-relevant stimuli (Schupp et al., 2000). The majority of empirical work on the LPP has been conducted in adults even though traditional paradigms for LPP elicitation involve the only passively viewing images presented on a computer screen. In fact, work in other domains demonstrates that such tasks, which do not necessitate active responses, can be successfully completed by infants (Bell & Cuevas, 2012; Brooker et al., 2019). Infant emotion

characteristics predict socioemotional outcomes across early childhood and adolescence (Calkins et al., 2011; Tang et al. 2020), including risk for later disorder (Morales et al., 2022), but are notoriously difficult to assess (Zentner & Bates, 2008). As such, the field maintains a need for broad and unbiased multi-trait, multimethod approaches in the assessment of complex emotion characteristics in early life (Goldsmith & Gagne, 2012). Direct assessments of neural processing would be a valuable addition to the current repertoire of available assessment strategies; thus, one aim of the current work was to demonstrate a novel paradigm for eliciting LPP in infants. A second aim for this work draws from evidence that maternal characteristics predict emotional responses in infants that are relevant for infants' long-term development. Specifically, maternal anxiety is associated with propensities for emotional reactivity and regulation, and socioemotional development more broadly, in infants and young children (Price & Kiel, 2021; Kiel et al, 2021; Price et al., 2022). As such, we explored whether the LPP, assessed in our novel paradigm, was associated with levels of maternal anxiety symptoms. Seventy-eight infants and their mothers visited the laboratory when infants were 12 months old (M = 12.82, SD = 1.77). For LPP elicitation, EEG was recorded while infants viewed 48 pictures, half depicting their mother and half depicting a female confederate. Both pictures contained only the head and neck, were taken with the same background, and displayed women making a neutral face. A patterned image and interesting sound were played between picture presentations to capture infant attention. As suggested in Figure 1, and consistent with the LPP, amplitudes between roughly 200 and 600 ms following picture presentation were greater in response to photos of mothers relative to photos of confederates ($F(1, 64) = 3.897$, $p = 0.05$), although this difference did not differ across midline electrodes (Fz, Cz, Pz; $F(2, 64 = 0.12$, $p = 0.89$). In addition, even when controlling for correlations across electrodes and levels of general distress, LPP amplitudes in response to photos of mothers were greater when levels of maternal anxiety were higher (beta = 0.407, SE = 0.170, $p = 0.017$) and smaller when levels of maternal depression were higher (beta = -0.314, SE = 0.094, $p = 0.001$). This pattern mirrors effects observed in adults (MacNamara et al., 2015). Results offer initial evidence that LPP can be assessed in infants as early as 12 months of age and that infant LPP is liked with maternal anxiety. As data collection related to this project is ongoing, a larger sample size is anticipated by the time of the conference.

FIT'NG Flash Talk Abstracts

FLASH TALKS #1

Each flash talk presentation precedes the poster session where the poster will be presented. Please visit the poster presenter to find out more information about their research.

1-B-6 Establishing high-density diffuse optical tomography for bedside neuromonitoring of cortical hemodynamics in pediatric patients on ECMO

Sophia Mcmorrow[1], Tessa George[1], Chloe Sobolewski[1], Dalin Yang[1], Sung Min Park[1], Kelsey King[2], Ahmed Said[1], Adam Eggebrecht[1]

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

Introduction: Extracorporeal membrane oxygenation (ECMO) is a medical intervention that provides life-sustaining care for patients experiencing life-threatening respiratory and/or cardiac failure. Patients on ECMO are susceptible to neurological complications including seizures, hemorrhage, and infarction. Neurological injury on ECMO is associated with an increased risk of neurodevelopmental, behavioral, and functional deficits. Unfortunately, conventional neuroimaging techniques suffer limited sensitivity to detect early signs of brain injury or pose additional risks such as transportation to a magnetic resonance imaging (MRI) facility. Therefore, it is crucial to develop bedside neuromonitoring tools with high sensitivity and specificity for early detection of brain injury, with the ultimate goal of promoting early interventions and improving neurodevelopmental outcomes. Herein, we present high-density diffuse optical tomography (HD-DOT) tools for safe, non-invasive bedside neuroimaging with image quality comparable to functional MRI. Specifically, we assess the feasibility of HD-DOT for bedside assessment of cerebral hemodynamics and brain functional connectivity in ECMO-supported patients. **Method:** HD-DOT data were collected from four patients (age 2 weeks, 9 months, 28 months, and 16 years), with multi-day longitudinal data in three patients. Data collection periods lasted 1-3 hours. Minute-by-minute physiological measurements were obtained and aligned with 10 Hz HD-DOT data. Herein, we present example results from one neonatal patient on veno-arterial ECMO that included ECMO clamp trials. Periods of high quality data were identified for further analyses using NeuroDOT data processing (https://www.nitrc.org/projects/neurodot; Fig. 1). Clamp trials were pre-planned periods of temporary separation from ECMO support, wherein ECMO cannulas were clamped to stop blood flow and test the patient's ability to come off ECMO. The resulting temporal response of cerebral vasculature hemoglobin concentrations were quantified via modelled exponential functions. **Results:** HD-DOT data reveals rapid and notable changes in concentrations of deoxygenated (HbR) and oxygenated hemoglobin (HbO) and their difference (HbD), in response to ECMO clamp trials (Fig. 1G). Upon cessation of ECMO flow, there is rapid and significant relative reduction in HbO and HbD, along with an increase in HbR (Table 1). Additionally, oxygen saturation, mean arterial pressure (MAP), and renal near-infrared spectroscopy decreased with ECMO cessation. Our results indicate that changes in HbD are strongly correlated with changes in MAP, a sign of diminished cerebral autoregulation and an indication that the patient needs to remain on ECMO. When ECMO resumed, both relative hemoglobin and systemic physiologic metrics returned to baseline levels seen prior to the clamp trial. **Conclusions:** In this study, we establish feasibility of HD-DOT for real-time bedside neuromonitoring during ECMO maintenance, a valuable step towards understanding brain dynamics during ECMO support and promoting early identification of potential brain injury. Future analyses will investigate spatial-temporal variation in functional connectivity and cerebral oxygenation, as well as their relationship with physiological parameters and outcomes, with the potential to illuminate associations between brain integrity during ECMO maintenance and neurodevelopmental outcomes.

1-C-21 Optimizing data retention in awake infant fMRI: Lessons learned from over 300 scans

Lillian Behm[1], Nicholas Turk-Browne[1], Tristan Yates[1], Sheri Dawoon Choi[1], Juliana Trach[1], Cameron Ellis[2]

[1]Yale University, [2]Stanford University

Functional magnetic resonance imaging (fMRI) in awake infants can provide valuable insights into how the early developing brain gives rise to cognition and behavior. Although a few studies have now been published using this method, awake infant fMRI poses significant methodological challenges that impact data quality and quantity, and that have hampered wider adoption. After collecting a lot of such data in our lab over the past six years, it is now possible to evaluate and make recommendations on participant recruitment, experimental design, and data collection in order to maximize data retention in future studies. Here, we explore how various factors influence the amount of usable data collected during a session and discuss how researchers can address these factors to minimize data loss. To date, our lab has conducted 302 awake infant fMRI scans with 122 unique infants and toddlers aged 3-33 months (M=11.0, SD=6.1). A subset of these sessions (N=36) resulted in no usable functional data because we were unable to get the infant to enter the scanner and/or remain laying down once positioned in the bore. A logistic regression analysis indicated an effect of infant age, with younger infants more likely to enter the scanner. From infants who successfully entered (N=266), we collected a total of 12.2 minutes of functional data on average. After preprocessing and removing timepoints when the infant was sleeping or not attending to the visual display, an average of 8.3 minutes of awake, task-based data were usable. We assessed whether the number of minutes of usable data could be predicted by infant age, infant sex, time of scan, and year of scan (a proxy for researcher experience). A multiple regression model indicated that infant age and sex were significant predictors, such that older infants and female infants provided larger quantities of usable data. We next assessed the factors that led to functional data exclusion. Excess motion was the most common cause, with an average of 2.1 minutes (17.2%) of lost data per session. Using a multiple regression model with the same predictors as before, infant age was a significant predictor of minutes of data excluded due to motion, with more timepoints excluded for younger infants. Following these motion exclusions, an additional 1.0 minutes (8.1%) of data per session were excluded due to inattention (gaze away from the visual display or eyes closed). Here, a multiple regression model indicated that infant sex significantly predicted inattention, with more timepoints excluded for females than males. A third reason for exclusion was failure to collect a structural scan for anatomical alignment (N=12), which occurred because we prioritized functional data collection. Finally, because some infants completed several tasks and sessions, we investigated whether the type of experiment influenced the proportion of data retained as usable. Movie-based designs

yielded the greatest proportion of usable data, followed by block designs then event-related designs. Taken together, these results demonstrate the promise of this method and suggest that factors such as infant age, sex, and experimental design impact the success rate of awake infant fMRI studies. Although younger infants are easier to get into the scanner, older infants tend to move less, providing more usable data overall. Continuous, naturalistic task designs also yield more data, which may inform the design of experiments to improve retention.

1-F-51 Proof-of-concept: Whole-head high-density diffuse optical tomography in infants

Liam Collins-Jones[1], Louisa Gossé[2], Chiara Bulgarelli[3], Maheen Siddiqui[2], Borja Blanco[4], Ernesto Vidal-Rosas[1], Nida Duobaitė[5], Reuben Nixon-Hill[5], Greg Smith[5], James Skipper[5], Tim Sargent[5], Sam Powell[5], Nick Everdell[5], Emily Jones[6], Robert Cooper[1]

[1]University College London, [2]Centre for Brain and Cognitive Development, Birkbeck University of London, [3]Birkbeck College, [4]The University of Cambridge, [5]Gowerlabs Ltd., [6]Birkbeck, University of London

Introduction: Infancy is a critical time where early symptoms of neurodevelopmental conditions emerge. High-density diffuse optical tomography (HD-DOT) is an optical neuroimaging method that localises changes in haemoglobin concentration in three dimensions, and has been applied to study the infant brain. HD-DOT is motion-tolerant and portable, allowing the awake baby brain to be studied in ecologically-valid settings. Recent years have seen a huge advance in wearable hardware for HD-DOT, however previous headgear has only been capable of sampling specific areas of the cortex. In this work, we aimed to develop headgear capable of sampling across the whole scalp surface and to conduct a proof-of-concept demonstration of whole-head HD-DOT in infants aged 6-months. **Methods:** We developed a whole-head infant implementation of the high-density LUMO design developed by Gowerlabs Ltd. (UK). The LUMO system consists of multiple independent hexagonal modules, each containing three dual-wavelength LED sources and four photodiode detectors. In our prototype, 33 LUMO modules were embedded in a neoprene cap. For a proof-of-concept demonstration, HD-DOT data were collected from infants aged 5- to 7-months (N=24) during the presentation of a screen-based paradigm (see Fig. 1b). Data pre-processing and motion artefact correction were completed using the Homer2 and DOT-HUB toolboxes. A 6-month infant MRI atlas was used to model light propagation in the infant head, and was combined with the data to reconstruct a time-series of images for each individual mapping changes in cortical oxy-haemoglobin (HbO) concentration. Using a general linear model approach, beta weights and t-statistic values for each experimental condition were computed. **Results:** The completed whole-head HD-DOT cap is shown in Figure 1a. Our final sample included valid data from N=16 participants. For both conditions, increased beta weights (Fig. 1c and e) and t-statistic values (Fig. 1d and f) for changes in HbO concentration can be seen bilaterally in the superior temporal gyrus and temporoparietal junction (STG-TPJ), and in the occipital lobe. An increase in HbO concentration is a hallmark of a functional brain activation. For the social condition, a greater increase in HbO concentration (and more spatially focal response) is seen in the right STG-TPJ region, as well as a more spatially constrained response in the occipital lobe. We also note a functional response in the inferior frontal gyrus bilaterally, as well as an inverted response (i.e. decrease in HbO concentration) in the pre- and post-central gyri. **Conclusions:** This is the first demonstration of whole-head HD-DOT in infants. We have mapped activity in regions across the entire cortex, including regions outside the STG-TPJ that typically have not been sampled in previous infant optical neuroimaging research of social interaction. In the STG-TPJ region, our results are consistent with findings in previous infant research, and we have localised what appears to be a visual response in the occipital lobe. We found inverted responses in the pre- and post-central gyri, potentially caused by increased motor activity during the baseline condition. Following this proof-of-concept, we envisage that whole-head HD-DOT will be applied to map the interaction between different regions of the brain, opening new avenues to map connectivity in the awake infant brain to better understand the trajectory of typical and atypical neurodevelopment.

FLASH TALKS #2

Each flash talk presentation precedes the poster session where the poster will be presented. Please visit the poster presenter to find out more information about their research.

2-C-26 EEGWISE: an EEG Workflow Improvement and Signal Enhancement toolbox for infant data

Ran Xiao[1], Beth A. Smith[2], Holly Bradley[2]

[1]Emory University, [2]Children's Hospital Los Angeles

Introduction: Researchers in the field of pediatric EEG data are concerned about obtaining an adequate amount of artifact-free data. The infant EEG signal is contaminated by both experimental and participant artifacts. Manual artifact selection is time-consuming and subject to bias. Therefore, a standardized and automatic approach to the preprocessing of infant EEG data would facilitate the process for all researchers, regardless of EEG analysis experience, and allow for more accurate data comparisons across studies and institutions. A small number of publicly available pre-processing pipelines, such as HAPPE and MADE, have been made available to achieve greater standardization of infant EEG preprocessing. Inspired by these efforts, our toolbox, EEGWISE, aims to add several unique features to further enhance performance. **Toolbox:** EEGWISE has a GUI interface to make the pipeline more accessible and improve the user experience (see Figure 1). It offers both an autopilot model, a fully automatic hands-off experience, and a hybrid mode that allows more advanced users to make manual adjustments to the analysis. Like most other toolboxes, EEGWISE contains four major components that deal with artifacts through temporal, spectral, spatial, and source domains using independent component analysis (ICA). Users can choose from three machine learning-based artifact IC classification algorithms (i.e., iMARA, MARA, and ICLabel) that estimate the likelihood of artifactual IC components. We then designed an innovative approach for selecting the optimal operating point for the cutoff probability, which strikes a balance by maximizing the brain IC probabilities while minimizing the amount of information for rejection. EEGWISE also generates all intermediate results and figures, and provides a detailed report about the data quality after preprocessing. This report can improve the overall workflow by directing the user to data files that need attention for further cleaning. **Evaluation:** In this pilot study, we applied EEGWISE to 53 infant EEG files that had previously been manually preprocessed by an experienced neuroscientist. The manually preprocessed data files were compared to data files that had been preprocessed using EEGWISE in terms of information retention and the average probability of obtaining brain IC components. **Results:** Our results show that EEGWISE retains an average of 58.99% of the data, which is significantly longer ($p<<0.01$) than the manual process at 40.16%, and EEGWISE retains a

mean brain IC probability of 92.94%, compared to 78.77% from the manual process (p<<0.01). **Discussion:** The preliminary results establish the potential of EEGWISE as an efficient pipeline for processing developmental EEG data. Our next step will be to compare EEGWISE to already established infant EEG preprocessing pipelines and make EEGWISE publicly available for use.

2-D-37 Development of infant brain iron couples with resting-state neural activity during the first 150 days of life

Lanxin Ji[1, 2], Youngwoo B Yoon[2], Cassandra Hendrix[3], Ellyn Kennelly, Amyn Majbri[1], Tanya Bhatia, Alexis Taylor[4], Moriah Thomason[3]

[1]NYU Langone Health, [2]New York University School of Medicine, [3]New York University, [4]Wayne State University

Background: Non-heme iron is a vital metabolic cofactor for many core processes of brain development including myelination, dendritogenesis, and neurotransmitter synthesis, and accumulates in the brain with age1, 2. However, little is known about brain iron development in the first 150 days of life and its association with neural activity. Here, we use two early infant MRI datasets and a multi-modal fusion technique3 to address this gap. **Methods:** Sixty-three infants (29 females) aged 22-"144 days of the Perinatal Imaging of Neural Connectivity (PINC) cohort are included in the present analysis. T2* maps were estimated by a maximum-likelihood fit function for TE-dependent exponential decay, and R2* values were calculated from the inverse of the T2* (1/T2*), where higher values indicate greater iron content. We conducted correlation analyses between age and the average R2* values across the whole brain and within six regions of interest (ROIs): caudate nucleus, globus pallidus, putamen, thalamus, hippocampus, and amygdala. We further preformed Linked Independent Component Analysis (LICA) to unmask associations between iron deposition and spontaneous neural activity, as measured by the Amplitude of Low Frequency Fluctuations (ALFF). This analysis interrogates shared component loadings across modalities. To validate our findings, we repeated these analyses in an independent dataset (n = 38, 20 females, 38-147 days) drawn from the COVID-19 Perinatal Experiences (COPE) cohort. **Results:** Brain iron accumulates rapidly with advancing age, as indicated by a significant age effect on both the whole-brain averaged R2* (PINC: r = 0.75, p < 0.001, COPE: r = 0.61, p < 0.001) and R2* within deep gray matter ROIs. LICA showed co-localization between iron and neural activity across brain regions (components shown in Figure 1), and a strong correlation between the global R2* and ALFF within the Default Mode Network (DMN). A significant correlation was also found between age and the average ALFF within regions identified by component 1 (r = 0.56, p < 0.001). **Conclusions:** This study is the first to identify a coupled developmental effect between global iron levels and neural activity within DMN. This raises intriguing questions about whether regions comprising the DMN, recognized as being areas of high metabolic energy demand, are relationally dependent on properties contributing to R2*, including widespread brain iron stores. This study invites opportunity to further explore chemical systems important for the emergence and patterning of the DMN in early human development. Reference 1. Hect JL, Daugherty AM, Hermez KM, Thomason ME. Developmental variation in regional brain iron and its relation to cognitive functions in childhood. Developmental Cognitive Neuroscience. 2018;34:18-26. 2. Larsen B, Olafsson V, Calabro F, Laymon C, Tervo-Clemmens B, Campbell E, Minhas D, Montez D, Price J, Luna B. Maturation of the human striatal dopamine system revealed by PET and quantitative MRI. Nature Communications. 2020;11(1):846. 3. Groves AR, Beckmann CF, Smith SM, Woolrich MW. Linked independent component analysis for multimodal data fusion. Neuroimage. 2011;54(3):2198-217.

2-E-50 Predicting fMEG manifestations of fetal spontaneous neural activity using premature EEG.

Alban Gallard[1], Benoit Brebion, Katrin Sippel[2], Amer Zaylaa, Yael Fregier, Hubert Preissl, Fabrice Wallois, Sahar Moghimi

[1]Groupe de Recherches sur l'Analyse Multimodale de la Fonction Cérébrale, [2]Helmholtz Center Munich at the University of Tuebingen

Evaluation of normal and pathological fetal brain development is a very challenging and complex task. Fetal magnetoencephalography (fMEG) has been developed to investigate brain activity at the earliest stage of development. A lot of effort has been made to better analyze evoked responses, but the study of spontaneous activity remains challenging due to the complexity of the extraction and of the analysis of fetal brain signals. It also lacks of a model to predict what the fMEG manifestation of spontaneous neural activity look like. However, a large body of electroencephalography (EEG) studies has characterized the spontaneous neural activity in premature neonates at different gestational ages. The EEG in premature babies is dominated by discontinuous occurrence of bursts of complex activities. In this study, 10 EEG recordings in preterm at gestational age 28 to 31 weeks and 10 fMEG recordings at gestational ages 34 to 37 weeks has been used with Cycle Generative Adversarial Network (CycleGAN) to propose a transfer function for prediction of spontaneous neural activity in fMEG, based on our knowledge in premature EEG. Toward this, first fMEG data were filtered (0.5-25 Hz) and then preprocessed to remove the artifacts corresponding to the cardiac activity of the mother and that of the fetus, using orthogonal projections. Then, the bursts of spontaneous activity in fMEG and premature EEG were detected using the non-linear energy operator (NLEO) algorithm. Next, unpaired matrices consisting of 5s windows of bursts of activity in fMEG and EEG, pooled over all subjects, were used to train a CycleGAN, to transfer the burst of spontaneous activity in EEG into bursts in fMEG. For each population, 80% of the burst windows were used for training and 20% for testing the model. The detection for the premature EEG were accurate as confirmed through visual inspection by one clinician (FW); only the short periods with debatable burst were not detected. In fMEG, the NLEO algorithm can detect inter-bursts as bursts and bursts as inter-bursts. So, the threshold of the algorithm has been chosen higher to reduce the number of inter-bursts detected as bursts. The point of this choice is to have the minimum inter-burst for the CycleGan. Then, the transformed data has been visually inspected in the CycleGAN.

FIT'NG Conference Poster Sessions

Poster Session 1
Sunday, September 10 8:30–6:45pm

Poster Session 2
Monday, September 11 8:30–6:45pm

Poster numbers are divided first by session, then by theme, and finally with a unique number.

Session – Theme – Board Number (Example: 1-A-1)

Location of the individual poster boards are indicated on poster board floor plans following the poster author index list.

Themes

A Early Neural Predicators of Psychiatric Risk
B Effects of Early Exposures on Neurodevelopment
C Methods Development or Dissemination
D Neural Correlates of Early Cognitive and Emotional Development
E Other
F Sensitive Periods and Brain Plasticity

FIT'NG Conference Posters | Abstracts

POSTER SESSION 1
SUNDAY, SEPTEMBER 10 5:15–6:45PM

A - Early Neural Predicators of Psychiatric Risk

1-A-1 Thalamic shape during early extra-uterine life is related to long-term neurodevelopmental outcome in preterm infants

Emiliano Trimarco[1], Bahram Jafrasteh[1], Simón Pedro Lubián López[1], Isabel Benavente-Fernańdez[1]

[1]*Puerta del Mar University Hospital*

Introduction: Several studies show the relationship between the volumetric analysis of the thalamus in neonatal magnetic resonance imaging (MRI) and the neurodevelopmental outcomes of very preterm infants (VPI) (Loh et al., 2017; Kline et al., 2020; Pagnozzi et al., 2022). However, less is known about the shape of the thalamus during the early life after preterm birth (Boelens Keun et al., 2021). This study aims to investigate the thalamic shape during early and term equivalent age (TEA) MRI and its relation with neurodevelopment at two years. **Methods:** We included 112 scans from 56 patients (57.6% male) of a longitudinal cohort that involves VPI recruited at Hospital Puerta del Mar, CÃ¡diz, Spain, with a mean (Â± SD) gestational age (GA) at the birth of 29.2 (Â± 2.42) weeks. The recruited infants underwent two MRIs, an early scan at 32.5 (Â± 2.85) weeks postmenstrual age (PMA) and another scan at TEA of 42.7 (Â± 4.87) weeks. Infants were followed-up and assessed at two years of corrected age using the Bayley Scales of Infant and Toddler Development, Third Edition (BSITD-III), composed of three separate subscales: cognitive, motor, and language (Bayley, 2006). The preprocessing of T1-weighted images (1.5 Tesla scanner, slice thickness 1.0 mm; echo-time 3.53 ms; flip angle 15Â°; field of view 192 Ã— 256 mm2) included automatic brain extraction (Hoopes et al., 2022) manually corrected using the software MELAGE (Jafrasteh et al., 2022), N-4 bias field correction and semi-automatic thalamus segmentation similar to our previous work (Trimarco et al., 2022). Surface-volume ratio, sphericity, flatness and elongation were extracted from the segmentation (van Griethuysen et al., 2017) and related with BSITD-III subscale scores through multiple linear regression (MLR). All the MLR models include GA, PMA at scan, and sex. Statistical analyses were performed with STATA, version 17 (StataCorp., 2021). **Results:** Table 1 summarizes the principal statistics obtained from MLR models. Early thalamic shape features are significantly related to the three BSITD-III subscale scores (cognitive: $p = 0.013$; motor: $p = 0.003$; language: $p = 0.026$). Thalamic shape features in the TEA scan are also significantly related to the three BSITD-III subscale scores (respectively: $p < 0.001$; $p < 0.001$; $p = 0.001$).

Table 1: MLR statistics for each model.

	Early thalamic features			TEA thalamic features		
	Cognitive	Motor	Language	Cognitive	Motor	Language
R2	0.30	0.34	0.27	0.40	0.46	0.38
F(7,48)	2.88	3.60	2.54	4.61	5.75	4.13
p-value	0.013	0.003	0.026	<0.001	<0.001	0.001

The surface-volume ratio in early MRI scans was found to be significantly associated with all three BSITD-III subscale scores ($p = 0.003$; $p = 0.006$; $p = 0.028$, respectively) while only with motor ($p = 0.010$) and language ($p = 0.014$) scores in the TEA scans. In addition, flatness at TEA was related to cognitive outcome ($p = 0.008$). **Conclusions:** Thalamic shape features during early postnatal life after preterm birth are related to 2-year neurodevelopmental outcome. Surface-volume ratio and flatness were the most significant features.

1-A-2 Impact of fetal inflammation on functional connectivity in neonates: a replication study

Iris Menu[1], Lanxin Ji[1], Christopher Trentacosta[2], Suzanne Jacques[2], Faisal Qureshi[2], Moriah Thomason[3]

[1]NYU Langone Health, [2]Wayne State University, [3]New York University

Strong evidence suggests that prenatal inflammation is a significant risk factor for neurodevelopmental and psychotic disorders in offspring. The prevailing belief is that inflammation during pregnancy can alter maturation of the fetal brain, with long-term consequences for offspring health and development. Previous research has found that newborns born to mothers with higher prenatal interleukin-6 serum levels, a biological indicator of inflammation, show differences in functional connectivity in salience, dorsal attention, medial temporal, and subcortical networks (Graham et al., 2018; Rudolph et al., 2018; Spann et al., 2018). These studies were conducted on healthy community samples, demonstrating that even moderate inflammation experienced by a mother during pregnancy can affect subsequent brain outcomes in her child. There is strong reason to examine whether this work replicates when using methods more reflective of inflammatory effects that reach the fetal compartment. Indeed, peripheral circulating blood in a mother at one timepoint in pregnancy may not accurately capture the myriad factors that contribute to elevated cytokine levels, nor the processes that influence expression of these signaling molecules within the maternal-fetal compartment. In an effort toward bolstering reproducible science, we examined whether prior findings replicated when placental histopathology was used to measure chronic inflammatory load over the course of pregnancy. Pregnant mothers (N = 64; 85% racial/ethnic minority) were recruited during the third trimester of pregnancy, and inflammation was assessed based on placental histology. Precisely, we used a placental chronic inflammation score ranging from 0 (no lesion/sign of chronic inflammation) to 3 (three different types of lesions). The types of lesions included chronic chorioamnionitis, villitis of unknown etiology, and chronic deciduitis. Resting-state imaging data were acquired in infants aged 25-140 days, and functional connectivity was measured from seeds placed in the anterior cingulate cortex (ACC), insula, and amygdala following priors (Graham et al., 2018; Spann et al., 2018). We found that chronic inflammation was associated with lower connectivity between the right ACC and the dorsomedial prefrontal cortex (DMPFC; $p < .001$, corrected; see Figure 1, in blue), as well as higher connectivity between the right insula and the posterior cingulate cortex (PCC; $p < .01$, corrected; see Figure 1, in red). Reduced connectivity between the ACC and DMPFC replicates prior research by Spann and colleagues (2018). We did not reproduce related results referenced above. Our findings (i) substantiate a prior result, (ii) suggest that placental pathology is a comparable means of assessing prenatal inflammation, and (iii) introduce a new inflammation-related finding in connectivity of the insula network to the PCC, worthy of further study. A caveat of failure to replicate prior works is that the method used to determine inflammation and additional procedural differences of this study may influence reproducibility. Thus, we encourage further research to better understand the role that maternal inflammation may play in perinatal programming, and we highlight the unique opportunity in leveraging the placenta as a marker of inflammation proximal to the fetus and potentially more representative of chronicity of inflammation over the course of pregnancy.

1-A-3 Neural Responses to Audiovisual Speech in Infants at Increased Familial Likelihood for Autism: An ERP Pilot Study

Kacie Dunham-Carr[1], Bahar Keceli-Kaysili[2], Alexandra Golden[1], Pooja Santapuram[1], Jennifer Markfeld[1], Jacob Feldman[2], Tiffany Woynaroski[2]

[1]Vanderbilt University, [2]Vanderbilt University Medical Center

Speech is inherently a multisensory process, wherein synchronized visual cues from the moving mouth complement the dynamic acoustic stream. Past research has shown that neurotypical infants tune in to multisensory speech, looking to the mouth of their communication partners during the first year of life, presumably to access audiovisual cues that facilitate speech processing and language learning. Empirical support for audiovisual speech cues facilitating speech processing in older children has been provided by evidence from event-related potentials (ERPs). Specifically, audiovisual speech processing efficiency has been indexed by P2 amplitude suppression in response to audiovisual versus auditory-only speech in school-aged autistic and non-autistic children, and P2 amplitude suppression has been shown to explain individual variation in vocabulary across both groups. This study aims to extend the aforementioned findings to evaluate the role of audiovisual speech processing in early language development by determining: (a) if visual cues increase efficiency of speech processing as indexed by ERPs in infants at general population-level likelihood for autism (infant siblings of non-autistic children; Sibs-NA), (b) if infants at increased familial likelihood for autism (infant siblings of children with autism; Sibs-AUT) display a lesser boost in speech processing efficiency with access to audiovisual versus auditory-only cues compared to Sibs-NA, and (c) if individual differences in audiovisual speech processing efficiency covary with language ability. Sixty 12-"18-month-old infants (30 Sibs-AUT; 30 Sibs-NA matched on sex and chronological age) are being recruited. Participants view videos of a female speaking syllables in audiovisual (auditory speech + synchronous visual mouth movements) and auditory only (auditory speech + still image of the face) conditions. Data are collected using NetStation and a 128-channel Geodesic sensor net (Net Amps 400 amplifier, Hydrocel GSN 128 EEG cap, EGI Systems Inc.). The raw EEG signal is sampled at 1000 Hz and referenced to vertex (Cz). The amplitude of the P2 component (defined a priori as occurring between 250 ms and 410 ms) as measured at Cz is extracted from the average ERP of each participant. Participants' language ability is measured via the MacArthur-Bates Communicative Development Inventories, the receptive and expressive subscales of the Vineland Adaptive Behavior Scales, and the receptive and expressive language subscales of the Mullen Scales of Early Learning. Scores from these measures are averaged following z-score transformation to derive receptive and expressive language aggregates. Preliminary results from data processed to date (12 Sibs-AUT; 16 Sibs-NA) suggest that there are no significant between-group differences, on average, in P2 amplitude suppression. However, there is considerable individual variability in the degree of P2 amplitude suppression experienced with access to audiovisual vs auditory-only cues, and P2 amplitude suppression significantly influences expressive language through its effects on receptive language. These findings not only replicate prior results in school-aged children, but also suggest that differential processing of audiovisual speech may emerge early in life and be clinically useful for explaining individual differences in language in infants at high and low likelihood for autism.

1-A-4 Deep generative modelling of cortical microstructural development in preterm neonates

Saga Masui[1], Abdulah Fawaz[1], Logan Z. J. Williams[1], Emma C. Robinson[1]

[1]King's College London

Introduction: Preterm birth is the leading cause of perinatal mortality in developed countries and a significant risk factor for neurodevelopmental impairment [1]. Recent studies have highlighted the role of cortical dysmaturation, detectable through diffusion

MRI (dMRI), in the long-term development of cognitive disabilities in preterm neonates [2][3]; however, most models used to analyse dMRI have been designed based on empirical data from adult white matter. Furthermore, complex neuropsychiatric and developmental disorders are known to display significant heterogeneity in their presentation across individuals [5], and consequently, there has been a shift toward using generative models that consider how each subject individually deviates from a normative model of typical brain development. While Gaussian process regression (GPR) models are a common choice for this, deep generative models are more robust to image registration errors due to. Hence, we combine optimised diffusion modelling for neonatal cortical grey matter (CGM) with a deep generative model to understand the development of cortical microstructure and how it is impacted by preterm birth.
Methods and Results: All subjects were recruited for the developing Human Connectome Project (dHCP) and part of the publicly available third data release [6]. Our dataset consists of 408 neonates, 103 of which were born preterm. Gestational ages (GA) at birth range from 25 to 42 weeks and all subjects were scanned between 28 and 45 weeks postmenstrual age (PMA). Diffusion tensor imaging (DTI) metrics of fractional anisotropy (FA) and mean diffusivity (MD) were calculated using MRtrix3 from b=0 and b=1000 diffusion-weighted imaging data [7], and Neurite Orientation Dispersion and Density Imaging (NODDI) metrics neurite density index (NDI) and orientation dispersion index (ODI) were obtained using AMICO [8][9]. The intrinsic parallel diffusivity (dll) in NODDI was optimised using the approach proposed in [4], for a group of 35 neonates that also included 10 preterms. All subjects showed a minimum NRMSE for dll = 1.3 Î¼m2 msâˆ’1 confirming [4]'s conclusion that the traditional value of 1.7 Î¼m2 msâˆ’1 is an overestimate for neonatal CGM. Following this optimisation all metrics were projected onto the cortical surface and registered using Multimodal Surface Mapping (MSM) driven by sulcation [10][11]. Our deep generative model is an adapted cycle GAN similar to [12], except age is modelled as a continuous rather than a discretised variable. An independently trained deep regression model with a mean absolute error (MAE) of 0.947 was used to quantitatively evaluate the accuracy of the apparent ages of our synthetic images. The model was applied to the aforementioned diffusion metrics in two experiments. The first experiment conditioned on PMA to describe the typical trajectory of healthy cortical development, generating synthetic images with an MAE of 1.09 weeks. The second experiment conditioned on GA to delineate the effect of preterm birth, yielding synthetic images with XXXweeks MAE, and difference maps that correlate with known preterm imaging biomarkers. We optimised NODDI for neonatal CGM and successfully modelled changes in cortical microstructure associated with typical neurodevelopment. Our model was also able to make individual-level predictions regarding the effects of preterm birth on the developing cortex.

1-A-5 Examination of iron content in the striatum from functional MRI in young children with autism spectrum disorder (pre-registered report)

Bosi Chen[1], Sara Bock[1], Lindsay Olson[2], Adriana Rios[1], Judy Mahmalji[1], Stephanie Peña[1], Annika Linke[1], Inna Fishman[1]
[1]San Diego State University, [2]Brain Development Imaging Laboratories

Brain tissue iron is essential for multiple aspects of brain function, including oxidative metabolism, myelination, and neurotransmitter (e.g., dopamine) synthesis and function. Previous studies have suggested age-related increase in brain iron content in the deep gray matter structures (basal ganglia) across the first two decades of life, with iron concentration plateauing in early adulthood in normative development. Atypically low iron content in the basal ganglia has been associated with poor cognitive outcomes in the context of iron deficiency in infancy. The only known study in young children with autism found reduced iron content in the striatum in toddlers with autism spectrum disorder (ASD) compared to typically developing (TD) children (Tang et al., 2022). Given the scarcity of such data in autism, it remains unknown how the maturational trajectory of iron content in the striatum deviates from normative development across the first years of life in ASD. The current study aims to examine (1) age-related effects in iron content in the striatum in preschoolers with ASD compared to TD peers and (2) the links between iron content and developmental skills in ASD and typical development. Participants include young children with ASD (n=59, mean age: 39Â±15 months) and typically developing (TD) children (n=39, mean age: 35Â±16 months) enrolled in a longitudinal study of early brain markers of autism. All participants underwent standardized assessment of developmental skills using the Mullen Scales of Early Learning (MSEL). Two 6-minute resting state fMRI scans were acquired during natural sleep on a 3T GE scanner. The ASD and TD groups do not significantly differ on age and head motion (root mean square displacement). A subset of the sample for whom longitudinal fMRI and behavioral data are available will be used for exploratory longitudinal analyses. Iron content will be estimated with R2*=1/normalized T2* from fMRI data and extracted in the bilateral caudate, putamen, nucleus accumbens, and pallidum. For Aim 1, ANCOVA will be employed to test for effects of age, diagnostic group, and age-by-group interaction in each region of interest (ROI) while controlling for sex, head motion, gestational age at birth, and socioeconomic variables. For Aim 2, linear regressions will be conducted between iron content in each ROI and MSEL cognitive domain T scores. Corrections for multiple comparisons will be conducted using Benjamini-Hochberg False Discovery Rate (FDR) at $q < 0.05$. For Aim 1, we hypothesize to find age-by-group interaction effect on iron content, with the normative age-related increase observed (cross-sectionally) in TD children and a weaker age-related increase (a shallower slope) observed in children with ASD. We also expect to find lower iron content in the striatum in children with ASD compared to TD children (main effect of diagnostic group), replicating the results of the only other known study in young children with ASD. For Aim 2, we expect that lower iron content will be associated with lower developmental skills (as assessed by the MSEL) in all children, with and without ASD. Data collection for this study is complete. The proposed analysis plan will be implemented and results will be presented at the Flux conference.

B - Effects of Early Exposures on Neurodevelopment; Methods Development or Dissemination

1-B-6 Establishing high-density diffuse optical tomography for bedside neuromonitoring of cortical hemodynamics in pediatric patients on ECMO

Sophia Mcmorrow[1], Tessa George[1], Chloe Sobolewski[1], Dalin Yang[1], Sung Min Park[1], Kelsey King[2], Ahmed Said[1], Adam Eggebrecht[1]
[1]Washington University in St. Louis, [2]Roosevelt University

Introduction: Extracorporeal membrane oxygenation (ECMO) is a medical intervention that provides life-sustaining care for patients experiencing life-threatening respiratory and/or cardiac failure. Patients on ECMO are susceptible to neurological complications including seizures, hemorrhage, and infarction. Neurological injury on ECMO is associated with an increased risk of neurodevelopmental, behavioral, and functional deficits. Unfortunately, conventional neuroimaging techniques suffer limited sensitivity to detect early signs of brain injury or pose additional risks such as transportation to a magnetic resonance imaging (MRI) facility. Therefore, it is

crucial to develop bedside neuromonitoring tools with high sensitivity and specificity for early detection of brain injury, with the ultimate goal of promoting early interventions and improving neurodevelopmental outcomes. Herein, we present high-density diffuse optical tomography (HD-DOT) tools for safe, non-invasive bedside neuroimaging with image quality comparable to functional MRI. Specifically, we assess the feasibility of HD-DOT for bedside assessment of cerebral hemodynamics and brain functional connectivity in ECMO-supported patients. **Method:** HD-DOT data were collected from four patients (age 2 weeks, 9 months, 28 months, and 16 years), with multi-day longitudinal data in three patients. Data collection periods lasted 1-3 hours. Minute-by-minute physiological measurements were obtained and aligned with 10 Hz HD-DOT data. Herein, we present example results from one neonatal patient on veno-arterial ECMO that included ECMO clamp trials. Periods of high quality data were identified for further analyses using NeuroDOT data processing (https://www.nitrc.org/projects/neurodot; Fig. 1). Clamp trials were pre-planned periods of temporary separation from ECMO support, wherein ECMO cannulas were clamped to stop blood flow and test the patient's ability to come off ECMO. The resulting temporal response of cerebral vasculature hemoglobin concentrations were quantified via modelled exponential functions. **Results:** HD-DOT data reveals rapid and notable changes in concentrations of deoxygenated (HbR) and oxygenated hemoglobin (HbO) and their difference (HbD), in response to ECMO clamp trials (Fig. 1G). Upon cessation of ECMO flow, there is rapid and significant relative reduction in HbO and HbD, along with an increase in HbR (Table 1). Additionally, oxygen saturation, mean arterial pressure (MAP), and renal near-infrared spectroscopy decreased with ECMO cessation. Our results indicate that changes in HbD are strongly correlated with changes in MAP, a sign of diminished cerebral autoregulation and an indication that the patient needs to remain on ECMO. When ECMO resumed, both relative hemoglobin and systemic physiologic metrics returned to baseline levels seen prior to the clamp trial. **Conclusions:** In this study, we establish feasibility of HD-DOT for real-time bedside neuromonitoring during ECMO maintenance, a valuable step towards understanding brain dynamics during ECMO support and promoting early identification of potential brain injury. Future analyses will investigate spatial-temporal variation in functional connectivity and cerebral oxygenation, as well as their relationship with physiological parameters and outcomes, with the potential to illuminate associations between brain integrity during ECMO maintenance and neurodevelopmental outcomes.

1-B-7 Prenatal Familial Income Volatility and Infant Subcortical Brain Volumes

Genevieve Patterson[1], Alexander Dufford[2], Sun Hyung Kim[3], Martin Styner[3], Pilyoung Kim[1]

[1]University of Denver, [2]Northwestern University, [3]University of North Carolina at Chapel Hill

Objective: Unpredictable environments can be a source of stress influencing the developing brain, including during the prenatal period. Emerging evidence suggests that socioeconomic status is associated with child brain development including in infancy (Betancourt et al. 2015; Ramphal et al., 2020; Gao et al., 2015). Household chaos and unpredictability have also been associated with child development at a behavioral (Evans et al. 2005; Davis et al., 2019), physiological (Tarullo et al., 2020; NoroÃ±a-Zhou et al. 2020), and neural (Granger et al., 2021) level. Income volatility, specifically income losses, has been associated with both externalizing and internalizing symptoms throughout development (Miller et al. 2021). However, little is known about the role of income instability and infant brain development. Here we examine the association between familial income instability and subcortical brain volumes in early infancy. **Methods:** The current study includes 63 infants from a prospective longitudinal study of pregnant individuals and their infants from diverse socioeconomic backgrounds (31.7% low income, prenatal income to needs ratio <=2)). Arc Percent Change (APC) in household earned income was calculated for each month compared to the previous month for the time period covering conception to the month of the childâ€™s birth. An income shock was defined as APC > 25% for a given month, with increases defined as a positive shock and decreases defined as a negative shock. The number of income shocks were summed across the prenatal time period for positive, negative, and total shocks. Infants completed an MRI after birth during natural sleep (Mean Age = 34.9 days, SD = 19.9 days; 52.4% female). Infant amygdala and hippocampus as well as tissue segmentation were individually segmented using a multimodality, multi-template-based automatic method combining T1- and T2-weighted high resolution images via workflow MultiSegPipeline software (Cherel et al., 2015), which employs atlas-registration and label fusion from the ANTs toolset (Tustison et al., 2021). **Results:** The number of negative income shocks during the prenatal period was associated with smaller volumes in the right hippocampus (r(61)=-.29, p=.02), left hippocampus (r(61)=-.26, p=.04), right amygdala (r(61)=-.44, p<.001), and left amygdala (r(61)=-.30, p=.02). These relationships all remained significant in regressions controlling for total brain volume, infant gestational age at scan, infant sex, and average prenatal income-to-needs ratio. **Conclusions:** We found evidence that familial income volatility during the perinatal period is associated with infant brain structure after birth, even when controlling for average income to needs ratio. These findings provide support for the development of public programs that prioritize consistency, especially for families and during sensitive periods like pregnancy.

1-B-8 Impact of maternal early life adversity and emotion dysregulation on infant neurodevelopment (pre-registered report)

Anna Constantino-Pettit[1], George Slavich[2], Rachel Lean[3], Barbara Warner[1], Joan Luby[1], Christopher Smyser[1], Deanna Barch[3], Cynthia Rogers[1]

[1]Washington University in St. Louis, [2]University of California, Los Angeles, [3]Washington University

Objective: Pervasive emotion dysregulation is a transdiagnostic marker of psychopathology that is associated with high-risk behaviors including suicidality and drug misuse. While prior research has linked maternal emotion dysregulation (MED) with offspring socioemotional problems, no existing study has attempted to investigate whether a neurodevelopmental signal of prenatal exposure to MED can be detected on offspring outcomes at birth. In this pre-registered report, we propose to investigate the impact of MED during in utero development on infant brain and behavioral outcomes. First, we will examine the impact MED on the earliest stages of neurodevelopment via white matter connectivity at birth in three tracts (fornix, cingulum bundle [CB], and uncinate fasciculus [UF]) that have been implicated in infant emotion development. Second, we will examine whether MED is a robust predictor of white matter connectivity while also taking into account maternal early life adversity (MELA) which is an established predictor of poor infant neurodevelopmental outcomes. Therefore, we will explore a mediation model to investigate the extent to which MED mediates the association between MELA and infant white matter microstructure. **Methods:** We will utilize data from the Early Life Adversity and Biological Embedding (eLABE) study, which recruited 398 mother-infant dyads during pregnancy. **Primary Measures:** Maternal early life adversity: MELA was ascertained using the Stress and Adversity Inventory (STRAIN). Maternal mood dysregulation: Maternal mood dysregulation was ascertained using the Adult Self Report (ASR) and the Inventory of Callous and Unemotional Traits (ICU). Maternal suicidal thoughts and behaviors (SITB): Maternal SITB was ascertained using both the Edinburgh Postnatal Depression Scale (EPDS) and

lifetime self-harm and suicidality behavior using the STRAIN. Infant Neuroimaging: Probabilistic tractography will be used to assess the CB, UF, and fornix from the birth diffusion MRI data. **Data Analytic Plan:** The eLABE study has completed data collection for all the timepoints spanning Prenatal timepoint 1 through Postpartum Year 3. All data has been extracted and cleaned, and analysis for this project will be completed by July. First, multiple regression models will examine the association between MED and neonatal UF, fornix, and CB mean diffusivity and fractional anisotropy (Model 1). Second, a mediation model will examine (a) the direct effects of MELA on white matter connectivity and (b) the indirect effect of MELA via MED (Model 2). **Hypotheses:** 1. Model 1: Higher levels of MED during gestation will be significantly associated with greater MD and lower FA in the prespecified white matter tracts. 2. Model 2: MELA and infant white matter connectivity will exhibit a dose-response relationship, such that mothers at the extremes of chronicity, severity, and duration of lifetime adversities will be associated with the greatest deficits in white matter connectivity. This association will be partially mediated by MED. **Conclusions:** Understanding the relative contribution of MELA and MED on infant neurodevelopment will clarify potential mechanistic pathways in the intergenerational transfer of psychopathology. MED is an especially modifiable target and, if implicated in this pathway, can provide robust support for the dissemination of interventions to ease the burden of MED during the perinatal period.

1-B-9 Social touch during feeding predicts infants' BOLD response in immature neural pathways

Cabell Williams[1], Meghan Puglia[1], James Morris[1], Kevin Pelphrey[1]

[1]*University of Virginia*

Social touch is nonsexual, pleasurable, affective touch that conveys social information and aids in the formation of social bonds. In infancy, feeding is a unique opportunity for parent-child bonding, due to the significant amount of social and operational touch. Gentle, affectionate touch (such as soft caresses or strokes) during breastfeeding has been shown to be neuroprotective in infant development, although the neurological mechanisms have yet to be explored. In adults, c-tactile afferents encode the emotional valence of touch through contralateral projections in the spinal cord, which traverse through the thalamus and into the insular cortex. Similarly, tactile sensory information is encoded via afferents, which travel ipsilaterally into the medulla, traverse contralaterally, where they continue to the thalamus and somatosensory cortex. However, infants display both ipsilateral and contralateral neural responses to touch, which may be reflective of immature neural profiles that rely on callosal connections. Around three months of age, callosal pruning occurs, making the thalamo-cortical pathways more salient. Thus, our research aims to assess how external environmental factors, like gentle touch, may influence the salience and lateralization of social tactile processing. We hypothesize that infants who experience more gentle touch during feeding will show a greater BOLD response to social compared to non-social touch in the thalamus, somatosensory cortex, insula, and medulla. To assess this question, to date nine full-term infants under five months of age underwent a five-minute feeding paradigm where parents were instructed to feed the infant as they would at home. These videos were behaviorally coded to measure the total duration of gentle touch. Afterwards, infants were rocked to sleep and underwent functional magnetic resonance imaging (fMRI). During the fMRI, infants were gently stroked with a paintbrush on their left leg to simulate both social (paintbrush on skin) and non-social (paintbrush strokes with plastic placed between paintbrush and the skin) touch. Group-level analyses for the main effect of social compared to non-social touch showed greater BOLD response in the left occipital cortex, somatosensory cortex, occipital pole, the right frontal pole, precuneus cortex, medial prefrontal gyrus, central opercular cortex, planum temporale, medial and inferior frontal gyrus, occipital fusiform gyrus, temporal fusiform cortex, right and left supramarginal gyrus, precentral gyrus, superior parietal lobe, superior frontal gyrus, and middle temporal gyrus. A general linear model was then used to predict whole-brain BOLD response from the total duration of gentle touch during feeding. Gentle touch positively predicted BOLD response in the right brainstem. These results indicate that infants globally process social touch in neural regions similar to adults. However, the lack of contra-lateralization of the neurological responses to social tactile stimuli may be indicative of immature neural pathways that may be ascending through callosal connections. Additionally, studies in adults have shown spatial representation of touch discrimination within the brainstem and midbrain regions. Perhaps gentle touch aids in the development of discriminatory pathways early in life. Future work should take a longitudinal approach to measure the trajectory of change from processing via callosal connections to thalamo-cortical connections.

1-B-10 Caregiver inhibitory control and infant visual working memory

Christina Davidson[1], Aimee Theyer[1], Ghada Amaireh[1], Sobana Wijeakumar[1]

[1]*University of Nottingham*

Objective: Caregivers play a significant role in shaping children's early cognitive development. Previous research has shown that maternal executive functions (EF) can predict child EF at 24 months of age. However, it is unknown if maternal EF sub-functions begin to have an impact on child executive functions as early as the first year of life. Further, to uncover underlying mechanism(s), it is important to examine whether maternal executive function behaviours also shape the infant brain. Here, we used experimental tasks to investigate how inhibitory control in caregivers, an important executive sub-function linked to socio-emotional regulation was associated with visual working memory (VWM) function in their infants. **Methods:** 88 caregivers (*Mage* = 33.4 years, *SD* = 4.4) and 86 infants (*Mage* = 250.6 days, *SD* = 35.8) participated in the study. To measure inhibitory control, the caregivers completed a Go-NoGo (GNG) task. Caregivers had to either elicit or inhibit a response for four separate stimuli. A GNG efficiency score was calculated for each caregiver by dividing the average reaction time across both responses by the rate of correct responses to provide an index of processing efficiency such that higher scores indicated more efficient GNG performance. To assess VWM, infants were presented with a preferential looking task. In this task, two side-by-side displays of coloured shapes flashed on and off. On the 'unchanging' side, the colours were always the same and on the 'changing' side, a random shape changed colour after each flash. VWM load was manipulated by presenting 1 (low), 2 (medium) or 3 (high) items. Change preference (CP) scores were extracted by calculating how long the infant looked towards the changing side and dividing this by the total looking time. Functional near-infrared spectroscopy was used to record brain activation from caregivers and infants as they engaged in their respective tasks. fNIRS image reconstruction was implemented to analyse data in the voxel space. Linear mixed effects modelling was used to examine the behavioural and brain data. **Results:** Our results revealed no association between caregiver GNG efficiency and infant CP score. Linear modelling of the brain data revealed two significant interactions highlighting associations between the caregiver GNG efficiency score and infant brain function. First, a higher GNG efficiency score in caregivers was associated with increased left inferior parietal cortex activation in infants. Second, there was a four-way interaction between VWM load,

CP, GNG efficiency, and chromophore in the left inferior parietal lobule, a region important for maintaining object representations in VWM. Specifically, infants who had better CP scores and/or were reared by caregivers with greater GNG efficiency showed greater left inferior parietal cortex activation. Importantly, infants who had poorer CP scores and caregivers with poorer efficiency scores poorly activated this region. Our findings collectively suggest that caregiver inhibitory control might be important for honing brain function associated with VWM processing. **Conclusions:** Our findings shed light on potential mechanisms through which caregiver executive sub-functions might shape very early neurocognition.

1-B-11 Associations between stressful life events, prenatal anxiety, and infant amygdala-ACC functional connectivity

Jenna Chin[1], Haitao Chen[2], Wei Gao[3], Pilyoung Kim[1]

[1]University of Denver, [2]University of California, Los Angeles, [3]Cedars-Sinai Medical Center

Background: Extant literature has demonstrated associations between prenatal stress and infant brain outcomes. However, studies examining the role of prenatal life events in shaping infant functional connectivity (FC) remain limited. It is also unclear how prenatal psychological distress may interact with stressful event exposure. Here we use resting-state fMRI (rs-fMRI) to examine the effects of stressful event exposure and gestational parent anxiety symptoms on amygdala (amyg)-anterior cingulate cortex (ACC) FC, a neural circuit with known stress-related alterations. **Method:** Participants were 56 gestational parent-infant dyads. Prenatal stress was measured at three prenatal time points using a Life Events Interview (Lobel et al., 1992). Participants rated the severity of endorsed events from neither negative nor undesirable (1) to extremely negative or undesirable (5). Severity scores were summed to compute severity-weighted life event totals. To assess prenatal anxiety symptoms, gestational parents completed the State-Trait Anxiety Inventory at three prenatal time points (Spielberger, 1989). Scores across the three prenatal time points were averaged to create a composite prenatal anxiety score. Infants completed a rs-fMRI scan (M=32.31, SD=16.14 days). Amyg to ACC FC values were computed based on the infant 2-year AAL atlas (Shi et al., 2011). The average fMRI time series for each ROI were calculated by averaging the time series across all voxels within the region. Pair-wise correlations were calculated and values were Fisher-Z transformed. First, associations between each ROI to ROI FC (i.e., left amyg-left ACC, left amyg-right ACC, right amyg-left ACC, right amyg-right ACC) and prenatal stress were tested using four separate regressions. All analyses controlled for infant postnatal age and sex. We then tested whether gestational parent prenatal anxiety symptoms mediated significant associations between prenatal stress and infant rs-FC. **Results:** Higher prenatal stress, operationalized as severity-weighted stressful life event totals, was associated with decreased left amyg-left ACC FC values (b= -.294, SE = .002, p =.030; Fig. 1a) and decreased right amyg-left ACC FC values (b = -.312, SE = .002, p =.021; Fig. 1b). Prenatal stress was not significantly associated with left amyg-right ACC FC or right amyg-right ACC FC. The effect of prenatal stressful events on infant left amyg-left ACC was fully mediated by prenatal anxiety symptoms, such that the indirect effect of prenatal stressful events on left amyg-left ACC FC was significant (b = -.003, [-.0053, -.0003]; Fig. 2a). The remaining direct effect of prenatal stressful events on left amyg-left ACC was not significant. We did not find evidence that the effect of prenatal stress on infant right amyg-left ACC was mediated by prenatal anxiety symptoms (Fig. 2b). **Conclusion:** We found evidence that prenatal stress characterized as severity-weighted stressful life events is associated with infant functional connectivity. We also found evidence that gestational parent prenatal anxiety symptoms may mediate this relationship. Our findings contribute to the growing literature on prenatal stress exposure and the functional connectivity of emotional circuits in infants and highlight the prenatal period as target for interventions that improve infant and family well-being.

1-B-12 The infant negative central ERP component in response to face gender and race

Kira Ashton[1], Ian Vaughan[1], Nicole Sugden[2], Margaret Moulson[3], Laurie Bayet[1]

[1]American University, [2]University of British Columbia, [3]Ryerson University

Infants show an early visual preference for faces and face-like objects (Mondloch et al., 1999; Viola Macchi et al., 2004). There is an established visual preference that develops between 3-6 months for faces of an infant's own race, or the race of their primary caregiver (Kelly, Liu, et al., 2007). Gender also influences infants' face preferences, with a visual preference for female faces observed as young as 3 months (Liu et al., 2015; Quinn et al., 2008). We used an existing electroencephalography (EEG) dataset collected while 3, 6, and 9 month old infants viewed images of faces. Infants were shown male and female faces, of the same race as their primary caregiver (own-race) and of the race of neither caregiver (other-race). Male other-race condition data was excluded due to confounding low level visual differences in these stimuli. The negative central (Nc) event related potential (ERP) component is thought to reflect attention orienting, and shows an increased amplitude in response to novel or unexpected stimuli in infants (Richards, 2003). To examine how face race and gender influenced attention as indexed by the Nc over central and frontal electrodes, we used linear mixed effect models to assess the interactive and additive effects of face race, face gender, and infant age on average Nc amplitude during the 300-700 ms time window post-stimulus onset (Figure 1A). We then performed source analysis using age-appropriate MRI head models to calculate current density reconstruction (CDR) over the medial prefrontal cortex, cingulate cortex, and precuneus (Figure 1B). The results of the ERP analysis (Figure 2) showed significant main effects of ROI and age (ps<0.01). Significant interactions were found between face gender and ROI (p=0.033), face gender and age (p<0.001), and ROI, age, and face gender (p=0.002). In the 3-month-old age group, there were significant main effects of face gender and ROI, as well as an interaction between face gender and ROI (ps<0.001). Nc amplitude was significantly stronger in response to female faces overall, specifically in the frontal midline region. There was a significant interaction between face gender and ROI in the 6-month-olds, with greater response to male faces in the midline frontal region and female faces in the center right region. There were no significant effects of gender or ROI in the 9-month-old age group. CDR was also significantly affected by ROI (p<0.001), an interaction between face race and age (p=0.035), and an interaction between ROI and age (p=0.007) (Figure 3). The race by age interaction was driven by a significantly greater response to other race faces in 3 month olds. Taken together, the results of the ERP analysis suggest increased attention to female faces in younger infants, with region specific increases in response to male and female faces. The source analysis results suggest a regional shift in response to faces over different age groups, with overall stronger responses to own-race faces at 3 months.

1-B-13 Using functional near-infrared spectroscopy (fNIRS) to assess the interplay among malnourishment, brain connectivity and behavioral outcome in 12-month-old Bangladeshi children (pre-registered report)

Renata Di Lorenzo[1], Laura Pirazzoli[1], Eileen Sullivan[1], Talat Shama[2], Charles Nelson[1, 3], Terrence Forester[4], Justin O'sullivan[5]

[1]Boston Children's Hospital, [2]ICDDR,B, [3]Harvard Medical School, [4]University of the West Indies, [5]University of Auckland

Millions of children under 5 years suffer from chronic and acute malnutrition in Bangladesh (UNICEF). Malnutrition is particularly impactful during infancy, given that it is during this period when the brain architecture supporting the foundations for the development of cognitive, motor, and social-emotional skills are built. Recent findings have started to shed light on its impact on brain development4,5. Therefore, nutritional deficiencies during infancy are likely to affect cognition and behavior throughout childhood possibly leading to long-term consequences into adulthood2. While a wealth of research has been conducted in low- and middle-income countries (LMICs) on the behavioral outcomes of children facing adverse circumstances (e.g., malnutrition), few studies have attempted to probe the mechanisms underlying links among malnutrition, brain development, and behavioral outcomes in LMICs. Our study uses fNIRS to investigate how functional brain connectivity (FC) in 12-month-old Bangladeshi children is related to malnourishment and investigates relations to behavior. During our fNIRS paradigm, we recorded brain activity from 42 channels covering fronto-temporo-parietal areas, while infants passively watched a 10-minute nonsocial cartoon. We indexed malnutrition using weight-for-length z-scores (wasting), a common metric to assess acute malnutrition in LMICs; while to index behavioral outcome we used the Bayley Scales of Infant and Toddler Development (a gold-standard tool to assess early cognitive performance which has been previously deployed in Bangladesh3) as well as other measures of executive functioning (e.g., inhibitory control tasks). While the processing of the behavioral assessments is ongoing, here we show preliminary analyses on the FC patterns measured in acutely malnourished/wasted children and in controls. We estimated FC between the regions of interest covered by our headcap (ROIs are currently defined using DevFold1; Figure1). For each group, we correlated (Oxy-hemoglobin) FC measures with the Bayley raw scores obtained from cognitive, expressive and receptive communication scales. Our results show several significant positive correlations between FC and the Bayley scores indexing expressive and receptive communication for the control group, while no correlation reached significance for the wasted group. These preliminary results highlight the critical effects of malnutrition on brain development, which in turn seems to affect behavior. Possibly, malnourishment suppresses the brain-behavior relations emerged for the controls. Notably, this simple fNIRS task shows sensitivity in identifying language differences between these groups. **References:** 1. Fu, X., & Richards, J. E.(2021). devfOLD: a toolbox for designing age-specific fNIRS channel placement. 2.Prado, E. L.,& Dewey(2014). Nutrition and brain development in early life. *Nutrition reviews,72*(4), 267-284 3.Tofail, F. et al.(2013). Psychosocial stimulation benefits development in nonanemic children but not in anemic, iron-deficient children. *The Journal of nutrition,143*(6), 885-893. 4.Turesky, T. et al.(2020). Relating anthropometric indicators to brain structure in 2-month-old Bangladeshi infants growing up in poverty: A pilot study. *Neuroimage, 210* 5.Xie, W. et al. (2019). Growth faltering is associated with altered brain functional connectivity and cognitive outcomes in urban Bangladeshi children exposed to early adversity. *BMC medicine, 17*

1-B-14 Simultaneous EEG-fMRI exploration of the relationship between resting state network connectivity and the EEG aperiodic exponent in preterm infants

Ryan Stanyard[1], Tanya Poppe[1], Lucas Franca[2], Kimberley Whitehead[3], Lorenzo Fabrizi[3], Dafnis Batalle[1], Tomoki Arichi[1]

[1]King's College London, [2]Northumbria University, [3]University College London

The perinatal period is a crucial neurodevelopmental window for the growth and maturation of synapses and circuits fundamental for neural communication and behaviour across the lifespan. Preterm birth engenders multiple adverse effects on the functional and structural properties of the brain, with many studies demonstrating altered functional connectivity compared to term-born infants, including that of resting-state networks (RSNs). Yet how these emerging networks are functionally shaped by local circuit spiking remains largely unaddressed. EEG measures of neural spiking reflect gradual changes across the period concomitant with brain maturation and development, with marked differences between preterm and term-born infants. In addition, the 1/f EEG signal has physiological relevance as an in vivo proxy of excitation:inhibition (E:I) homeostasis in local circuits. However, little is known about the role of aperiodic (1/f) exponent (Donoghue *et al.*, 2020) maturation in the emergence of RSN development, which may serve as biomarkers of atypical neurodevelopment. Simultaneous resting-state EEG (17 channels) and BOLD fMRI data (T2*-weighted single-shot gradient echo echo-planar imaging sequence, 2.5*2.5*4.00mm, 21 slices, TE: 30-45msec, TR: 1500msec, FA: 60-"90degrees, SENSE factor 2) were acquired using a 3T Philips scanner in 33 (17 females) naturally sleeping infants (Postmenstrual age [PMA] range: 30.71-39.29wks, mean: 34.59Â±2.00wks; gestational age range: 25.71-39.00wks, mean: 32.15Â±2.83wks). Following fMRI data despiking (AFNI 3dDespike), group networks were determined using FSL MELODIC ICA (Beckmann *et al.*, 2005) on subjects with minimal head motion (framewise displacement <1.25mm) and EEG data with 1/f specparams model (Donoghue *et al.*, 2020) fitted to 0.5-10Hz with goodness-of-fit â‰¥ 0.95. fMRI volumes (215TRs, 322.5s) were extracted per infant and group ICA networks were regressed onto individual subject data. Beta averages in thresholded group-network ROIs yielded core network strength (CNStr), per network, per infant. Aperiodic (slope/exponent) and periodic (aperiodic-adjusted power, canonical power) features were extracted from EEG data for a 150-volume subset. Multivariate regression analyses explored how fMRI CNStr was explained by aperiodic/periodic EEG measures. Whilst the average aperiodic exponent was not associated with CNStr, a regional descriptor (principal component) of channel-wise exponents was. The regional aperiodic descriptor, maximally represented by electrode C3, was significantly associated with increases in somatosensory CNStr ($p_{corrected}$=.03). Exploratory associations between delta power and CNStr for a dorsal frontocortical network were observed (p=.03), alongside aperiodic-adjusted delta power (power above the exponent) and medial motor CNStr (p=.02), but do not survive multiple comparisons correction. Similar to studies in later life (Cellier *et al* 2021; Hill *et al.*, 2022) we show the regional aperiodic exponent descriptor plays a functional role in the development and maturation of neural communication. The average exponent decreases as PMA increases, also in line with later lifespan studies (though the developmental process and timescale will differ at later ages), suggesting a maturational flattening (decrease) in the exponent. This suggests the maturing strength of the network may reflect changes in circuit-level E:I homeostasis.

1-B-15 The effects of acculturative stress during pregnancy on the developing offspring brain

Vinus Mahmoodi[1], Cristin Holland[1], Kiarra Alleyne[1], Antonette Davids[1], Arline Pierre-Louis[1], Claire Bang[1], Victoria Oyeneye[2], Rebecca Kiflom[1], Eileen Shea[3], Bin Cheng[4], Bradley Peterson[5], Catherine Monk[1], Dustin Scheinost[6, 7], Marisa Spann[1]

[1]Columbia University, [2]Rutgers University, [3]New York Psychiatric Institute, [4]Columbia University Irving Medical Center, [5]University of Southern California, [6]Wayne State University, [7]Yale University

Introduction: Acculturation is the process by which individuals adapt and cope within a culture different from their own, which is often associated with stressors and challenges. Acculturative stress emerges from the demands, strains, and -œwear and tear-□ of acculturation. The negative effects of acculturative stress can have deleterious effects on the mental wellbeing of pregnant women, and is associated with depression and anxiety, as well as on brain development of the fetus. Purpose: The purpose of this study was to better characterize ethnic and racial stressors during pregnancy in predominantly Hispanic adolescents and the relationships these stressors have with their offsprings' neonatal functional connectivity. **Method:** A sample of 165 nulliparous predominantly Hispanic pregnant women, aged 14 to 19 years, were recruited through obstetrics and gynecology departments at two different hospitals. Participants completed two self-reported measures on acculturation during the 2nd or 3rd trimester: 1) the Acculturation, Habits, and Interests Multicultural Scale for Adolescents (AHIMSA) and the Short Acculturation Scale for Hispanics (SASH). They also completed measures on maternal distress (depression, perceived stress, and childhood trauma) and experiences of discrimination. A data-driven clustering of acculturation, discrimination, perceived stress, depressive symptoms, trauma, and sociodemographic variables during pregnancy were performed to determine whether acculturation clustered with other types of factors. Additionally, infant MRIs occurred within the first five weeks of life to assess whole-brain seed connectivity from the right and left amygdala combined into a single seed. The time course of a reference region was computed as average time course across all voxels in the region, and this was correlated with time course for every other voxel in the gray matter to create a map of r-values, reflecting seed-to-whole-brain connectivity. These r-values were transformed to z-values yielding a map for each seed, representing the strength of correlation with the seed for each participant. **Results:** Acculturation styles loaded onto different factors from perceived stress, depressive symptoms, trauma, and socioeconomic status. An optimal model including only the AHIMSA and the SASH led to the following three factors: assimilation-separation, assimilation-integration, and marginalized. Higher maternal report of assimilation-separation was associated with weaker connectivity between the amygdala and bilateral fusiform gyrus of their neonate. **Conclusion:** Our findings suggest that maternal prenatal acculturative stress is an additional stressor associated with neonatal functional connectivity of the amygdala. This is intriguing, as previous literature demonstrates an association between the fusiform and ethnic or racial processing in adults. Cautiously, results may suggest a similarity to studies with adults, noting that experience of acculturation may have a possible effect on amygdala circuitry across generations. Further studies that have a more diverse population of minoritized individuals and use comprehensive assessment of ethnic, racial, and structural stressors are needed.

1-B-16 Maternal report of home chaos at 18 months is associated with change in infant anger and social fear between 18 and 24 months

Ysa Fernandez[1], Koraly Pérez-Edgar[2], Kristin Buss[1], Vanessa LoBue[3], Morgan Gilmer[2], Kelley Gunther[4, 5]

[1]Penn State University, [2]The Pennsylvania State University, [3]Rutgers University, [4]Wayne State University, [5]Yale University

Household chaos refers to the level of stability, routine, and organization there is in a home (Matheny et al., 1995). Prior work has linked household chaos to overall environmental stress, as well as parental traits such as depression and parenting behaviors. Each of these factors, individually and together, have been associated with behavior problems in children and early temperamental traits. However, we know relatively less about change in temperament in infancy. The current analysis focuses on infant anger and social fear because these early appearing forms of negative affect may uniquely reflect the day-to-day stress and instability of a home environment reflecting higher levels of chaos. The current study leveraged a large-scale longitudinal study (Perez-Edgar et al., 2021) of infants from 4 to 24 months of age. In this analysis we focused on maternal reports of chaos on the Confusion, Hubbub, and Order Scale (CHAOS) at 18 months. Mothers also reported infant levels of anger and social fear using the Toddler Behavior Assessment Questionnaire (TBAQ) at 18 and 24 months. First, we tested the zero-order correlations between home chaos at 18 months and TBAQ scores at 18 and 24 months. As expected, Anger scores at 18 months were highly correlated with Anger at 24 months (r=0.53, p<0.001) and Social Fear scores were correlated between 18 and 24 months (r=0.45, p<0.001). In addition, Anger and Social Fear were correlated at both 18 (r=0.15, p=0.032) and 24 (r=0.17, p=0.033) months. However, change in Anger between 18 and 24 months was not correlated with change in Social Fear (r=0.08, p=0.322). CHAOS was only correlated with Anger at 24 months (r=0.23, p=0.008), with no significant relation at 18 months or with Social Fear at either time-point (r's<0.13, p's>0.142). Second, we used separate general linear models to examine change in Anger and Social Fear as a function of CHAOS at 18 months. Sex as reported by parent was included as a covariate in each model. For Anger, there was a significant positive relation such that higher levels of CHAOS were associated with larger increases in Anger over the following 6 months (b=0.024, p=0.015). This reflects the zero-order correlation between CHAOS and the difference score (r=0.21, p=0.013). Although similar in direction, the relation between CHAOS and Social Fear was not significant (b=0.022, p=0.078). These findings suggest that maternal perception of home chaos may be an important facet of the environment to consider in influences on a child's socioemotional development. Although both anger and social fear were correlated at both time points in line with the larger literature, the specific relation between chaos and change in negative affect was only significant for anger. This may reflect unique child-driven responses in this developmental window. However, future work will need to disentangle the mechanisms that may differentiate profiles of negative affect into toddlerhood. Future directions should examine these interrelations longitudinally.

1-B-17 Decoding infants' native and non-native stress cue-weighting

Zhen Zeng[1, 2], Liquan Liu[3]

[1]The Chinese University of Hong Kong, [2]MARCS Institute, WSU, [3]Western Sydney University

Sensitivity to speech rhythmic patterns facilitates its acquisition, from segmenting words to tracking hierarchical structures in natural speech (see Barajas et al., 2021 for a review), yet the extent to which the processing is contributed by phonological and auditory-general mechanisms is under discussion and debate, especially in infancy. Most of the infant EEG studies investigated event-related potentials (ERPs) where the polarity of the brain responses to signals at a given age have been inconsistently reported and interpreted

(e.g., Friedrich et al., 2007; RagÃ³ et al., 2021; Weber et al., 2004). In particular, positive and negative mis-match responses were found cancelled out when signals are averaged at the group level (e.g., Kidd et al., 2018; Kooijman et al., 2009). Time-resolved multivariate decoding methods have gained popularity in recent years as an alternative in examining the signal processing in the infant brain. The current study aims to better understand cue-weighting of pitch, intensity and duration that signal lexical stress in infants learning a stress language -" English, versus infants learning a non-stress and tonal language - Mandarin. Previous ERP findings show cross-linguistic cue-weighting differences in adult speakers of these languages, such that adult native speakers of English weight intensity as the most important cue signalling lexical stress, but adult native speaker of Mandarin weight pitch as the most important, followed by intensity and duration. Mandarin adults also show diminished responses to duration cues compared to the English adults. However, these Mandarin adults also have had second language learning experience of English, creating a confound for understanding the language-specific influences. In the present study, we investigate the developmental trajectory of the cross-linguistic cue-weighting in preverbal infancy at 7-8 months and 10-11 months, when English infants undergo enhanced lexical stress processing from an initial trochaic stress bias to being capable of processing both trochaic and iambic stress patterns (Jusczyk et al., 1999). These ages are also chosen to investigate potential perceptual reorganisation effects reported in French and Spanish infants (Skoruppa et al., 2009, 2013) We investigated the time-resolved brain responses in the decoding the initial and final stress placement signalled by pitch, intensity or duration in a dissyllabic nonword structure /dede/ (previously reported in Zeng et al., 2022) by English-learning and Mandarin-learning infants at 7-8 months (younger; English n = 15, Mandarin n = 15) and 10-11 months of age (older; English = 16, Mandarin n = 16). Decoding of stress placement for each cue revealed that: 1) for English-learning infants, above-chance decoding was found for intensity and duration in the younger group, but for all three cues in the older group; 2) for Mandarin-learning infants, significant decoding was observed for pitch and intensity in the younger group but only for pitch in the older group. These results provided detailed auditory neural profiles of stress-cue-weighting in English and Mandarin-learning infants and suggest that infants decode stress placement across syllable positions when the signalling cues are relevant to their native language.

1-B-18 Maternal blood pressure during pregnancy and its' role in infant autonomic nervous system brain development

Cristin Holland[1], Isabelle Mueller[1], Richard Sloan[1], Dustin Scheinost[2, 3], Marisa Spann[1]

[1]Columbia University, [2]Wayne State University, [3]Yale University

High blood pressure, or hypertension (HTN), is a major risk factor for cardiovascular disease, and one in ten women experiences a form of HTN while pregnant. HTN in pregnancy increases risk of fetal demise and prematurity, and can be associated with poor perinatal outcomes including fetal growth restriction, preterm birth, and stillbirth. Offspring exposed to hypertensive disorders of pregnancy are at elevated risk for developing HTN and cardiovascular disease.The ANS is critical regulating blood pressure, which starting prenatally, and involves input from higher order brain regions (e.g. prefrontal cortex) after 30 weeks gestation. Connections between the ANS and cortex help interpret environmental stressors and generate physiologic responses, but few studies consider higher order brain relative to brainstem regulators of ANS in early life. Further, how HTN affects early regulation in offspring has not be studied. As such, this study aims to evaluate relationships between maternal ANS modulation during pregnancy via blood pressure and offspring ANS brain development. **Methods:** This study sample consists of 50 mother-offspring dyads. Continuous blood pressure was collected from the mothers in their third trimester of pregnancy during a standardized physiological protocol. Blood pressure signals were digitized and passed to a microcomputer. Then custom-written software detects the time and magnitude of each systolic peak and diastolic trough, resulting in a blood pressure time series. Infant fcMRI scans of the women's offspring occurred between 2-6 weeks of postnatal age. With three layers of ear protection applied, the infant was fed, swaddled, and once asleep, he/she placed and secured on the scanner bed. Images in 6 resting state scans were acquired and averaged off-line to allow for rescanning one of the acquisitions if the infant moved. Infant fcMRI data were transformed to the 2 week (+/- 2 weeks) old template from the NIH Normal Brain Development Study using a concatenation of three registrations. Data was slice time and motion corrected, and images were iteratively smoothed. Brain regions of interest (ROI) are the hypothalamus, dorsal anterior cingulate, dorsal medial frontal cortex, and amygdala because of their involvement in regulation. The time course of a ROI were computed as average time course across all voxels in the ROI, and this was correlated with time course for every other voxel in the gray matter to create a map of r-values, reflecting seed-to-whole-brain connectivity. These r-values are transformed to z-values yielding a map for each participant representing the strength of correlation to the seed region. **Analytic Plan:** Linear regression with ROI connectivity maps as the dependent variable and maternal blood pressure during pregnancy as the predictor variable will be used. A model for each ROI connectivity map will be repeated. P<0.05 corrected will be considered significant. **Preliminary Results:** Preliminary data showed that newborns exposed to maternal hypertensive [n=11] compared to normotensive [n=20] levels of blood pressure, had increased connectivity between the right amygdala and the dorsal medial frontal cortex and anterior cingulate. **Conclusion:** This study will demonstrate the influence of exposure to a hypertensive in utero environment on offspring brain development, and further elucidate intergenerational mechanisms that impact the development of ANS regulation in early infancy.

1-B-19 Evaluating uncertainty in absolute concentrations of infant metabolic brain signatures using in vivo proton magnetic resonance spectroscopy (pre-registered report)

Ronald Instrella[1], Marisa Spann[1], Isabelle Mueller[1], Dustin Scheinost[2, 3], Christoph Juchem[1, 4]

[1]Columbia University, [2]Wayne State University, [3]Yale University, [4]

There is increasing interest in the use of proton in vivo magnetic resonance spectroscopy (^{1}H-MRS) to perform non-invasive metabolic profiling of an interrogated region of interest in the infant brain.[1-3] This method can be used to measure the concentration of various metabolites. Notably, ^{1}H-MRS has been employed to study indicators of neurochemical profiles during gestation.[4] Ensuring the accuracy of such methods is crucial, particularly in studies that involve unique technical challenges and vulnerable populations.[5] Traditional reporting metrics for the uncertainty of absolute concentrations derived from ^{1}H-MRS, such as the CramÃ©r Rao Lower Bound (CRLB),[6] do not incorporate several potential sources of error from the standard quantification pipeline. This includes parameter uncertainties used in correction factors applied in absolute quantification,[7] which is a standard method for translating the individual metabolic signal contributions from arbitrary to absolute units. A previous retrospective case study showed the total precision to be overestimated by a factor ranging from 1.4 to 6 in metabolites quantified using this technique compared to the CRLB.[8] The purpose of this study is

to examine the effect of multiple uncertainty sources on MRS-derived concentrations, by providing a comprehensive estimate of the concentration uncertainty from a set of quantified ^{1}H-MRS spectra acquired in healthy infants. We hypothesize the overall precision of metabolite concentrations to be severely overestimated when accounting for correction factor variances. Single voxel spectroscopy scans were acquired from healthy infants (n=21, ages 0 to 9 months) on a GE SIGNA 3 T scanner at the New York State Psychiatric Institute using a semi-LASER sequence.[9] 8 cm^3 isotropic voxels were positioned in the anterior cingulate cortex, cerebellum, occipital lobe, prefrontal cortex and temporoparietal junction, and each region of interest was scanned twice per subject. Standard MRS pre-processing will be performed in INSPECTOR[10], including frequency and phase alignment, signal baseline handling, eddy current correction, line broadening, signal apodization and zero-filling, among others. Spectral quantification will be performed using linear combination modeling approaches,[11] and absolute quantification methods will be used to estimate the molar concentration of the following metabolites: myo-inositol, + glycine, total N-acetyl aspartate, and glutamate + glutamine. The propagation of uncertainty will be used to estimate the precision of concentrations using both analytical approximations and Monte Carlo simulations. Absolute quantification will be performed using both an internal total creatine and tissue-specific water reference. Parameters for correction factors to account for differences in the relaxation times (e.g. T_1, T_2), and reference concentrations will be taken from in vivo ^{1}H-MRS literature with published standard deviations. The overall uncertainty will subsequently be compared to the CRLB of the metabolite of interest. This study will help strengthen efforts to not only understand the underlying neurochemical profiles of the developing offspring brain but will also improve processing methodology in ^{1}H-MRS through more rigorous evaluation of intermediary post-processing, ultimately bringing this technology closer to more widespread clinical use.

1-B-20 Identifying Prenatal Psychological Influences on Infant Neural Signatures

Tara Rutter[1], Kelly Molloy[1], Madelyn Heise[2], Joel Nigg[1], Sarah Karalunas[2], Elinor Sullivan[1], Hanna Gustafsson[1]

[1]Oregon Health & Science University, [2]Purdue University

Background: Frontal EEG asymmetry, a neural index of behavioral approach and withdrawal, is related to risk for depression (Allen & Reznik, 2015). Infants of birthing parents who are depressed in the postnatal period demonstrate greater right frontal asymmetry (Field et al., 2011), a pattern that has been associated with impaired emotional processing and risk for psychopathology. While several studies have linked greater infant frontal asymmetry with birthing parent depression postnatally, the effects of prenatal depression on infant brain development are not well understood, despite evidence that prenatal depressive symptoms exert unique effects on other metrics of infant brain development (Dufford et al., 2021). Research guided by the Developmental Origins of Health and Disease framework (Wadwha et al., 2009) has shown that birthing parent psychological states during pregnancy can alter gestational-fetal-placental biology in ways that influence fetal brain development. While preliminary studies suggest that prenatal depression is associated with greater infant frontal asymmetry (Goodman et al., 2021), several questions remain and constitute our study **Objectives:** 1) Depression and anxiety commonly co-occur in the perinatal period, yet no study has examined whether prenatal anxiety also relates to infant frontal asymmetry. Given that depression and anxiety have similar biological correlates in the perinatal period (and these biological sequelae are the purported mechanism of effect), we hypothesize that both symptom types will contribute to infant frontal asymmetry, independent of the effect of postnatal symptoms; 2) Previous research has almost exclusively examined diagnostic group differences (i.e., clinically depressed vs. controls), but evidence suggests that variation in subclinical levels of anxiety and depression also exert meaningful effects on infant brain development (Graham et al., 2020). If dimensional measures of depression and anxiety are related to infant frontal asymmetry, this would indicate a broader approach to screening and intervening on perinatal symptomatology; and 3) The postnatal environment has potential to perpetuate, exacerbate, or ameliorate the effects of prenatal symptomatology (Pluess & Belsky, 2011), yet interactions between prenatal and postnatal symptomatology remain underexplored. We hypothesize that infants whose mothers endorsed high levels of anxiety and depression in both prenatal and postnatal periods will have greater frontal asymmetry than those whose mothers only endorsed high symptoms during pregnancy. **Methods:** Birthing parents (N=100) completed the Spielberger State-Trait Anxiety Inventory (Spielberger et al., 1999) and Center for Epidemiologic Studies-Depression Scale (Radloff, 1977) during the 2nd and 3rd trimesters and at 1 month postpartum. Infant resting state EEG was recorded using a 32-channel system (MChildAge=1.44 months), as described previously (Karalunas et al., 2022). Frontal asymmetry was calculated within the 3-12 Hz band by comparing power at right (F3) and left (F4) frontal sites. Hypotheses will be tested using multiple regression. Independent and interactive effects of a) anxiety and depressive symptoms and b) pre- and post-natal symptoms will be tested. Trimester-specific and child-sex effects will be explored in secondary analyses. Covariates (e.g., child age, sex, demographics) will be included in models as appropriate. FIML will be used for missing data.

C - Methods Development or Dissemination

1-C-21 Optimizing data retention in awake infant fMRI: Lessons learned from over 300 scans

Lillian Behm[1], Nicholas Turk-Browne[1], Tristan Yates[1], Sheri Dawoon Choi[1], Juliana Trach[1], Cameron Ellis[2]

[1]Yale University, [2]Stanford University

Functional magnetic resonance imaging (fMRI) in awake infants can provide valuable insights into how the early developing brain gives rise to cognition and behavior. Although a few studies have now been published using this method, awake infant fMRI poses significant methodological challenges that impact data quality and quantity, and that have hampered wider adoption. After collecting a lot of such data in our lab over the past six years, it is now possible to evaluate and make recommendations on participant recruitment, experimental design, and data collection in order to maximize data retention in future studies. Here, we explore how various factors influence the amount of usable data collected during a session and discuss how researchers can address these factors to minimize data loss. To date, our lab has conducted 302 awake infant fMRI scans with 122 unique infants and toddlers aged 3-33 months (M=11.0, SD=6.1). A subset of these sessions (N=36) resulted in no usable functional data because we were unable to get the infant to enter the scanner and/or remain laying down once positioned in the bore. A logistic regression analysis indicated an effect of infant age, with younger infants more likely to enter the scanner. From infants who successfully entered (N=266), we collected a total of 12.2 minutes of functional data on average. After preprocessing and removing timepoints when the infant was sleeping or not attending to the visual display, an average of 8.3 minutes of awake, task-based data were usable. We assessed whether the number of minutes of usable data could be predicted by infant age, infant sex, time of scan, and year of scan (a proxy for researcher experience). A multiple regression

model indicated that infant age and sex were significant predictors, such that older infants and female infants provided larger quantities of usable data. We next assessed the factors that led to functional data exclusion. Excess motion was the most common cause, with an average of 2.1 minutes (17.2%) of lost data per session. Using a multiple regression model with the same predictors as before, infant age was a significant predictor of minutes of data excluded due to motion, with more timepoints excluded for younger infants. Following these motion exclusions, an additional 1.0 minutes (8.1%) of data per session were excluded due to inattention (gaze away from the visual display or eyes closed). Here, a multiple regression model indicated that infant sex significantly predicted inattention, with more timepoints excluded for females than males. A third reason for exclusion was failure to collect a structural scan for anatomical alignment (N=12), which occurred because we prioritized functional data collection. Finally, because some infants completed several tasks and sessions, we investigated whether the type of experiment influenced the proportion of data retained as usable. Movie-based designs yielded the greatest proportion of usable data, followed by block designs then event-related designs. Taken together, these results demonstrate the promise of this method and suggest that factors such as infant age, sex, and experimental design impact the success rate of awake infant fMRI studies. Although younger infants are easier to get into the scanner, older infants tend to move less, providing more usable data overall. Continuous, naturalistic task designs also yield more data, which may inform the design of experiments to improve retention.

1-C-22 Comparing Developmentally-Appropriate Resting-State Contexts: Methodological Considerations From Infancy to Early Childhood (pre-registered report)

Kimberly Cuevas[1], Kelsey Davinson[1], Leslie Patton[2], Zhe Wang[3], Martha Ann Bell[2]

[1]University of Connecticut, [2]Virginia Tech, [3]Texas A&M University

An important consideration for developmental neuroimaging research is the context of resting-state (or "baseline") activity. Conceptually, resting-state reflects neural activity when participants are awake, calm, still, and not engaged in active processing. In the EEG literature, this is typically measured during conditions of eyes open and closed, with a focus on resting alpha rhythm. A challenge during infancy and early childhood is to utilize developmentally-appropriate procedures that require no or minimal instructions to obtain periods of "quiet visual attention". A wide variety of resting-state modifications have used observation-based procedures, ranging from video clips (cartoon, movie) to static or moving stimuli displayed "live" or via screen to "live" social events (e.g., a researcher manipulating objects, blowing bubbles). The current lack of standardization in early resting-state procedures makes cross-study comparisons challenging both within the developmental literature and when conceptualizing findings in terms of the adult literature. Developmental resting-state procedures that more closely mimic current adult procedures would enhance interpretability and comparability of findings across the lifespan (Anderson & Perone, 2018). At the same time, however, it has been proposed that identical resting-state procedures can have different processing demands (e.g., cognitive control to remain still and quiet) for young children as compared to older children and adults (Camacho et al., 2020). The present pre-registered methodological report details the systematic investigation of multiple resting-state procedures throughout infancy and early childhood. The primary aim of our longitudinal project is to identify and compare developmentally appropriate resting-state techniques from 6 to 48 months of age. In order to capture an early analog of the eyes open-closed resting-state procedure, two different protocols will be used to compare effectiveness across individuals and developmental time points. A *lights on-off* protocol (Stroganova et al., 1999) includes alternating 20-s intervals of moving visual stimuli on a screen and room darkening. A *space video* (Perone et al., 2018) will use a similar protocol except the lights will remain off the entire time with the screen brightness changing (dark vs. light). Low-stimulation video clips have been used as a resting-state measure because they yield minimal eye movements and gross motor movements. Thus, we will also compare resting-state data during a *low stimulation video clip* with screensaver-like colorful, slowly moving abstract images and soft music (Inscapes; Vanderwal et al., 2015). Furthermore, there has been a recent movement in the neuroimaging field to include more naturalistic, ecologically valid stimuli (Vanderwal et al., 2019). To this end, we will also examine multiple *cartoon clips* to include social/nonsocial and verbal/nonverbal stimuli. However, the above resting-state contexts are all screen-based; thus, infants will also observe a *live 3-D moving object* for brief intervals. In sum, we are collecting EEG in multiple resting-state contexts to determine which is the most developmentally appropriate with respect to amount and quality of data, enhancing the signal-to-noise ratio. Our presentation will include detailed information about the stimuli and feasibility based on pilot and initial testing.

1-C-23 Precision functional mapping reveals functional networks with anterior-posterior connectivity at birth in a single neonate

Alyssa Labonte[1], Julia Moser[2], Ursula Tooley[1], M. Catalina Camacho[1], Sanju Koirala[2], Michael Myers[1], Evan Gordon[1], Timothy Laumann[1], Damien Fair[2], Chad Sylvester[3]

[1]Washington University in St. Louis, [2]University of Minnesota, [3]Washington University

Introduction: The human brain is organized into distinct functional networks, sets of brain regions that work together to implement specific processes. Functional networks are comprised of nodes (brain regions) and edges (connections between brain regions) and are constructed over the course of development, yet little is known about the earliest stages of brain network development. Current work on neonatal functional brain networks is inconsistent with regards to the apparent maturity or adult-likeness of network architecture. While some work suggests that networks found in neonates do not resemble those of adults -" specifically, that anterior and posterior regions of higher-order association networks such as the default mode network (DMN) are assigned to seemingly separate networks, suggestive of immature long-range anterior-posterior connectivity -" other research has found similar network assignments in neonates as in adults. These studies are based on group averaged data and inconsistency in functional network assignments may be related to heterogeneity across neonates, such that averaging functional data across participants obscures network assignments. To uncover the organization of functional networks in neonates, we may need to examine patterns of network assignment, or network topography, at an individual level. Precision functional mapping (PFM) involves collecting many hours of data in individuals over multiple days, and PFM in adults has revealed that details of functional network organization vary substantially across participants. Thus, the use of PFM in neonates may allow for a more robust characterization of functional networks early in development. Objective: In this study, we characterized functional brain network organization in an individual neonate using PFM. We hypothesized that by looking at the brain of an individual neonate we can see adult-like network organization including anterior-posterior connectivity among networks including

DMN, dorsal attention network (DAN), and frontal parietal network (FPN). **Methods:** Using PFM data collected from a single neonate across 5 scan sessions within one week, we empirically derived functional brain network assignments using the Infomap community detection algorithm. Functional connectivity (FC) matrices for all 5 scan sessions were averaged, generating a single FC matrix representing all 210 minutes of resting-state fMRI data collected. This all-sessions FC matrix was then masked to set any functional connections < 49mm in adult Talairach atlas space to zero. Next, the top X% of positive functional connections (X ranging from 0.25 to 10, the 'edge density') were set to 1 and all other functional connections were set to zero. Finally, Infomap was run on the resulting masked FC matrix, separately at each edge density. **Results:** Our results from a single neonate indicate that the functional brain network organization of an individual neonate includes multiple networks with anterior-posterior connectivity, which likely comprise adult-like DMN, DAN, and FPN. Discussion: The presence of such adult-like networks at birth highlights the importance of maternal-fetal biology in establishing the foundations of functional network organization in humans. Future analyses will include deriving functional network assignments for additional neonates using PFM, to empirically characterize functional network brain organization at birth.

1-C-24 Using Applied Behavior Analysis to Increase EEG Participation in Toddlers with Profound Autism (pre-registered report)

Angela Manessis[1], Sonya Troller-Renfree[1], Daniel Fienup[1]

[1]Columbia University

It is common for individuals with profound Autism to be noncompliant with medical procedures (Pugliese et al., 2023). In contemporary EEG research, inquiries into individuals with Autism are commonly limited to samples of children that are able to tolerate the recording devices. This limits the generalizability of the results and conclusions that can be drawn from current research. The lack of reporting and the limited inclusion of participants across minoritized groups suggest a need to examine practices in Autism research from planning to dissemination (Steinbrenner et al., 2022). An approach to address this need is to use Applied Behavior Analysis and single-subject methodology, by creating a mobile EEG prototype and a social story to increase gradual exposure and sensory desensitization with direct reinforcement. Preliminary pilot data suggested applying Applied Behavioral Analysis approaches to help families with toddlers that are Autistic tolerate a mobile EEG cap for 10-15 minutes during a recording. This project also aimed at increasing the representation of underrepresented minority young children in EEG research and producing more culturally relevant and anti-racist approaches during data collection. This project will also share the stories of families that participated in this study and their experiences with EEG in their homes.

1-C-25 A novel approach for studying the development of sustained attention using features of caregiver-infant dyadic head-mounted eye-tracking during play and EEG microstates during resting-state: Feasibility, reliability, and preliminary findings

Armen Bagdasarov[1], Sarah Markert[1], Denis Brunet[2], Christoph Michel[2], Michael Gaffrey[1]

[1]Duke University, [2]University of Geneva

Introduction: Early individual differences in sustained attention (SA) during infancy -" maintaining attention to an object over a period of time -" predict individual differences in cognitive and socioemotional development. As such, investigating the neurobiological correlates of SA during infancy will provide insight for identifying early markers of cognitive and socioemotional deficits that are known to underly risk for poor life outcomes and psychopathology. The earliest behaviorally measured signs of SA appear to come online during the 6-9-month-old period of infant development when the brain's orienting network - responsible for directing attention to target stimuli -exerts much of the control over other brain networks to improve the priority of task-relevant information. However, whether and how SA is related to spontaneous brain activity (e.g., orienting network) has not been reliably examined in 6- and 9-month-old infants. This gap in knowledge is in part due to the challenge of collecting ecologically valid and reliable measures of looking patterns and brain activity. We propose a novel approach that addresses this challenge and show how it can be used to investigate the neurobiological correlates of SA in a preliminary sample of 44, 6-month-old infants. **Method:** Dyadic head-mounted eye-tracking (D-ET) is a unique method that uses tiny cameras placed on an individual's head to precisely record where they look during an activity. It was employed during 6 minutes of caregiver-infant naturalistic play with novel toys and the duration of infants' SA to toys was quantified by trained coders. 10 minutes of resting-state EEG (infants watched relaxing videos) was collected to identify EEG microstates; patterns of scalp potential topographies derived with *k*-means clustering that reflect the dynamically evolving activity of large-scale brain networks. Microstate analysis has never been employed in awake infants but is uniquely positioned to provide rich and cost-effective spatiotemporal information about intrinsic brain activity. **Results:** 38 infants at 6-months (84% of 44) provided usable D-ET and 5 minutes of EEG data. Of these, 18 had data at 9-months of age (data collection is in progress). Five microstates were identified in each infant (Figure 1). Their temporal properties were quantified and demonstrated excellent internal consistency (Spearman-Brown-corrected split-half reliability estimates above .80 for all properties). Statistical analyses revealed that longer periods of SA during D-ET at 6-months predicted greater coverage of microstate 4 during rest (% of time that microstate 4 was present) cross-sectionally at 6-months (R^2=.16, p=.01; Figure 2a) and longitudinally at 9-months (R^2=.34, p=.01; Figure 2b). Source localization is in progress to determine whether underlying neural generators of microstate 4 represent parts of the orienting network. **Conclusion:** As our sample grows, we will continue to assess whether SA predicts microstate 4 coverage. We will also use the rich information captured with D-ET to assess how caregivers scaffold infants' attention and whether this modulates microstate 4 coverage. Lastly, we will assess relationships with cognitive and socioemotional outcomes in the same infants during toddlerhood. Doing so has the potential to critically inform early interventions and policy measures that ensure the well-being of all children from day one.

1-C-26 Visual processing of stimuli in the human fetus: A peripheral field advantage?

Jessica Leov[1], Kirsty Dunn[2], Vincent Reid[1]

[1]University of Waikato, [2]Lancaster University

Our knowledge of fetal visual perception is highly limited. Recent modelling has demonstrated that the prenatal environment has greater luminosity than previously thought (Giudice, 2011), with visual experiences beginning before birth. How the human fetus interacts with the visual world is still relatively unknown. Clear anatomical differences exist between the fetal and adult eyes. Noticeably, the central retina is structurally immature in the fetal period, with the peripheral retina relatively more developmentally advanced prior to birth (Hendrickson et al., 2012; Hendrickson & Drucker, 1992). Assessment of premature infants demonstrates that the central retina

continues to develop post-birth (Maldonado et al., 2011). Neonatal behavioural responses to visual stimuli reflect asymmetric anatomic development in the peripheral and central retina. For this reason, neonates more readily orient to stimuli initially presented to the peripheral visual field (Lewis et al., 1978; Lewis & Maurer, 1992a, 1992b; Simion et al., 1998). The present study explores whether the human fetus will preferentially orient to light stimuli in their peripheral visual field when contrasted with central presentations. Based on the anatomical development of the eye and neonate visual responses, we hypothesise that the fetus will be more responsive to stimuli presented to the peripheral visual field. Participants include 80 singleton fetuses between 33 and 36 weeks gestation. 2D ultrasound is used to visualise the fetal lens and records fetal eye movements. A light stimulus (dot diode emitting at 650nm) is presented to the fetus in two separate locations; the peripheral and central visual fields (figure one). This is moved in a vertical orientation to the face of the fetus. Eye movements are recorded in each condition with the view to measuring fetal visual engagement with the stimulus. The collected data is currently undergoing coding and analysis. Preliminary analyses were conducted on 19 fetuses. A Shapiro-Wilks test indicated that neither peripheral (W=0.867, p-value= 0.013) nor central (W= 0.721, p-value= 0.000) conditions were normally distributed. Analysis of the preliminary data revealed a trend towards increased eye movements in the peripheral presentation condition (M= 3.789, SD=3.867) compared to the central presentation condition (M= 0.947, SD= 1.432), although non-parametric tests revealed this difference was not statistically significant (Sign test, 19 trials with 13 successes, p-value = 0.17, 95% CI[0.43, 0.87]). Complete consideration of the full dataset may reveal distinct trends that are not currently reflected in the preliminary analysis. Investigating prenatal vision illuminates the initial origins and predispositions of visual perception; however, fetal vision in utero has been largely understudied in the developmental sciences. Understanding peripheral visual responding in utero will aid in our understanding of the developmental trajectory of vision across the lifespan and lay the groundwork for the exploration of fetal vision via the establishment of replicable and robust experimental methods.

1-C-27 A Qualitative Review of Active Recruitment in Neuro-Imaging Studies

Ogoamaka Nwana[1], Dana Demaster[2], Kelly Vaughn[3, 4]

[1]University of Texas Health Science Center, [2]University of Texas Health Science Center at Houston, [3]University of Texas Health Science Center - Houston, [4]University of Texas Health Sciences Center at Houston

Objective: Studies using fetal, infant, and toddler neuroimaging are critical to advance our understanding of early brain development and its relation with behavioral outcomes; however, research findings have limited generalizability when samples follow the overall trend of over sampling of individuals from higher resourced communities who identify as white (Sterling et. al., 2022). For longitudinal studies, enrolling a more diverse sample requires effective recruitment strategies that encourage initial enrollment and commitment to participation for the duration of the study. Active recruitment strategies, whereby a recruiter meets face-to-face with prospective families, yield a higher number of enrolled participants compared to other means such as flyers (Darden et. al. 2022). The goal of this qualitative study is to identify successful active recruitment strategies from experienced and knowledgeable researchers who have recruited diverse samples. **Method and Results:** We interviewed experienced recruitment staff from large longitudinal clinical neuroimaging studies with samples from highly diverse socio-economic families. The Principal Investigator, a post-bac senior research assistant, invited recruiters to participate in a semi-structured interview to identify effective strategies for increasing recruitment of underrepresented populations. Importantly, this research provides recruitment staff the opportunity to share their experiences with a peer researcher rather than their employer. Data collection is complete and yields important findings including the effects of racial and cultural likeness on a recruiters' experience and methodology for approaching potential participants to increase chance of enrollment. Ongoing analysis of this rich dataset has produced interesting themes. For example, participants who recognize potential study benefits are more likely to consent regardless of their social-cultural background; however, building trust is critical for families to perceive a study as an opportunity that is "for them". One recruiter reported, "[Parents think], if your study is fulfilling a need of mine, that's awesome. But can I trust you?... That piece is important.- First impressions of the study play a key factor in effective recruitment and study completion rates. Similar socio-cultural likeness between researchers and participants affords a positive impact on enrollment; however, recruiters who are observant, empathetic and solve problems quickly are more successful in recruiting participants. While discussing socio-cultural likeness and recruitment success, another recruiter said, "A lot of times me being able to speak Spanish as opposed to doing it through a translator, [the parents] are like OK, you're a Spanish speaker, so they feel like it works a bit better-¦ [they are] inclined to be like ohh, you know, she's also a Hispanic". **Conclusions:** Study findings will build on these themes and offer specific methodological guidelines for improved recruitment strategies. Increasing the diversity of research samples will facilitate understanding of brain development and inform the development of interventions that can improve outcomes for children and families. Study findings have the potential to increase ethical recruitment and promote equal opportunities for families to participate in research that is reflective of linguistic, ethnic, racial diversity in the U.S.

1-C-28 Stability of the intrinsic brain architecture across sleep and wakefulness in children with autism

Phoebe Thomson[1], Ting Xu[1], Seok-Jun Hong[2], Shinwon Park[1], Francisco Castellanos[3], Michael Milham[1], Adriana Di Martino[1]

[1]Child Mind Institute, [2]Sungkyunkwan University, [3]NYU Langone Health

Evidence suggests that spatial resting state fMRI (R-fMRI) maps obtained during sleep in infants and young children are similar to those observed in older children and adults during wakefulness. This has supported the use of natural sleep R-fMRI to probe multiple functional systems in young and/or clinically challenging populations. Nevertheless, adult studies have shown within-subject R-fMRI differences between sleep and wakefulness, and knowledge of the stability of brain functional architecture between states within children remains limited. Accordingly, we examined the stability of connection- and voxel-wise R-fMRI metrics in children with autism completing MRI scans while awake and asleep. Two MRI sessions -"one in wakefulness and one in natural sleep-" were completed by 28 children with autism (22 male) aged 5-8 years (inter-session mean time=12Â±12 days). Scans were conducted on an Allegra 3T scanner (TR=2s, TE=15ms, voxel size=3x3x3mm), including one 6-min awake and at least 12-min sleep R-fMRI. Data with median framewise displacement (medFD)<0.2mm were preprocessed using CPAC version 1.8.4. Functional connectivity was extracted between pairs of regions from Schaefer-400 cortical and Tian-54 subcortical parcellations. Voxel-wise measures were also investigated given their relevance to typical development and autism, including amplitude of low-frequency fluctuation (ALFF), degree centrality (DC), regional homogeneity (ReHo) and voxel-mirrored homotopic connectivity (VMHC). Intra-class correlation coefficients (ICC) between states were

calculated using a one-way random model in Reliability Explorer (covariates: awake MRI age, inter-session interval, sex, medFD). Given prior findings of the impact of scan duration on ICC, we first computed between-state ICC using 6, 9 and 12-min sleep segments. As a qualitative stability benchmark, within-state ICC was also computed using two 6-min segments within each state separately (n=16 wakefulness, n=28 sleep). Across all R-fMRI metrics, keeping awake R-fMRI duration constant, between-state ICC was higher with 12 min of sleep data compared to 6 or 9 min. Thus, results from between-state ICC analyses are reported with 12-min sleep data. Across measures, ICC within state (wakefulness or sleep) was higher than between-state ICC (Fig 1). Across parcels, whole-brain summary measures of ALFF and DC had between-state ICC in the moderate range (i.e.,â‰¥.4 â‰¤.7), in contrast ReHo, VMHC and connection-wise summary measures had low between-state ICC (i.e.,<.4). However, ICC substantially varied by region/circuit examined (Fig 2). For most voxel-wise metrics, moderate-"high ICC was most often observed in visual and default mode networks, as well as in salience and dorsal attention networks for ALFF and DC. Connection-wise, moderate-"high ICC occurred predominantly within and between higher-order functional networks. Consistent with prior reports, within-state R-fMRI findings were generally reliable. While our results of moderate-"low ICC between states suggest caution when combining sleep and wakefulness data, results of improved ICC with at least 12 min of sleep data, and variable ICC by measure and spatial location can provide a guide for interpretation. For example, moderate-"high consistency across sleep and wakefulness were observed in the default mode network (particularly for ALFF and DC) and functional connectivity within and between high-order functional networks was more consistent across states.

1-C-29 High-Resolution Post-Mortem Infant Brainstem OCT Imaging: Validation by Histology

Ream Gebrekidan[1], Lilla Zollei[2], Caroline Magnain[3], Chris Clickner[4], Jean Augustinack[4], Robin Haynes[5], Hannah C. Kinney[5]

[1]Harvard College, [2]Massachusetts General Hospital / Harvard Medical School, [3]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital/Harvard Medical School, [4]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital/Harvard Medical, [5]Boston Children's Hospital

Sudden infant death syndrome (SIDS) remains a leading cause of neonatal infant death in the US (Ely and Driscoll, 2022) (Pretorius and Rew, 2019). However, very little is known about the underlying physiological risk factors that can hinder autonomic responses and lead to SIDS. It has been theorized that disruptions to brainstem structures, such as ones in the ascending arousal network, can prevent proper autonomic responses and increase the risk of SIDS (Kinney and Haynes, 2019). This theory is yet to be confirmed. This is in large part due to the difficulty of studying infant brainstems. In order to better investigate infant brainstem development and search for potential neurophysiological markers that indicate a higher risk of SIDS, better imaging tools are needed. To achieve this, after tissue acquisition and MRI imaging, we have utilized optical coherence tomography (OCT). OCT has the potential to take high-resolution images prior to the slicing of brain tissue, allowing for the preservation of 3-dimensional structure. To assess the efficacy of OCT as an imaging technique that can accurately image brainstem structures, we aim to compare it to the current literature standard, histology. First, the brainstem was imaged using OCT coupled with a vibratome to section slices after imaging. Those slices then underwent staining using Nissl protocol and immunocytochemistry to stain for myelin basic protein (MBP) and tryptophan hydroxylase isoforms 1 2 (TPH2) to identify serotonergic neurons. These imaging modalities were then registered to achieve spatial alignment. Additionally, the imaging modalities were independently segmented. The likeness of these segmentations was then assessed using a Dice similarity coefficient (DSC). This process is outlined in Figure 1. To assess the validity of our histology to OCT registrations, we quantify the registration results based on manually selected features. First, we identified key landmarks that were visible in both the OCT and histology imaging and independently tagged these landmarks on both imaging modalities. Then we applied the registration deformation field to the points identified on the histology images and measured how far off these points were from the points demarcated on the OCT imaging. We found that the average displacement between these points was below 100 Î¼m. Thus, this registration appears to map targets to within 10 voxels of their true location. The results of the histology registration can be seen in Figure 2. To assess how well the OCT segmentation reflects the true brainstem structure, it was compared against the segmentation of the corresponding histology slices. This analysis was performed on the segmentation of the caudal medulla of case #3 for the following nuclei: inferior olivary nucleus, arcuate nucleus, spinal trigeminal nucleus, cuneate nucleus, gracile nucleus, and hypoglossal nucleus (Figure 3). Additionally. a DSC was then calculated for the segmentation of each brain structure (Dice, 1945). Using a significance threshold of 0.7 as proposed by Zijdenbos et al., 4 out of the 6 nuclei showed significant overlap between their respective OCT and histology segmentations (Zijdenbos et al., 1994) (Figure 4). Additionally, Hausdorff distances were calculated as an alternative to DSC scores (Figure 5). This suggests that the contrast seen in OCT can yield comparable results to what is seen in histology imaging.

1-C-30 Structurally Derived Radiomic Features Improve Predictors of Fetal Brain Health Outcomes

William Reynolds[1], Rafael Ceschin[1, 2], Ashok Panigrahy, Vidya Rajagopalan[3]

[1]University of Pittsburgh, [2]University of Pittsburgh School of Medicine, [3]Childrens Hospital Los Angeles

Fetuses with congenital heart disease (CHD) may have impaired in-utero brain growth, which can be impacted by socio-demographic factors. While total fetal brain volume (TBV) is a proxy of neurodevelopmental outcomes, it only captures macroscopic features of neural development from motion-corrected structural T2 images acquired using a single-shot fast spin echo sequence. These images can be used to generate radiomic features which can provide information beyond volume, including shape, texture, and intensity, that may be surrogates of microstructural features (cellularity). We tested the hypothesis that macroscopically derived radiomics could improve baseline CHD and diverse socio-demographic predictors of fetal TBV. Our group curated a dataset of 200 fetal MRI images that were segmented volumetrically. This dataset includes subjects with/without CHD from two ethnically diverse sites; UPMC Children's Hospital of Pittsburgh (Pittsburgh, PA) and Children's Hospital Los Angeles (Los Angeles, CA). Three baseline linear models predicting TBV were constructed using these predictors: (1) gestational age (GA); (2) GA, site, maternal ethnicity, and fetal sex; (3) all of model #2 predictors plus CHD presence. Radiomic features were generated through PyRadiomics, an open-source Python radiomics package. To avoid overfitting, we selected the top five radiomic features using Principal Component Analysis (x 4), Pearson correlation coefficients, univariate modeling, or random forest regression. The baseline models' performance was tested, followed by the addition of the radiomic features and retesting. All baseline models had adjusted R-squared values ranging from 0.72 to 0.80. The baseline models did show that lower GA, Hispanic ethnicity, and the presence of CHD predicted reduced adding the top radiomic features chosen via the random forest, the best-performing model increased its adjusted R-squared value to 0.945. Overall, adding radiomic features improved

the explained variance compared to the best baseline model in the 12/21 models tested. Results suggest that structural-derived radiomics can improve ethnically diverse CHD predictors of fetal brain volume and that radiomic features may improve the prediction of brain health outcomes in CHD. The fetal time point is a critical period for neurodevelopment of CHD patients and without proper tools, researchers are at a severe disadvantage in predicting important brain health outcomes. Radiomics is a powerful tool in extracting important microstructural information from macrostructurally (volume) analyzed fetal MRIs. Our working mechanistic hypothesis is that radiomic features likely reflect cellular neural correlates of impaired fetal brain development as impacted by poor in-utero substrate delivery from CHD lesions and social determinants of health. Since structural fetal MRIs are less likely to fail due to motion compared to diffusion MR, our radiomics approach can be a pragmatic addition to clinicians' workflow with minimal extra costs either from MRI scanning or processing.

1-C-31 Developing a segmentation protocol for hippocampal subfields in human infants (pre-registered report)

Zehua Cui[1], Tracy Riggins[2]

[1]University of Maryland, College Park, [2]University of Maryland

Introduction: The hippocampus is a complex neural structure consisting of multiple internal circuits (i.e., subfields), including the Cornu Ammonis (CA) fields 1-4, dentate gyrus (DG), and subiculum (Amaral & Lavenex, 2007). Perhaps one of the most striking features is its protracted developmental course; the hippocampus is one of only two structures argued to undergo postnatal neurogenesis (Seress, 2001), which may contribute to its rapid non-linear development across infancy (Uematsu et al., 2012). Neuroanatomical data from non-human primates suggests that early development of hippocampal circuitry is critical for memory development (Lavenex & Lavenex, 2013). However, knowledge of structural development and age-related differences within the hippocampal subfields during infancy are limited. The lack of research on infant hippocampal subfield development is due to the inherent challenges associated with scanning infants as well as the unavailability of automated tools to reliably demarcate subfield boundaries. Given the rapid development and heightened neural plasticity early in life (due to continued neurogenesis), more research is needed to better understand the structural and functional organization of the hippocampal subfields among infants. The present study aims to gauge the feasibility and assess the reliability of conducting manual segmentation of hippocampal subfields in human infants. Ultimately, we seek to develop an automated and robust method that provides accurate infant hippocampal subfield segmentation. Development of such tools can support future research endeavors that strive to investigate the normative developmental trajectories of the hippocampus during infancy and how factors in the prenatal and postnatal environments might produce individual differences. **Method:** Participants: At the time of this submission, 9 infants have completed our scanning protocol (6 female, M_{age} = 8.8 weeks). Data collection is ongoing. The final sample size will depend on reviews of each infant's data quality. Image Acquisition: Neuroimaging data were collected on a Siemens 3.0T MRI scanner with a 32-channel head coil. To identify the boundaries of the hippocampus, we first acquired a whole-brain T1-weighted scan (voxel size = 0.8 mm^3; TR = 1.9s; TE = 2.43 ms). We then positioned the field of view to encompass the hippocampus and acquired an ultra-high resolution structural T2-weighted scan of the medial temporal lobe (voxel size = 0.4 Ã— 0.4 Ã— 2.0 mm; TR = 3s; TE = 41 ms). Infants were swaddled and scanned during natural sleep. Manual Segmentation: The manual hippocampal subfield segmentation protocol that will be used yields all subfield regions of interest (ROI) in both the head and body of the hippocampus (La Joie et al., 2010) and has been used in preschool children (Riggins et al., 2018). The protocol yields three ROIs: subiculum, CA1, and CA2-4/DG. We will begin with identifying subfields in the body of the hippocampus and, as time permits, we will continue to identify subfields in the head of the hippocampus. Consistent with previous research, subfield segmentation will not be conducted on the hippocampal tail due to its small size and the difficulty of identifying subfield boundaries. Two researchers will trace all cases with high quality data and a single rater will re-trace a subset of their cases. Inter- and intra-rater reliability will be assessed via dice similarity and intra-class correlation coefficients.

D - Neural Correlates of Early Cognitive and Emotional Development

1-D-31 Why you need to measure behaviour too: on studying event locked inter-brain synchrony in developmental two-person neuroscience

Ira Marriott Haresign[1], Emily Phillips[1], Sam Wass[1]

[1]University of East London

Early social interactions, by definition, are bidirectional. But traditionally, cognitive neuroscience has studied early social cognition in unidirectional, non-interactive settings, by, for example, presenting infants with images of social stimuli on-screen (Redcay & Schilbach, 2019). Recently, however, driven by technological advances that have allowed for the simultaneous neuroimaging of two or more individuals (hyperscanning), there has been a rapid increase in studying the neural mechanisms that underpin the development of early social cognition using two-person, interactive, naturalistic paradigms (Wass et al., 2020). At the moment this is typically achieved through non-event locked analyses, which involve averaging together large chunks of developmental brain data without time-locking neural activity to underlying behaviours. The amount of inter-brain synchrony is then typically compared between experimental conditions (e.g., Piazza et al., 2020), and/or is correlated with an outcome measure (Davidesco et al., 2023). Here we build on previous theory (Bilek et al., 2022) to argue against this approach, for two reasons. First, we argue that it will never allow researchers to be sure that observed effects are not attributable to underlying artifact. We present data, from N=90, typically developing parent-infant (*M* = 12.2-month-old (*SD* =1.47)) dual EEG datasets, taken from a broader, Leverhulme Trust funded programme of research, suggesting that fine-grained temporal interdependencies in behaviour between interacting adult-infant dyads (e.g., I look up to you and you return my gaze) can leave residual artifact in brain data, manifesting as both power and (through that) phase effects in EEG and affecting wavelet transform coherence in fNIRS analyses. Second, we argue that non-event-locked approaches will never allow researchers to understand the mechanisms that give rise to associations in brain activity during early social interactions. Slow time-resolution techniques cannot tell fine-grained sequential entrainment (I look at you and you return my gaze) from genuine synchrony (things happening at the same time). An alternative less commonly used approach is to use "event-locked methods" which measure changes in brain activity time-locked to particular behavioural events. This approach is similar to the more well-established approaches within cognitive neuroscience that have typically been used to study individual brain behaviour relationships but have yet to be widely adopted to study naturalistic dual EEG data. Here brain activity is time-locked to a behaviour or exogenously presented event and fine-grained temporal dynamics

in entrainment are studied (Friston et al., 2003). We argue that event locked methods need to be at the forefront of future research investigating the neurobiological underpinnings of early social interaction.

1-D-32 The neural bases of language processing during shared book reading

Meredith Pecukonis[1], Meryem Yucel[1], David Boas[1], Helen Tager-Flusberg[1]

[1]*Boston University*

Introduction: During the first few years of life, children's language skills are largely shaped by the language input that they receive at home during everyday activities, such as shared book reading. While several studies have shown that frequent, high quality shared book reading has a positive impact on children's language development (Noble et al., 2019), little is known about how children's brains function during shared book reading compared to other everyday activities, such as screen time. We utilized fNIRS to investigate how the brains of young children respond to live language that is presented during a shared book reading interaction compared to recorded language that is presented during screen time. We also explored whether brain response to live language is associated with children's language skills. **Methods:** The sample to date includes *N*=28 children (18M, 10F), 3.14 to 5.99 years of age (*M*=4.21). A TechEn CW6 fNIRS system (50 Hz, 690nm and 830nm) was used to measure the hemodynamic response during two conditions a live language condition and a recorded language condition (Figure 1). During the live language condition, an experimenter interacted with the child by reading them a scripted story from an illustrated book. During the recorded language condition, the child listened to a recording of a scripted story while viewing illustrations on a computer screen. Trials were approximately 10 seconds long followed by a 10-15 second long intertrial period during which a fixation cross was presented. Data were processed in Homer3 using standard procedures (YÃ¼cel et al., 2021), including channel pruning, wavelet motion artifact correction, low pass filtering, and GLM HRF estimation (Huppert, 2016). We then calculated the average HbO concentration from 6 to 10 seconds for each child and conducted within-subject paired sample t-tests to determine whether HbO concentration differed between conditions for each channel. We also used partial correlation analyses to explore the associations between HbO concentration during the live language condition and children's total language standard scores, as measured by the Preschool Language Scales, Fifth Edition (PLS-5), while controlling for age and NVDQ scores, as measured by the Mullen Scales of Early Learning (MSEL). **Results:** HbO concentration was significantly higher during the live language condition compared to the recorded language condition for channel 28, which covered the right frontal gyrus (*t*=2.546, *p*=.022; Figure 2a). PLS-5 total language standard scores were positively correlated with HbO concentration values during the live language condition for several channels covering the frontal gyri (Figure 2b), including channel 4 (*r*=.608, *p*=.013), channel 7 (*r*=.878, *p*=.004), channel 27 (*r*=.546, *p*=.035), and channel 32 (*r*=.561, *p*=.037). **Conclusion:** Preliminary results demonstrate the frontal gyrus plays an important role in processing language during socially salient activities, such as shared book reading. Children's brains responded more strongly to live language compared to recorded language, particularly in the right frontal gyrus, a region that has been associated with the processing of language and other social stimuli. Activation within the frontal gyri may serve as a functional biomarker for children's language skills.

1-D-33 Piloting a New Approach: fNIRS Study of Infant Object Exploration During Naturalistic Play

Aleksandra Dopierala[1], Lauren Emberson[1], Annie Schwartzstein[2], Yi (Koei) Yang[1]

[1]*University of British Columbia,* [2]*Princeton University*

Infants' first-person experiences during the early years are crucial to early cognitive and neural development. Decades of infant functional near-infrared spectroscopy (fNIRS) research has illuminated the cortical correlates of numerous cognitive processes (e.g., object perception); however, there is a gulf between an infant's first-person experiences and how these experiences are commonly studied. Most studies are highly constrained, with structured and passive tasks, where infants watch stimuli presented in a predetermined and strictly timed order. While these studies greatly improve our understanding of infant neurocognitive development, it remains unclear whether observed findings translate to real-life, naturalistic situations. In our study, we aimed to bring infant first-person experiences to the forefront of the scientific inquiry by measuring the neural correlates of object exploration during an infant-parent free-play interaction. We hypothesise that object exploration will elicit activation of the lateral occipital cortex, a brain region specialized for object perception in infants (Emberson et al., 2017). We also hypothesize that other behaviours involving object exploration (object touching, mouthing) will activate the same occipital region but in combination with other cortical regions (e.g., the inferior frontal and superior temporal cortices, Pirazzoli et al., 2019). Data collection is complete but analysis is ongoing. Nineteen 5- to 7-month-old infants (13 female; Mage = 5.9 months) engaged in face-to-face play with their parent, while we recorded infants' brain activity using a 44-channel NIRSport2 fNIRS system. To facilitate and slightly constrain the interactions, parents were encouraged to play with toys they brought with them (i.e., their infants' favourite toys) and a small number of novel toys provided by the lab though they could engage in any activity they liked. The only restrictions given to the parents were to keep the infant relatively still and play with one toy at a time. The recording continued for as long as the infant wanted to play and wear the cap (1-25 min, M = 13.4 min). All infants wore the fNIRS headgear; 16 played for the minimum criteria of 5 minutes; 12 of the 16 infants contributed high quality fNIRS data. We manually coded the synchronised video-recordings marking three behaviours of interest: infant looking at a toy, mouthing a toy, touching a toy with high inter-rater reliability. We quantified the frequency and duration of observed bouts of each behaviour to determine an analytic path for the pre-registration. Behavioural analyses revealed that the frequency and duration of two object exploratory behaviours -" looking and touching - across all tested infants met the standard criteria for a block design, i.e., repeat at least 3 times and last between 5 and 20 s (looking: M = 17 bouts, M = 9.39 s; touching: M = 8 bouts, M = 23.65 s), see Fig. 1. Only 50% of infants had over 3 bouts of mouthing that lasted between 5 and 20 s (M = 6 bouts, M = 9.29 s) which provides an insufficient number of participants. Based on this analysis, hypotheses will be pre-registered and cortical responses in the lateral occipital region to touching and looking will be quantified. Our findings suggest that measuring the infant brain at play is feasible and can be implemented in any environment, making it a versatile method to investigate the effects of environment on neurodevelopment in infancy.

1-D-34 Emergence of the Mid-Fusiform Sulcus: Comparing Infants at Average and High Likelihood of Autism

Alisa Zoltowski[1], Fiona Wu[1], Emily Plump[1], Rankin Mcgugin[1], Carissa Cascio[2]

[1]Vanderbilt University, [2]Vanderbilt University Medical Center

Background: The Mid-Fusiform Sulcus (MFS), which divides the medial from lateral fusiform gyrus, is a recently identified neuroanatomical landmark that strongly predicts the location of face-selective cortex. The discovery of this area allows us to study neural correlates of facial processing in individuals who are limited in their ability to complete face processing tasks, including infants. However, this region has not been previously studied in infants, and the developmental timing of its emergence is unknown. Infants are highly exposed to faces during their first year of life. Thus, we examined the timing of MFS development across several timepoints in this critical period of facial learning. Additionally, we compared the timecourse of MFS emergence in infants who did versus did not later receive an autism diagnosis. **Methods:** We used data from the Infant Brain Imaging Studies (IBIS) Network, focusing on n = 93 participants who had completed all structural (T1) scans at 6 months, 12 months, and 24 months of age. Some of these infants were at an elevated likelihood of receiving a later autism diagnosis, based on having an older sibling with an autism diagnosis. We identified the MFS bilaterally on coronal slices by searching for the characteristic omega-shaped pattern between the occipitotemporal sulcus (OTS) and collateral sulcus (CoS). Mixed effects logistic regression was used to examine the relationship between MFS presence, brain hemisphere (left or right), group, and age. **Results:** At 6 months of age, we identified the right MFS (rMFS) in 81 (87%) subjects and the left MFS (lMFS) in 69 (74%) subjects. At 12 months, we identified the rMFS in 91 (98%) subjects and the lMFS in 83 (89%) subjects. At 24 months, we identifed the rMFS in 93 (100%) subjects and the lMFS in 90 (97%) subjects. Model results showed that brain hemisphere (right > left, $b = 1.96$, $p < 0.001$) and the linear term of age ($b = 2.92$, $p < 0.001$) were significant predictors of MFS presence. Individuals who were later diagnosed with autism were slightly, though not significantly, less likely to have an identified MFS than those who were not diagnosed ($b = -1.12$, n.s.). **Conclusions:** Findings by age suggest that most subjects have an identifiable bilateral MFS by 12 and 24 months. At 6 and 12 months, the rMFS was more readily identified than the lMFS, aligning with known trends in development: the left fusiform gyrus is involved in processing printed forms of words, which develops later than face processing. Trends by diagnostic group suggest that infants who go on to develop autism show similar MFS emergence as infants who do not, though with potential differences that may be uncovered in future work (i.e., depth or width of the MFS, contiguous versus separated pattern of the MFS, etc.). These results suggest that even in very young infants, the MFS is a reliably developed landmark, paving the way for future studies of MFS structural features (such as cortical thickness and sulcal depth) with later behavioral measures of facial processing and social skills.

1-D-35 - Investigation of visual representations in infants using differential looking time as compared to electroencephalography

Benazir Neree[1], Kira Ashton[1], Laurie Bayet[1], Richard Aslin[2], Alexis Black[3], Lauren Emberson[3], Jack Maccallum[1], Daniella Olivares[1]

[1]American University, [2]Haskins Laboratories, [3]University of British Columbia

Infants cannot explicitly report their own mental states and representations, and thus experimenters have to uncover those representations through implicit measures, such as looking times. Differential looking times have recently been proposed as a behavioral index of representational distance in preverbal infants (Spriet et al, 2021). However, how this behavioral metric relates to underlying neural representations remains unknown: two images may be represented in a different way without eliciting a strong looking preference for either, and multiple factors (from lower-level perceptual properties to high-level semantics) may drive differential looking times. To address this gap, we seek to compare infants' representations of visual objects estimated in a differential looking time task to those estimated in a separate electroencephalography (EEG) task. In an in-progress EEG study, groups of 12-15-month-old infants are shown individual pictures of commonplace objects (e.g. bananas, cats, faces, bottles) while their EEG activity is recorded (Figure 1). In a parallel, in-progress looking-time study, a separate group of 12-15-month-old infants are shown pairs of the same pictures using the online platform Lookit, and their differential looking times to each image are interpreted as a measure of representational similarity. Adult participants are also being run in a similar task that uses the same EEG paradigm, and a behavioral paradigm in which adults sort images based on how similar they are. Preliminary Representational Dissimilarity Matrices (RDMs) and 2-D distance visualizations using Multidimensional Scaling (MDS) have been generated from the preliminary Adult EEG and behavioral data (Figure 2), and provide an example of the structure infant data will take once it is fully collected. We will create similar RDMs for infant EEG and looking-time data, and then compare group-averaged representational distances in each task using representational similarity analysis (Spearman's correlations). Though data collection is currently ongoing, the results will provide insights on the extent to which differential looking times and EEG provide indices of representational similarity that reflect similar or distinct underlying processes, and will pinpoint the timing of neural representations captured by EEG that best align with those captured by looking times. The findings will inform future studies using EEG or differential looking times to assess infants' visual representations. The findings will also give us greater insight into how adults and infants represent visual objects both neurologically and behaviorally, and how those representations change over time.

1-D-36 - Forming connections: Functional brain connectivity is associated with executive functioning abilities in early childhood

Caroline Kelsey[1], Adelia Kamenetskiy[1], Kaitlin Mulligan[1], Charles Nelson[2], Michelle Bosquet Enlow[1]

[1]Boston Children's Hospital, [2]Harvard Medical School

Executive functioning (EF) is a set of cognitions involved in everyday life, including making plans, following multi-step directions, and regulating one's own thoughts and actions (Carlson, 2003). Adult fMRI work has evidenced that functional brain networks, including the default mode network (DMN), underly executive functioning abilities (Mak et al., 2017). However, little work has assessed the developmental trajectories of these networks and their associations with executive functioning capabilities at the times when these behaviors first emerge. The present study utilized functional Near Infrared Spectroscopy (fNIRS) to assess resting state functional connectivity in a cortical approximation of the DMN at infancy (4-12 months) and at ages 3 and 5 years. We hypothesized that the DMN would show a degree of stability over time and that decreased functional connectivity in the DMN would be associated with greater EF abilities at ages 3 and 5 years. Children (N = 295; *n* = 159 male sex assigned at birth; *n* = 228 White) were recruited as part of a larger longitudinal study of emotional development. fNIRS data were recorded at infancy and ages 3 and 5 years while children watched a 2-minute non-social video. Within network functional connectivity was calculated by computing the correlation of the oxygenated hemoglobin concentration changes among channels located near the temporal cortex and channels near the medial prefrontal cortex

(Figure 1). At ages 3 and 5 years, children completed behavioral assessments and parents completed questionnaires to assess child EF abilities. A structural equation model was conducted using maximum likelihood estimation and bootstrapped confidence intervals (Figure 2). This model had acceptable levels of fit (CFI = .96, RMSEA = .06, SRMR = .06). DMN connectivity levels were not found to be stable over time (all auto-regressive paths CI included zero; however, there was a significant correlation between DMN connectivity in infancy and at age 5 years). There were significant associations between DMN connectivity and executive functioning, such that infant DMN connectivity was negatively associated with EF at age 3 years (B = -.13, SE = .06, CI [-.22, -.03]), and there were concurrent positive associations between DMN connectivity and EF at ages 3 years (B = 5.66, SE = 1.05, CI [3.87, 7.39]) and 5 years (B = 10.92, SE = 1.13, CI [8.86, 12.68]). Future analyses will explore associations with deoxygenated hemoglobin. The DMN undergoes marked change over the first few years of life. Although connectivity levels within the DMN are relatively unstable, the brain-behavior associations appear to be robust across time points. These results contribute to our understanding of the early emerging neural underpinnings of cognitive traits and may help inform early identification and intervention strategies.

1-D-37 Behavioural and neural underpinnings of preschoolers social preference: a proof-of-principle study on the use of wearable fNIRS and immersive virtual reality to study social development

Chiara Bulgarelli[1], Paola Pinti[2], Nadine Aburumman[3], Emily Jones[2]

[1]Birkbeck College, [2]Birkbeck, University of London, [3]Brunel University

Introduction: There is evidence that infants prefer to interact with adult females (Quinn, 2002). This may change during toddlerhood, when children spend time with their peers and understand gender-differences. Moreover, after the 2nd year of life children differentiate between themselves and others (Amsterdam, 1972), and therefore form social categorisation based on identification and self-comparisons. This suggests that preschoolers might prefer to interact with other same-gender preschoolers. As some gender-differences in social development have been hypothesised (Benenson et al., 2021), one may also think that girls only would be willing to interact with other girls as someone with similar advanced social skills. To date, preschoolers social development has been poorly investigated, as we lack suitable experimental approaches for this age which struggles to comply with rigid lab rules. Moreover, traditional assessments of social development are often far from the complexity and the dynamics of social interactions in real life (Vanderwal, 2019). Therefore, the community is rethinking about new methods to study social development. To answer this need, in this study, we investigated social preferences in 3-to-5-year-olds by using for the first time a virtual-reality set-up and wearable functional near-infrared spectroscopy (fNIRS). **Methods:** 37 preschoolers were exposed to 4 human-like avatars of different gender (male, female) and age (adult, child) in a virtual classroom, and invited to play popping bubbles with one. We then recorded their brain oscillations with fNIRS from 48 channels over the frontal cortex and the temporo-parietal regions known to be engaged in social categorisation and self-comparison (Bulgarelli, 2019; de Klerk, 2019; Molenberghs, 2013) were recorded while preschoolers freely played with the preferred and a randomly assigned avatar. Motion artefacts in the fNIRS data were corrected using wavelet and channels without a clear sign of cardiac pulsation were pruned (Hernandez, 2020). Data were then bandpass filtered (<0.08 Hz) and converted to relative concentrations of haemoglobin. Channels wew then averaged into regions of interest (ROIs) following their co-registration on an age-appropriate MRI template (Richards, 2015), and correlation matrix between the ROIs was calculated for each participant. **Results:** 60% of the participants chose to play with the same-gender and same-age avatar. This result was driven mainly by females, while males instead did not significantly match their features with the chosen avatar. fNIRS results need to be considered with caution due to the limited sample size, but there seems to be different connectivity patterns between social brain regions in females, but not males, when playing with preferred compared to assigned avatar. **Conclusions:** This work contributes theoretically to the field of developmental neuroscience by showing for the first time gender differences in preschoolers social preference, suggesting that females might perform more self-comparison processes than males. Behavioural results seem to be supported by different neural underpinning in social preferences, although this needs to be further explored. Importantly, this study provides a first proof-of-principle for using cutting edge technologies and naturalistic experiments to study social development, and open up new avenues of research, meeting the need for more dynamic and ecologically valid studies.

1-D-38 Steady-state visual evoked potentials to investigate statistical regularities in the infant brain

Chiara Capparini[1], Lauréline Fourdin[1], Alessia Testa[2], Pauline Dontaine[3], Vincent Wens[1], Mathieu Bourguignon[1], Xavier De Tiège[1], Alec Aeby[3], Julie Bertels[1]

[1]Université Libre de Bruxelles, [2]Università di Milano-Bicocca, [3]Hôpital Universitaire de Bruxelles

Visual statistical learning refers to the ability to detect and extract regularities from the environment. This learning mechanism allows to organize visual stimulation in a coherent representation and has been observed even in newborns (Bulf et al., 2011). Thus far, statistical learning has been primarily investigated with post-exposure behavioral tasks that can only reveal the outcome of learning. Notably, behavioral tasks may lead to ambiguous interpretations since there is no clear consensus about the directionality of the expected learning outcome in infancy (i.e., novelty vs. familiarity effect). Electrophysiological measures such as steady-state visual evoked potentials (SSVEPs) can be acquired while learning occurs and can shed light onto the temporal course of learning. At present, investigations of the ongoing learning processes during the exposure phase have been limited to the auditory domain (Choi et al., 2020). In the current study, we use SSVEPs to study infants' neural entrainment mechanisms in response to visual regularities. Participants were 4- to 6-month-old infants born at term. They were presented with a continuous stream of 8 colorful shapes appearing in the center of the screen at a frequency of 6 Hz. The procedure included 20-second sequences of shapes with an attention-getting video of variable duration in between. Participants were randomly assigned to one of three conditions: 1) the standard doublet condition, in which shapes were organized in doublets, 2) the control doublet condition, in which only the first element of the pair followed a rule, and 3) the single condition, in which individual shapes were randomly presented. We compared SSVEPs at the frequency of visual stimulation (6 Hz and its higher harmonics) and at the doublet frequency (3 Hz and its higher harmonics) across conditions. If the stream of shapes included visual regularities, we hypothesized not only a strong steady-state response at the base frequency of 6 Hz but also a progressive response at 3 Hz. Results revealed neural entrainment at the base frequency of visual stimulation (6 Hz and its harmonics) that did not differ across experimental conditions. This confirms that infants were similarly attending to the visual stream of stimuli in all conditions. On the other side, activity at the doublet presentation frequency (3 Hz and its harmonics) varied across conditions. Infants

assigned to the doublet conditions showed greater responses at the doublet frequency harmonics, especially at 9 Hz, compared to the single condition. Overall, these results suggest that the infant brain can detect visual regularities in a stream of shapes from very early on. These findings are crucial to better understand learning mechanisms during stimulus exposure.

1-D-39 Measuring language-evoked activation in the brains of awake toddlers using fMRI

Halie Olson[1], Emily Chen[1], Somaia Saba[1], Rebecca Saxe[1]

[1]Massachusetts Institute of Technology

Objective: Toddlers undergo immense changes in their language comprehension and production in a short period of time. However, compared to other age groups, we know relatively little about the neural underpinnings of language comprehension during this important developmental period, as awake toddlers are challenging to study using functional magnetic resonance imaging (fMRI). Our goal was to create a task tailored to this age group using engaging, naturalistic stimuli, as well as adapt our scanning protocol to maximize success with toddlers. **Methods:** We developed a novel, child-friendly fMRI task to measure language-evoked activation in the brains of awake toddlers (18-36 months). Using a block design, we presented 20-second videos of puppets (from *Sesame Street*) with the audio track played normally or rendered incomprehensible. The edited 20-second videos depict either monologue (speech directed to the child) or dialogue (two puppets interacting with each other). We previously validated that this task elicits robust and reliable language responses in adults. We then began using this task during fMRI scans with awake toddlers (N=6 toddlers with usable data analyzed thus far). Using Forward>Backward speech as our language contrast, we examined (1) group-level activation for the language contrast in the whole brain, (2) individual-level activation within language regions by condition, using individually-defined functional regions of interest for language iteratively defined and tested in held-out data, and (3) lateralization for language within individual participants. **Results:** Preliminary results from N=6 toddlers with usable data (ages 26-36 months) suggest that we can measure language-evoked activation in canonical left-hemisphere language regions in this age group. Furthermore, preliminary data indicates that language-evoked activation may be left lateralized in toddlers. **Conclusion:** Though preliminary, these results point to the possibility and promise of studying language network in awake toddlers using fMRI.

1-D-41 - Neural Correlates of Infant Joint Attention in a Naturalistic Live-Interactive Task

Aditi Hosangadi[1], Lindsay Bowman[1], Ruohan Xia[1], Tahli Frenkel[2], Amanda Brandone[3]

[1]University of California, Davis, [2]Reichman University, [3]Lehigh University

Joint attention, the sharing of attentional focus and perspective with a social partner, begins to develop early in infancy. This inherently social ability of tracking a partner's focus allows infants to consolidate language and social information with the relevant context, and has been associated with the healthy development of language, empathy, and social cognition (Tomasello & Farrar, 1986; Mundy & Newell, 2007). Previous studies in adults and young children have examined the neural underpinnings of joint attention, and found activation across cortical regions associated with the -œsocial brain- (Mundy, 2017). However, neural correlates of joint attention have been underexplored during early infancy, when joint attention skills are first emerging, and the neural correlates of real-time joint attention in naturalistic interactions are unknown. In this study, we expand on previous research by conducting a longitudinal investigation of the neural correlates of infant-mother joint attention during naturalistic interactions. At both 4- and 12-month timepoints, mothers and infants complete a 2-minute booklet interaction task, in which the mother displays and describes 4 images to the infant. The interactions will be coded for the infant's gaze shifts between their mother and the book (joint attention shifts) and between any third area of focus and either their mother or the book (non-joint attention shifts). We will examine these joint-attention and non-joint-attention events in the infant electroencephalogram (EEG). We will target infant alpha suppression (6-9 Hz) relative to baseline for each event type to investigate how the infant brain responds to joint attention events during naturalistic interactions. Alpha suppression has previously been related to social cognition in young children (e.g. Bowman et al., 2017), and occurs in infants during social interactions (Orekhova et al., 2006; St. John et al., 2016). We hypothesize that infants at both 4 and 12 months will show greater alpha suppression in frontal, central, and temporoparietal regions during joint attention shifts as compared to non-joint attention shifts. Further, we hypothesize that this neural response will strengthen across development from 4 to 12 months as joint attention skills develop. Preliminary data reveals infant alpha suppression in central and temporoparietal regions that is associated with infant gaze shifts. Data collection is ongoing. Results will reveal a neural correlate of joint attention early in infancy, just as joint attention skills are beginning to develop. This work will lay a foundation for future research to further explore how caregiver interactions and other factors impact early joint attention neural correlates.

1-D-42 Baby, can you hear me? An EEG study investigating prenatal learning of nursery rhymes

Michaela Reimann[1], Cristina Florea[1], Christina Münchberger[1], Jasmin Preiß[1], Eva Reisenberger[1], Monika Angerer[1], Manuel Schabus[1], Claudia Männel[2], Dietmar Roehm[1]

[1]University of Salzburg, [2]Max Planck Institute for Human Cognitive and Brain

Even before infants see the light of day, they encounter their surrounding language through the mother's womb. Using prenatally learned prosodic information, newborns discriminate speech sounds (Mehler et al., 1988) and languages based on rhythmic patterns (Nazzi et al., 1998). Moreover, neonates' activation in brain regions, typically involved in processing auditory language in adults, are larger in response to normal speech than modified speech without prosodic information (Perani et al., 2011). The aim of our study is to gain a closer insight into prenatal learning of nursery rhymes, and whether this early learning experience is driven by fetuses' discrimination of prosodic patterns per se or metric structures (i.e., rhythm, feet). To this end, we familiarized fetuses (n = 38) in the womb with one of two rhymes (e.g., 3-4 meter, dactyl or 4-4 meter, trochee) twice a day from the 34th week of gestation until birth. Two weeks after birth, both groups of neonates (familiarized with 3-4 or 4-4 meters), were presented with the familiar and unfamiliar rhymes, as well as two modifications of the familiar rhyme: a low-pass filtered version containing mainly prosodic information and a manipulation of the rhythm. EEG data recorded during the rhyme presentation are first analyzed for proof-of principle evidence whether fetuses already perceive rhymes in the womb (contrast of familiar vs. unfamiliar rhymes), and second to evaluate whether this prenatal perception is based on prosodic patterns or metric structures (contrast of familiar vs. manipulated rhymes). We will assess cortical tracking of speech by means of speech-brain coherence as an indication of preferential processing. Here, we expect higher speech-

brain coherence for the familiar rhyme compared to the unfamiliar rhyme indicating prenatal learning. Moreover, potential differences between the cortical tracking of the familiar rhyme in comparison to the low-pass filtered version and the rhythmic manipulation will point to the kind of information that drives prenatal perception. The EEG data analysis will be finished by the time of the conference. Our findings will contribute to a better understanding of prenatal perception and learning. Mehler, J., Jusczyk, P., Lambertz, G., Halsted, N., Bertoncini, J., & Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition, 29*(2), 143-"178. Nazzi, T., Bertoncini, J., & Mehler, J. (1998). Language discrimination by newborns: Toward an understanding of the role of rhythm. *Journal of Experimental Psychology: Human Perception and Performance, 24*(3), 756-"766. Perani, D., Saccuman, M. C., Scifo, P., Anwander, A., Spada, D., Baldoli, C., Poloniato, A., Lohmann, G., & Friederici, A. D. (2011). Neural language networks at birth. *Proceedings of the National Academy of Sciences, 108*(38), 16056-"16061.

1-D-43 Auditory start-of-scan effects are different in the neonatal brain

Rebecca Schwarzlose[1], Michael Myers[1], Timothy Laumann[1], Scott Marek[1], Chad Sylvester[2]

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

Objective: Participants scanned using functional MRI always receive an incidental sensory stimulus: loud, repetitive noises generated by echo-planar imaging gradients that begin at the start of each run and continue throughout data acquisition. The onset of this stimulation at the start of each run may elicit activity changes in primary auditory cortex (A1) at the start of scan (SOS) that reflect evoked and/or modulatory responses -" effects that may differ across development. Such effects could inform our understanding of developmental effects in sensory processing and might serve as a confounding variable in fMRI studies of auditory processing over development **Methods:** Resting-state data from five datasets were analyzed to compare activity changes in four cortical parcels corresponding bilaterally to the core region of A1 over the first 30 seconds of resting-state runs. These datasets included the following samples: healthy adults (N=120), children oversampled for anxiety disorders (N=61, ages 8-14 years), a low-motion subset of children participating in the Adolescent Brain Cognitive Development (ABCD) Study (N=1,964, ages 9-10 years), and two single-subject datasets from full-term neonates (ages at first scan: 20 and 37 days old) scanned repeatedly for precision functional neuroimaging and collected while infants slept. Data underwent preprocessing for functional connectivity (FC) processing, including censoring of high-motion frames, interpolation, bandpass filtering, and global signal regression. Permutation testing was applied to each dataset to determine whether blood oxygen level dependent (BOLD) signal deviations from zero in A1 parcels were significantly greater in the first 30 seconds than in all other 30-second windows within runs. **Results:** All four A1 parcels showed significant (p<0.0001) SOS effects in all five datasets. Of note, SOS effects in the adult and child datasets were due to large *negative* deflections in A1 parcels in the first 30 seconds of runs. In contrast, A1 parcels in the neonatal samples showed large *positive* deflections at the start of runs. **Conclusions:** Across several datasets, we find consistent evidence of robust SOS effects in A1. In adults and school-age children, these effects constitute a pronounced negative deflection that could be consistent with sensory suppression or regulation. Neonates exhibit the opposite pattern, producing positive deflections consistent with A1 activation. These differences could serve as confounding variables in analyses of age-associated changes in processing intended (*i.e.*, intentionally presented) auditory stimuli. They may also indicate developmental discontinuity between the neonatal and school-year ages in auditory suppression and processing.

1-D-44 Longitudinal associations between language network characteristics in infant brain and school-age reading abilities are mediated by early-developing phonological skills

Xinyi Tang[1], Xi Yu[1], Ted Turesky[2], Escalante S. Elizabeth[2], Mingrui Xia[1], Nadine Gaab[2]

[1]Beijing Normal University, [2]Harvard Graduate School of Education

Background: Reading acquisition is a prolonged learning process relying on sound and early language development starting in utero. Behavioral longitudinal studies have demonstrated that infant language abilities were prospectively associated with preschool/kindergarten language skills, which in turn related to school-age reading performance. The advances of pediatric neuroimaging techniques facilitate the characterization of the neural network mechanisms underlying language development in infancy. However, it is still unknown how these early-emerged language network scaffolds long-term reading acquisition. Objective: To examine whether and how the FC characteristics of the language neural network in infancy are associated with individual differences in children's language and preliteracy skills in kindergarten and subsequent reading abilities. **Methods:** Our research question was addressed using a seven-year longitudinal dataset, spanning infancy to elementary school ages.Seventy infants (32 females) completed resting-state fMRI scanning during natural sleep (mean age = 9.4 3.6 months), and were followed until kindergarten (mean age = 5.7 0.7 years), where their oral language, phonological processing skills, and rapid automatized naming (RAN) abilities were assessed behaviorally. Of this larger cohort, thirty-nine (20 females; mean age = 7.7 0.8 years) were subsequently seen in second grade and assessed on their word reading abilities. The intrinsic functional organization of the infant language network was first probed using the hierarchical clustering. Correlation and mediation analyses were subsequently performed to evaluate prospective associations between infant language network characteristics and school-age language and reading abilities. **Results:** 1. A modular architecture (Q = 0.30) was identified for the infant language network, which included three modules: a) an inferior frontal (IFG) module comprising bilateral inferior frontal gyri and their orbital part; b) a middle frontal (MFG) module consisting of bilateral middle frontal gyri; and c) a temporoparietal (TPG) module involving bilateral middle temporal and angular gyri (Figure 1). 2. Longitudinal behavior analyses showed that phonological processing skills and RAN abilities at the kindergarten time point were significantly correlated with word reading abilities at the elementary school time point. 3. FC of the IFG module within the infant language network was positively associated with phonological processing skills at kindergarten age and word reading abilities at elementary school while controlling for infant scan age, head motion, nonverbal IQ, home literacy environment, and family socioeconomic status. Moreover, keeping the covariates consistent, mediation analyses further revealed a significant mediation role of kindergarten-age phonological processing skills on the relationship between the infant FC and school-age word reading abilities (Figure 2). **Conclusion:** The current study demonstrates that the functional characteristics of the infant language network are linked to kindergarten-age phonological processing skills, and further support later reading development. Our findings shed light on the scaffolding role of the early-emerging language neural network in supporting the development of core language/preliteracy skills and laying the foundations for subsequent reading acquisition.

1-D-45 - A new passive experimental paradigm to assess anticipation and response to reward using Event-Related Potentials (ERPs) in infants and toddlers (pre-registered report)

Caitlin Clements[1, 2], Charles Nelson[3], Sarah Krystkowiak[4], Marine Nimblette[4], Deborah Obiajulu[5]

[1]University of Notre Dame, [2]Boston Children's Hospital, [3]Harvard Medical School, [4]Northeastern University, [5]Harvard College

Introduction: Alterations in reward processing are core features of many neurodevelopmental disorders, including autism, ADHD, schizophrenia, and others (Clements, Ascunce, and Nelson, 2022). Developmental study of such a transdiagnostic construct could have far-reaching implications, particularly as a biomarker for use in intervention studies of neurodevelopmental disorders such as autism. We developed ePeekboo to elicit multiple components (association learning, valuation, anticipation, response) of reward processing via EEG. In this paradigm, one of two auditory cues is followed by a nonsocial (fractal moving) or social (caregiver smiling) video that appears on the left or right side, corresponding to the cue. The two outcomes of interest are the Stimulus Preceding Negativity (SPN) to index anticipation, and the Reward Positivity (RewP) to index valuation and/or response. The RewP has been reported in 4-6 year-olds (Hennefield et al., 2022), while the SPN has been shown in 3- and 4-year olds by Engle et al., (2021), who reported a stronger SPN to social than nonsocial stimuli. We adapt their paradigm (personalized stimuli, auditory cues), and extend the age range downward. Research questions: 1. Do children under age 3 years show evidence of a) an SPN, and b) a RewP? 2. If so, do these ERPs differ for social and nonsocial rewarding stimuli? **Methods:** We will pilot test this paradigm with n=8 infants and toddlers; data collection is ongoing (current n=4), and data have not yet been analyzed. In order to validate the feasibility of the paradigm for eliciting the SPN and RewP, data were collected from n=12 adult participants. In this pre-registration, we propose that data be preprocessed to remove trials with inattention to the screen. Cleaned data will be processed in HAPPE 3.0 (Monachino et al., 2022) for artifact removal. Participant data will be rejected if pre- and post- waveletting correlations fall below 0.05 for 3 frequency bands. The SPN will be measured from 2000ms before stimulus onset to 0ms, with the window of interest as 200-0ms before stimulus onset (mean amplitude). In 4-6 year olds, the RewP occurs between 400-500ms (Hennefield et al, 2022) compared to 250-350ms in adults (Ait Oumeziane, Jones, and Foti, 2019). Both the presence and time window of the RewP in infancy or toddlerhood are unknown, so visual inspection from 0-800ms will determine the similarity between the infant's waveform and the older child RewP waveform. **Results:** We hypothesize that the RewP and SPN will be present in children >12 months, with larger amplitudes to social than nonsocial stimuli, and slower latency than older child waveforms. We hypothesize that the effects will be stronger in the first half of trials than the second. **Conclusions:** If our hypotheses are correct, we will observe SPN and RewP to rewarding stimuli (social > nonsocial) in children >12 months. This pattern of results would imply that this experimental paradigm could be repeatedly longitudinally to track the development of the SPN and RewP. If our hypotheses are not correct, we will explore alternative analyses to identify confounds and alternative explanations.

1-D-46 An EEG study to investigate individual differences in statistical learning in one-month-olds (pre-registered report)

Johannes Mohn[1, 2], Franziska Gronow[2], Katharina Pittner[1, 2], Martin Bauer[1, 2], Claudia Buss[3], Yee Lee Shing[4], Valentina Pittol Nercolini[2]

[1]Charité - Universitätsmedizin Berlin, [2]Charité – Universtitätsmedizin Berlin, [3]Institut für Medizinische Psychologie, [4]Goethe University Frankfurt

Human infants possess the ability to rapidly learn the structure of their environments from repeated exposure, termed statistical learning. This ability is present early and may scaffold later emerging learning and memory abilities. However, little is known about the longitudinal development of statistical learning and inter-individual differences therein. This lack is possibly due to the challenges of assessing them in preverbal infants using traditional behavioral paradigms. We are conducting an EEG study to assess the neural responses of 100 one-month-old infants to statistical regularities in an auditory learning paradigm. We project that by FIT'NG 2023, 30 infants will have been assessed based on which preliminary data will be presented. Awake infants are exposed to a stream of 12 natural language stimuli that are concatenated into four trisyllabic pseudo-words. EEG (32 channels, active electrodes) is measured concurrently. Our goal is to measure word segmentation. Based on previous work in older infants, this is expected to be indicated by a significant increase of phase locking at the word frequency relative to the syllable frequency in the EEG signal during learning (word learning index). First, we expect that word segmentation can be reliably observed on the level of the individual as early as at one month of age. Second, we hypothesize that considerable differences in word segmentation exist between individuals. To test this, we will calculate the word learning index in a sliding window over the experiment. This will allow us to uncover learning curves for every individual that can be mathematically modeled. The learning rate and final word learning index parameters represent learning speed and endpoint, respectively, and can serve to compare learning between individuals. Alternatively, we will explore if representational similarity analyses can be used to track the strengthening of word representations during learning. This study is embedded within a larger scale longitudinal project with the aim of predicting later memory development and how it relates to early brain development. This research will expand our understanding of early forms of learning and may provide clues to inform strategies to support optimal learning.

1-D-47 Functional connectivity of language networks in 3 to 6-month-old infants as a predictor of later language outcomes (pre-registered report)

Joshua Ceballos[1], Lauren Wagner[1], Emily Chiem[1], Mirella Dapretto[1]

[1]University of California, Los Angeles

Background: Language is an integral component of communication and is essential for social and cognitive development; yet 3.3% of children experience language delays according to the U.S. Census Bureau (Black et al., 2015). To understand the neural mechanisms underlying language impairments, it is critical to investigate developmental changes within the brain's language networks in infancy, and how these relate to language outcomes. While patterns of functional connectivity in infancy and early childhood have been shown to predict later language outcomes (Bruchhage et al., 2020; Yu et al., 2021), further investigations into the development of language networks in early infancy using a well-powered infant sample are still needed. Understanding the neural antecedents of language development and delay will advance the early identification and intervention of language-related disorders.
Objectives: To investigate how functional connectivity within language networks in a large infant sample may predict later language outcomes. **Methods:** Typically-developing infants underwent behavioral language assessments and resting-state functional MRI as part of the Baby Connectome Project (BCP; Howell et al., 2019). Functional MRI scans have been preprocessed with FSL. Approximately 84 infants will be included in current study, all of whom have resting-state scans at 3 to 6 months that pass quality control, as well as follow-up language assessments from subscales of the Mullen Scales of Early Learning (MSEL) and MacArthur-Bates Communicative

Development Inventories (MCDI). Three language-related regions of interest (ROIs) will be selected in each hemisphere: primary auditory cortex, superior temporal gyrus (STG), and inferior frontal gyrus (IFG). A 3-way mixed analysis of variance (ANOVA) will examine differences in language networks between age cohorts (3, 4, 5, and 6 months) with ROIs and hemispheres as two within-subject variables. The dependent variable will be the average functional connectivity between each ROI during resting-state. Functional connectivity metrics will also be extracted from the imaging data and correlated with MSEL and MCDI language scores to identify connectivity patterns that predict later language skills.Hypotheses: 1.Language ROIs of the left hemisphere will show greater intra-hemispheric functional connectivity with age than ROIs in the right hemisphere (Olulade et al., 2020). 2. Increased functional connectivity as a function of age will positively correlate with later language outcomes. Implications: These findings will have significant implications for understanding the development of language networks in early infancy. By identifying developmental patterns of early functional connectivity in language networks and understanding their relationship with language outcomes, these findings may inform the early identification of and timely interventions for language-related disorders. Characterizing the neurodevelopmental mechanisms underlying early language development is a critical first step toward earlier detection of delayed language development, which in turn may allow for earlier and more successful interventions when the brain is still highly plastic.

1-D-48 Frontal lobe gray matter effects on preterm toddlers' problem-solving skills

Megan Giles[1, 2], Ying Wang[2], Josselyn Munoz[2], Kelly Vaughn[3, 4], Johanna Bick[5], Dana Demaster[1]

[1]University of Texas Health Science Center at Houston, [2]Children's Learning Institute, University of Texas Health Science Center at Houston, [3]University of Texas Health Science Center - Houston, [4]University of Texas Health Sciences Center at Houston, [5]University of Houston

Children born preterm (PT) often face neurodevelopmental challenges with cascading effects on cognitive and emotion regulation (ER) skill development during the critical period of toddlerhood. This research examines the effects of prematurity on frontal lobe gray matter volume (GMV) and ER among toddlers during a problem-solving task. Specifically, the Tool Task was used to measure child and parent behaviors via an increasingly difficult three-level problem-solving task requiring increased toddler ER and parent support of child ER through co-regulation. We hypothesized that toddler frontal lobe GMV will predict ability to cope and comply during the task, and that parent support scores will be correlated with child frontal lobe GMV. The current study investigates neurodevelopmental differences in preterm toddlers ages 15-30 months corrected for prematurity. Recruited from public clinics in Houston, TX, the sample includes 45 toddlers (adjusted age M = 19.30 months) who have completed pre-intervention testing. The sample contains 25 extremely PT (EPT; 22-27 gestational weeks (GW); M = 25 GW) toddlers and 20 later PT (LPT; 28-35 GW; M = 32 GW) toddlers. Behavioral data was recorded during a 1-1.5-hour long session, with the Tool Task taking approximately 10 minutes to complete. MRI data was collected during the toddlers' natural sleep and processed using iBEAT for brain segmentation and FSL for GMV calculation. Data collection is ongoing; thus, we plan to expand our sample as we continue enrolling participants. The sum of parent support scores (supportive presence and quality of assistance) did not differ between the EPT and LPT groups. There was a trend indicating increasing child noncompliance with task difficulty for both groups. Repeated Measures ANCOVA indicated gestation-related group differences in noncompliance after accounting for age ($F = 4.47$, $p = .04$), such that LPT toddlers' noncompliance increased between levels 1 and 2, and EPT toddlers' noncompliance increased between levels 2 and 3. ANCOVA, controlling for total GMV and age, indicated a significant interaction of gestation and left frontal lobe GMV predicting relative increase in noncompliance between Tool Task levels 1-3 ($F = 4.89$, $p = .042$). Toddlers with higher left frontal lobe GMV and greater GW increased more in noncompliance as the task got more difficult. In addition, the sum of parent assistance scores for Tool Task levels 1-3 predicted left frontal lobe GMV ($F = 4.41$, $p = .05$). There was no significant interaction between parent support and gestation on left frontal lobe GMV. Child coping skills during the task were not significantly related to frontal lobe GMV or gestation. EPT and LPT toddlers increased their noncompliance with task difficulty during a supported problem-solving task, and variation in the increase in noncompliance can be partially accounted for by a gestation and frontal lobe GMV interaction. Developing cognitive skills may lead the toddlers to advance their own strategies that are not properly attended to by the parent, thus leading to noncompliance. Interestingly, all significant interactions were related to left frontal lobe GMV, not the right. This may be explained by acquisition of language during toddlerhood, its lateralization to the left hemisphere, and language effects on ER. Taken together, parent support may aid in cognitive development of preterm toddlers and reduce the risk for cognitive and ER disorders.

E - Other

1-E-49 Low-grade inflammation during pregnancy and its association with the pre- and perinatal head circumference

Ezra Aydin[1], Raimundo Rodrigues[2], Isabelle Mueller[3], Sanjana Inala[3], Bin Cheng[4], Bradley Peterson[5], Catherine Monk[3], Dustin Scheinost[2], Marisa Spann[3]

[1]Columbia University, [2]Yale University School of Medicine, [3]Columbia University, Vagelos College of Physicians and Surgeons, [4]Columbia University Irving Medical Center, [5]University of Southern California

Background: Maternal health and intrauterine exposures during pregnancy play a major role in molding and shaping the health and neurodevelopment of our offspring one such influence is maternal immune activation (MIA). In both animal and human studies, variation in maternal cytokine and inflammation levels during pregnancy have been associated with changes in offspring development (e.g., alterations in brain structure, functional connectivity, and behavioral outcomes). *However, can this relationship be observed in gross fetal biometric development?* Head circumference (HC) is an accepted measure to be used as a proxy for brain size in pre- and postnatal research. Ultrasound is a standardized clinical tool, that is non-invasive and is part of an individual's routine antenatal care. Therefore, this study aims to utilize ultrasound to explore the association between low-grade maternal immune exposure during pregnancy longitudinally using pre- and perinatal HC measures. **Sample:** 70 healthy women with singleton pregnancies were recruited and underwent blood draws at two-time points during pregnancy: (1) 24-27 weeks gestation, (2) 34-37 weeks gestation. Both adaptive (e.g., IgG) and innate (e.g., cytokines and acute phase reactants) immune markers were assayed, totaling 46 markers of maternal immune activation. HC measurements taken during the 2nd and 3rd trimester via ultrasound and at time of birth (mean = 39.3 weeks) were obtained from participantâ€™s medical records. Analysis: A principal component analysis (PCA) was performed to help identify profiles of immune expression. PCA revealed a top PC (a combination of 43 immune markers) explaining 42.1% of the variance. Each subject's score for the single PC was correlated with the HC measure at 3 independent timepoints (2nd and 3rd trimester and

newborn periods). The HC measure was z-scored and age-adjusted at each timepoint. HC velocity was observed between the 2nd & 3rd trimester and the 3rd trimester & newborn timepoints. The difference in growth between two time points was examined using a standardised growth velocity formula [1]. **Results:** There were no significant associations were observed between the top PC and HC growth velocity between the 2-3rd trimester time band or the 3rd trimester-birth time band. Summary: The initial findings suggests that low-grade inflammation immune profile during pregnancy may not influence fetal HC development *in utero*. In the context of the existing literature, the fetus may be more susceptible to high-grade maternal immune responses, which have led to deviations in growth and growth trajectories (e.g., small-for-gestational age and microcephaly). Continued work in identification of growth alterations, critical windows and long-term outcomes using accessible methodologies could lead to the development of preventative and mechanism-based healthcare and facilitate timely referral for appropriate interventions.

1. Hiersch, L. & Melamed, N. Am. J. Obstet. Gynecol. 218, S700-S711.e1 (2018).

1-E-50 - Social interaction processing in infants

Jamie Soeun Park, Lauren Smith[1, 2], Brandon Woo[3], Manasi Malik, Leyla Isik, Lindsey Powell[2]

[1]University of California, San Diego, [2]University of California San Diego, [3]Harvard University

Recognizing and attending to social interactions is an important ability for social development. Behavioral studies find that infants show increased attention to social interactions toward the end of the first year(Thiele et al., 2021), but neural evidence regarding the development of social interaction processing is thin. Previous research with adults found that a region of the posterior superior temporal sulcus (pSTS) is functionally specialized for processing social interactions relative to independent actions (Isik et al., 2017). In adults, this region responds both to naturalistic video of human interaction and simplified, abstract representations of interactions that retain relational features. In the current study, we will aim to answer two questions. First, can a functionally specialized region for processing social interactions can be found in infant pSTS? Second, if such a region can be identified, is it initially responsive 1) to concrete, naturalistic features of interacting people, 2) to abstract, relational features of social interactions in simplified animations, or 3) both? With respect to the first question, some functional specialization in the human cortex develops early in infancy, while other specializations only develop with extensive cultural experience (Deen et al., 2017; Dehaene & Cohen, 2011; Gomez et al., 2019). One existing paper finds selective activation to social interactions in medial prefrontal cortex but is inconclusive with respect to specialization in pSTS (Grossmann et al., 2013). To investigate this specialization further, we plan to test for differences in activation in the pSTS region in 7-9 month-old infants as they observe social interactions and independent actions, using functional near-infrared spectroscopy (fNIRS).We will optimize optode placement to cover the same area of pSTS in which Isik and colleagues identified adult specialization (2017), and we will use an individual functional localizer approach to be maximally sensitive to differential activation patterns within each individual's data set (Powell et al., 2018; Liu et al., 2022). To address the second question, we will also manipulate the features in the videos, to test if concrete or abstract features drive early specialized responses to social interactions. Half of the stimuli will feature videos of two human actors, either interacting with one another or acting in an independent manner. The other half of the stimuli will feature similar social interactions or independent actions, depicted using animated geometrical agents (with eyes, to retain the abstract feature of relational orientation). If a specialized pSTS region for social interaction initially responds only to social interactions featuring human agents, this could imply that familiar visual features of interacting humans initially drive responses in this region. Alternatively, if this region does not care about concrete features, but rather relational features in early development, then we expect to see similar increases in activation to social interaction depicted by both stimulus types. We plan to test for an interaction in the effects of social vs. independent action and human vs. abstract stimulus type on activation in the pSTS using a linear mixed effects model.

F - Sensitive Periods and Brain Plasticity

1-F-51 Proof-of-concept: Whole-head high-density diffuse optical tomography in infants

Liam Collins-Jones[1], Louisa Gossé[2], Chiara Bulgarelli[3], Maheen Siddiqui[2], Borja Blanco[4], Ernesto Vidal-Rosas[1], Nida Duobaitė[5], Reuben Nixon-Hill[5], Greg Smith[5], James Skipper[5], Tim Sargent[5], Sam Powell[5], Nick Everdell[5], Emily Jones[6], Robert Cooper[1]

[1]University College London, [2]Centre for Brain and Cognitive Development, Birkbeck University of London, [3]Birkbeck College, [4]The University of Cambridge, [5]Gowerlabs Ltd., [6]Birkbeck, University of London

Introduction: Infancy is a critical time where early symptoms of neurodevelopmental conditions emerge. High-density diffuse optical tomography (HD-DOT) is an optical neuroimaging method that localises changes in haemoglobin concentration in three dimensions, and has been applied to study the infant brain. HD-DOT is motion-tolerant and portable, allowing the awake baby brain to be studied in ecologically-valid settings. Recent years have seen a huge advance in wearable hardware for HD-DOT, however previous headgear has only been capable of sampling specific areas of the cortex. In this work, we aimed to develop headgear capable of sampling across the whole scalp surface and to conduct a proof-of-concept demonstration of whole-head HD-DOT in infants aged 6-months. **Methods:** We developed a whole-head infant implementation of the high-density LUMO design developed by Gowerlabs Ltd. (UK). The LUMO system consists of multiple independent hexagonal modules, each containing three dual-wavelength LED sources and four photodiode detectors. In our prototype, 33 LUMO modules were embedded in a neoprene cap. For a proof-of-concept demonstration, HD-DOT data were collected from infants aged 5- to 7-months (N=24) during the presentation of a screen-based paradigm (see Fig. 1b). Data pre-processing and motion artefact correction were completed using the Homer2 and DOT-HUB toolboxes. A 6-month infant MRI atlas was used to model light propagation in the infant head, and was combined with the data to reconstruct a time-series of images for each individual mapping changes in cortical oxy-haemoglobin (HbO) concentration. Using a general linear model approach, beta weights and t-statistic values for each experimental condition were computed. **Results:** The completed whole-head HD-DOT cap is shown in Figure 1a. Our final sample included valid data from N=16 participants. For both conditions, increased beta weights (Fig. 1c and e) and t-statistic values (Fig. 1d and f) for changes in HbO concentration can be seen bilaterally in the superior temporal gyrus and temporoparietal junction (STG-TPJ), and in the occipital lobe. An increase in HbO concentration is a hallmark of a functional brain activation. For the social condition, a greater increase in HbO concentration (and more spatially focal response) is seen in the right STG-TPJ region, as well as a more spatially constrained response in the occipital lobe. We also note a functional response in the inferior frontal gyrus bilaterally, as well as an inverted response (i.e. decrease in HbO concentration) in the pre- and post-central gyri.

Conclusions: This is the first demonstration of whole-head HD-DOT in infants. We have mapped activity in regions across the entire cortex, including regions outside the STG-TPJ that typically have not been sampled in previous infant optical neuroimaging research of social interaction. In the STG-TPJ region, our results are consistent with findings in previous infant research, and we have localised what appears to be a visual response in the occipital lobe. We found inverted responses in the pre- and post-central gyri, potentially caused by increased motor activity during the baseline condition. Following this proof-of-concept, we envisage that whole-head HD-DOT will be applied to map the interaction between different regions of the brain, opening new avenues to map connectivity in the awake infant brain to better understand the trajectory of typical and atypical neurodevelopment.

1-F-52 Linear association between age and specific EEG power spectra beginning in infancy in epilepsy

Jeremy Wong[1], Erin Conrad[2], Jessica Walter[3], Elizabeth Norton[3]

[1]Northwestern University Feinberg School of Medicine, [2]University of Pennsylvania, [3]Northwestern University

Rationale: From birth through infancy to pre-adolescence, neural plasticity occurs via various mechanisms such as neurogenesis, pruning, and myelination and is a significant contributing factor to achieving neurodevelopmental milestones across the lifespan. Neurodevelopment can be adversely impacted by neurologic diseases such as birth trauma leading to hypoxic ischemic encephalopathy, perinatal stroke, and epilepsy. In particular, the latter is the most common chronic neurologic disorder affecting over 50 million people worldwide. Children with epilepsy, particularly those with refractory epilepsy, have significantly higher rates of adverse neurocognitive sequelae than age-matched cohorts. Prior work has investigated developmental trends in EEG power, particularly in delta and alpha frequencies. However, norms for these trends have not yet been elucidated, nor has it been well studied in neonates, infants and children with epilepsy. **Methods:** 14 patients, ages six months to 18 years (median age 10 years), were enrolled in an IRB approved prospective observational cohort study between January and November 2021 in the Lurie Epilepsy Monitoring Unit. All had a prior epilepsy diagnosis and underwent clinically indicated EEG monitoring for 4 hours via Natus Xltek (Natus Medical, Pleasanton CA) comprised of 19 cup electrodes in clinical standard 10-20 system positions. For each patient, segments of up to 30 minutes of continuous sleep without significant artifact or epileptiform discharges were extracted. No post processing or filtering was performed prior to analysis. Automated data analysis was performed via a previously validated software package (Conrad et al, *Brain*, 2019) using MATLAB (Mathworks, Natick MA). Scalp average referencing was calculated for individual electrode amplitudes, followed by power spectral analysis for each channel in the following frequencies; delta (0.5 to 4 Hz), theta (4 to 8 Hz), alpha (8 to 13 Hz), beta (13 to 30 Hz), and gamma (30 to 50 Hz). Each of these frequency bands were averaged across all channels, and then ratios were calculated based on the total power. **Results:** We investigated the relationship between age and subsets of EEG power spectra. Figure 1 compares age versus distribution of relative EEG band power in all physiologic frequencies (delta, theta, alpha, beta and gamma) via linear regression analysis and subsequent Pearson correlation calculations. We demonstrate a strong negative correlation (R = -0.79) between age and delta power (Fig 1A) as well as strong positive correlations between age and alpha power (R = 0.79, Fig 1C) as well as age and beta power (R = 0.78, Fig 1D). These findings are concordant with what has previously been reported in neurodevelopmental studies in neurotypical children. **Conclusions:** In a small cross-sectional dataset, we demonstrate the strong possibility of a linear association between key physiologic EEG power spectra that may serve as a biomarker for adverse neurodevelopmental outcomes. Future directions include performing this analysis in a neurotypical cohort starting from birth as well as following individual patients from infancy through childhood to determine if similar associations exist between these frequencies and age.

1-F-53 Tots & tunes: The distribution of speech and music in the naturalistic auditory environment of infants

Tori Hennessy[1], Lindsay Hippe[1], Christina Zhao[1]

[1]University of Washington

Throughout infancy and early childhood, children across cultures and languages are exposed to a diverse collection of auditory input. Music, both vocal and instrumental, has been shown to capture the attention of children and facilitate neural speech processing during the sensitive period for language acquisition. Several studies have demonstrated that infants may even prefer infant-directed song over speech when tested in experimental settings. Yet, little is still known about the amount of music infants hear relative to speech on an average day. Much of early music exposure occurs in the home or daycare, which presents a challenge to capture and process data that is representative of an infant's typical auditory environment. We devised a novel, crowdsource-inspired approach to quantify and describe the music and speech that infants hear in their home environment during the first two years of life. 24 children, at 6, 10, 14, 18, and 24 months of age, wore small Language Environment Analysis (LENA) recorders designed to record their natural linguistic input and output. 12,000 10-second audio segments were then extracted from the dataset of recordings and uploaded to an online citizen science platform. A large group of listeners were instructed to listen to the segments and subsequently identify whether there is speech and/or music present, whether the speech and/or music is directed to the child wearing the LENA device, and if the speech and/or music is playing in-person, through an electronic device, or both. Each segment containing speech or music was coded by a minimum of 5 individual listeners to produce a consensus. In under 4 months, 7,200 segments were listened to and coded by nearly 500 participants. Preliminary findings revealed that at 6 months of age, infants hear significantly less music than speech in their home environment (see figure). The combination of ecological audio data and mass-group coding generates an efficient method for studying the early auditory environment of language-learning children. These findings may inform caregivers, researchers, and early childhood professionals about actions to enhance language acquisition through music and beyond.

1-F-54 Developmental trajectories of the default mode, executive control, and salience networks from the third trimester through the newborn period

Dustin Scheinost[1, 2], Emma Brennan-Wydra, Soo Kwon, Joseph Chang, Seyedmehdi Payabvash, Cheryl Lacadie, R. Todd Constable, Charles Duncan, Katarzyna Chawarska, Laura Ment

[1]Wayne State University, [2]Yale University

The default mode (DMN), executive control (ECN), and salience (SAL) networks are involved in social cognition, vulnerable to environmental insults, and are disrupted in neurobehavioral disorders. However, their development across the third trimester and perinatal transition remains largely unknown. Employing resting-state functional MRI at 30-32, 34-36, and 40-44 weeks postmenstrual

age (PMA), we tested the hypothesis that intra- and inter-network connectivity of these networks develop across 30-44 weeks PMA in 84 fetuses and neonates. After, establishing these trajectories, we compared connectivity involving these networks in preterm neonates to fetuses of the same postmenstrual age (PMA). A secondary analysis addressed the impact of maternal mental health on these networks. The DMN, ECN, and SAL develop across the third trimester and first postnatal month. At the intra-network level, significant increases occurred between 36 to 44 weeks PMA, with network strength values significantly >0 at 40 weeks PMA for all. Significant inter-network DMN-"ECN connectivity >0 was found from 36 weeks PMA through the first postnatal month, suggesting inter-network connectivity in fetal brain. Finally, higher maternal stress levels negatively affected the SAL across 30-44 weeks PMA. We found significantly greater within-network functional connectivity of the salience, default mode, executive control and language networks in extremely low gestational age neonates at 34 -" 36 weeks postmenstrual age (PMA) when compared to PMA-matched fetuses, while we did not find significant differences in between-network functional connectivity among these networks. These data provide a framework to compare fetuses and neonates at risk for neurobehavioral disorders and assess the impact of the environment on the developing brain. These data reveal the impact of the environment on these experience-expectant networks in prematurely born infants.

1-F-55 Ontogeny of the Ascending Arousal Networks

Roxane Licandro[1], Mark Olchanyi[2], Luiz F. Ferraz Da Silva[3], Andre Van Der Kouwe[2], Camilo Jaimes[4], Nathan Xi Ngo[2], William Kelley[2], Richard D. Goldstein[4], Robin Haynes[4], Hannah C. Kinney[4], Brian L. Edlow[2], Lilla Zollei[2]

[1]Medical University of Vienna, [2]Massachusetts General Hospital / Harvard Medical School, [3]University of São Paulo, Department of Pathology, São Paulo, BRASIL, [4]Boston Children's Hospital

Arousal, also referred to as wakefulness, is an essential element of consciousness. Human wakefulness is mediated by the ascending arousal network (AAN) and its connections from the brainstem tegmentum to the diencephalon, basal forebrain, and cerebral cortex. In this work, we are closing the gap with the more extensively studied adult population by analyzing seven timepoints (19,21,22 gestation weeks, 1 and 2 months, 60 and 61 years) of the perinatal and adult population to advance our understanding of the ontogeny of subcortical arousal networks in the human brain. We hypothesize that graph-theoretic measures can assess developmental patterns of the AAN by quantitatively characterizing the complex configuration of developing brain networks. As a corollary, we test the hypothesis that the structural connectome of the AAN becomes increasingly complex and progressively reaches rostral brain sites during the first year. Here, we investigate the ontogenic development of subcortical arousal networks by imaging 7 whole human brain samples, all reported with no developmental abnormalities after neuropathologic assessment. We acquire high-resolution ex-vivo MRI after brain fixation of 24hrs (fetuses), 30-50 days (neonates), and >90 days (adults). Subsequently, we perform probabilistic diffusion tractography incorporating 27 manually annotated seed regions of the AAN and additionally computing atlas-based segmentations of 58 cortical regions. To quantify network connectivity properties, we use graph theoretical analysis, including hub region determination by combining degree, clustering coefficient, and betweenness centrality ranks and estimating short- and long-range structural connectivity. For visual assessment, three-dimension tracts are derived by deterministic tractography. The AAN structural connectivity pattern analysis focuses on the hub rank since it provides information about the presumed functional importance of a region within a defined network. A key finding is that the dorsal raphe nucleus (DR) (serotonergic system) as an AAN connectivity hub beginning in the fetal period. We also observe that the ventral tegmental area (VTA) (dopaminergic system) shows the highest hub ranks for every age group within the AAN as well as within the whole brain network, including cortical regions. We show that the structural connectome of the AAN becomes increasingly integrated and progressively reaches rostral sites during the first year of development, highly correlating with myelination patterns. Short- and long-range (SR,LR) connectivity analysis revealed that highly probable connections of LR connectivity are evolving postnatally, while short-range connections are present over the entire observed period. Specifically, DR demonstrated to be a hub of SR connectivities, while VTA to be a hub of evolving LR connectivities. We demonstrated that graph-based analysis could be used to assess the ontogeny of structural connectivity in the AAN. This study is limited by the number of subjects, thus resulting connectivity maps should be considered as a case study to advance the understanding of human brain development. For future work we will use the established references to provide new insights into how arousal networks may fail in disorders of wakefulness, such as coma, seizures, and SIDS.

1-F-56 Exploring Mechanisms of Phonetic Category Learning Through Perceptual Attunement

Sarvenaz Oloomi[1], Janet Werker[1]

[1]University of British Columbia

Infants begin life able to discriminate both native and non-native speech sounds. By 10-months, infants improve at discriminating similar sounding native speech sound differences (e.g., English voiced 'ba' vs voiceless 'pa') and decline at discriminating speech sound differences that are not used to contrast meaning in the native language (e.g. Hindi retroflex 'É—a' vs dental 'É–a'; Werker & Tees, 1984). -œAcquired Distinctiveness-□ (AD), in which two similar speech sounds are consistently paired with two different objects, is a perceptual learning mechanism that boosts discrimination (Yeung & Werker, 2009). -œAcquired Equivalence-□ (AE), in which two similar speech sounds are inconsistently paired with two objects, is a learning mechanism that diminishes discrimination (Honey & Hall, 1989). AD (Yeung & Werker, 2009) has been shown to be effective in changing non-native speech sound discrimination in infants aged 6-8 months. In a recent study using the same EEG discrimination paradigm employed here, we found that a passive statistical learning mechanism, distributional learning, effectively changed speech sound discrimination at 6-8 months, but not after 10-months of age (Reh et al., 2021), consistent with the possibility of a critical period that begins closing by 10-months (Werker & Hensch, 2015). The current study was designed to test whether the efficacy of AE and AD similarly changes across the first year of life or, because AE and AD involve linking sound to meaning, they remain effective even at the older age. We are testing this by comparing English-learning 6- and 12-month-old monolingual infants. As in Reh, et al. (2021), we are using a native English, but acoustically difficult, phonetic contrast (English 'ra' vs "la'). At first, infants are presented with three sequential trials labelling a familiar object (e.g., " Look at the banana/dog/hand!") to signal an object labelling task (Yeung et al., 2014). Then infants are presented with either consistent or inconsistent speech sound/object pairings, following which phonetic discrimination is assessed. As in Reh, et al. (2021), discrimination is assessed by measuring the ERP (event related potential) response to change trials in an oddball task. To date, we have tested 55 of the proposed 80 infants, with 29 at 6-months and 26 at 12-months. If AE/AD are effective learning mechanisms across all ages, then AD will boost, and AE will diminish,

discrimination of 'ra' vs 'la' at both ages. If the efficacy of these learning mechanisms is delimited to a 6-"10-month sensitive window in perceptual development (Werker & Hensch, 2015), then these mechanisms will only be effective in the younger age group. Currently, the 6-month-olds are following the expected pattern, while there is still too much variability at 12-months to be confident of the pattern. The basic preliminary graphics of all consistent groups (n= 27) and inconsistent groups (n= 28) collapsed for age are attached. We expect to finish data collection and analysis by the end of summer 2023. The results of this study will advance our knowledge of how infants become adept -œnative language listeners- and will provide insight as to whether the kind of learning opportunity infants encounter (passive listening versus word learning) impacts the timing of plasticity.

1-F-57 Neurobiological changes across pregnancy

Yanbin Niu[1], M. Catalina Camacho[2], Benjamin Conrad[1], Sanjana Ravi[1], Hannah Piersiak[1], Ellen Clayton, Sarah Osmundson, Seth Smith, Autumn Kujawa[1], Kathryn Humphreys[1]

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

Reproduction-related neuroplasticity has been observed in non-human animal species. However, the extent to which pregnancy affects the human brain remains largely unexplored despite more than 80% of the women experiencing pregnancy and childbirth in their lifetime. An accumulating body of research indicates that hormones known to rise during pregnancy can modulate neuroplasticity in both humans and non-human animals. The present study aims to chart the neurobiological changes throughout pregnancy, including morphometric features, white matter microstructure, resting state functional activity, and associations with hormones. Hormone levels and multimodal images were collected from 10 women (mean age=28.97 yrs) repeatedly during pregnancy (mean gestational age=23.90 weeks and range=12.43-35.43 weeks; mean number of repeated measures=2.6 times, range=1-6 times). Waking salivary samples (cortisol, progesterone, and estradiol) across 2 mornings, 3D-QALAS (enable quantification of T1- and T2-weighted MRI), diffusion-weighted MRI (DWI; 12 b=0 volumes, 12 b=500 volumes, 47 b=1500 volumes, and 70 b=2500 70 volumes), and two 10-minute-run resting-state fMRI were acquired. Brain volumes were quantified using FreeSurfer (v7.1.0) longitudinal pipeline. After preprocessing by FSL (v6.0) and MRtrix3, DWI data was segmented into 50 well-described tracts by TractSeg. Neurite Orientation Dispersion and Density Imaging metrics were estimated using Accelerated Microstructure Imaging via Convex Optimization. Specifically, intra-cellular volume fraction (ICVF), isotropic volume fraction (ISOVF), and orientation dispersion (OD) were extracted for each tract. Resting-state fMRI were preprocessed using fMRIPrep 21.0.1. Processed functional time series were post-processed by eXtensible Connectivity Pipeline to estimate the amplitude of low-frequency fluctuation, and functional connectivity between each pair of brain network based on the Gordon atlas. Linear mixed-effects models were fitted for each metric, with a fixed effect of gestational week, necessary covariates, and a random subject intercept. Our main results revealed significant effects of gestational week on total brain volume (*B*=-0.11, *SE*=0.03, *p*=.004), total gray matter volume (*B*=-0.19, *SE*=0.05, *p*=.002) respectively. On average, total brain volume decreased by 0.45% per week (if constant over the full course of pregnancy it would translate to 18.11% estimated total decrease), and total gray matter volume decreased by 0.41% per week (a total estimated decrease of 16.58%; Fig 1). Progesterone levels were significantly related to total brain volume (*B*=-0.10, *SE*=0.03, *p*=.006) and total gray matter volume (*B*=-0.19, *SE*=0.05, *p*=.003). Additionally, we observed consistently increasing trends of ICVF and ISOVF in all tracts during pregnancy, with OD remaining relatively stable (Fig 2). ICVF and ISOVF of most tracts were significantly and positively associated with estradiol levels (Fig 3). Our preliminary findings indicate that pregnancy may exert significant impacts on brain structure and white matter microstructure. Additionally, our study revealed a potential involvement of progesterone and estradiol in these changes. These results could have implications for understanding the neural basis of maternal behavior and mental health issues that may arise during peripartum.

1-F-58 The spatiotemporal dynamics of EEG microstate networks during three to six months of infancy

Priyanka Ghosh[1], Cara Bosco[1], Michal R. Zieff[2], Lauren Davel[2], Zamazimba Madi[2], Thandeka Mazubane[2], Bokang Methola[2], Tembeka Mhlakwaphalwa[2], Nwabisa Mlandu[2], Khanyisa Nkubungu[2], Reese Samuels[2], Simone Williams[2], Khula Study Team[3], Kirsten Donald[2], Laurel Gabard-Durnam[1]

[1]Northeastern University, [2]University of Cape Town, [3]Khula Study Team

EEG microstates are brief (~80-100 ms) periods of quasi-stable spatial configurations of neural activity on a rapidly evolving time-scale (Lehman et al., 1987). Microstate analysis is an emerging method for investigating the instantaneous global brain networks and the functional organization of the dynamic brain (Michel & Koenig, 2018), particularly during the early developmental stages of human infants (Brown & Garstein, 2023). In a recent study, Gui et al. (2021) observed four microstates in infancy that corresponded with social attention and later potential emergence of ASD, suggesting that EEG microstates can be a powerful tool to predict functional brain dynamics and later developmental trajectories. The present study will examine EEG microstates at the first 3- and 6- months of age in the resting-state condition. We hypothesize that these infants would demonstrate distinct microstates comparable to those identified in adults and we expect to draw parallels with the fMRI resting-state networks. High-density EEG data were acquired from 3-month-old (N=257) and 6-month-old (data collection in progress, current N=250+) infants using Magstim EGI 128 channel system as part of an ongoing longitudinal study (KHULA) in Cape Town, South Africa. The infants were placed in a dimly lit room on the caregivers' laps where they silently held a toy/ watched bubbles or books placed in front of them. All data from the 3-month-old infants have been pre-processed using the Harvard Automated Processing Pipeline for EEG (HAPPE) (Gabard-Durnam et al., 2018). Data were acquired at a sampling frequency of 1000 Hz and 2000 ms long segments were extracted from the 3 min long recording sessions. Participant datasets that retained 15 or more segments were selected, making a total of 242 usable 3-month-old participants' data. We propose to conduct microstate analyses on the pre-processed EEG resting state/baseline data for both the age groups. First, we will compute the Global Field Power (GFP) across each age group to investigate the natural resting microstate fluctuations over time. Next, using a more recent development in microstate analysis known as Atomize and Agglomerate Hierarchical Clustering (Murray et al., 2008), we will simultaneously extract the topographies at all GFP peaks within a given age group and categorize them into small classes based on their topographic similarities using a modified K-means algorithm (Pascual-Marqui et al., 1995). The goodness of fit will be determined using the General Explained Variance (GEV) and/or the cross-validation (CV) criterion, the least representative cluster will be identified, atomized and the members will be reassigned to the most similar clusters. Based on this classification, the microstate topographies will be placed back into a sequential order to determine the amount of time spent in each of the microstate. Finally, we will statistically

compare these patterns across each time period (3-, and 6-months), which till date has not been reported. Additionally, we plan to implement these microstate features from the current EEGLAB microstate toolbox (Poulsen et al., 2018) into our HAPPE software with parameters customized exclusively for infant EEG data.

1-F-59 How much of the cortex is devoted to various functional networks at different ages?

Sanju Koirala[1], Julia Moser[1], Robert Hermosillo[1], Lucille Moore[1], Thomas Madison[1], Oscar Miranda-Dominguez[1], Eric Feczko[1], Alyssa Labonte[2], M. Catalina Camacho[2], Michael Myers[2], Kimberly Weldon[1], Alice Graham[3], Nico Dosenbach[4], Steve Nelson[1], Theodore Satterthwaite[5], Jed Elison[1], Chad Sylvester[4], Damien Fair[1]

[1]University of Minnesota, [2]Washington University in St. Louis, [3]Oregon Health & Science University, [4]Washington University, [5]University of Pennsylvania

Objective: A longstanding objective in neurocognitive research has been to subdivide the human brain into a mosaic of anatomically and functionally distinct areas to understand how the brain segregates and integrates information. The discovery of resting state functional MRI (rsfMRI) has led to the characterization of human brain organization based on the co-activation patterns of brain areas. However, such network organization is created by spatially coregistering data across multiple individuals which assumes homogeneity in brain organization and obscures meaningful subject-specific features. Recent work using Precision Functional Mapping (PFM) techniques have rendered unique insights into individual functional brain network architecture, revealing idiosyncratic network topography such as individual variation in functional network size (i.e., how much cortical real estate is taken by each network). Such variation in individual topography has been shown to relate to individual differences in behavior such as cognition and motor skills. However, it is not known when individual variation emerges over development. **Methods:** In this study, we aim to examine whether the surface area of functional networks differs between three different age groups: neonates, adolescents, and adults. We utilized functional neuroimaging data from the Adolescent Brain and Cognitive Development study (n=6000) and the Midnight Scan Club precision imaging study (n=10) to derive adolescent and adults individual network maps using Template Matching. For neonates, we derived individual network maps from extended acquisitions of neonatal resting state fMRI data (n=8, duration: 80-200 minutes). **Analysis:** In our analyses, we will calculate the mean total surface area for each group. As neonates have less gyrification than the other two groups, we hypothesize that the mean total surface area will be smaller for neonates compared to adolescents and adults. We will also calculate the proportional surface area for each individualized network in each age group. Using the large sample from ABCD, we will create a distribution of proportional surface area for each network and examine potential age effects based on where the network size for neonates and adults fall within this distribution. We hypothesize that the relative proportion of the cortex devoted to each network at different age points will vary **Implications:** Taken together, our study will provide important insights into age-related changes in individual-level functional network topography, and open opportunities to investigate how such changes in functional network topography relate to emergence of various behaviors in health and disease.

POSTER SESSION 2
MONDAY, SEPTEMBER 11 5:15–6:45PM

A - Early Neural Predicators of Psychiatric Risk

2-A-1 Functional network correlates of social motivation in infants and toddlers at elevated familial likelihood for ASD

Natasha Marrus[1], Annella Fernandez, Muhamed Talovic, Tomoyuki Nishino, Alexandre Todorov, Zoe Hawks, Savannah Davis, Adam Eggebrecht[2], Jed Elison[3], Annette Estes, Lonnie Zwaigenbaum[4], Kelly Botteron[2], Robert Mckinstry[1], Alan Evans, Heather Hazlett[5], Stephen Dager, Juhi Pandey, John Constantino, Robert Schultz, Martin Styner, Guido Gerig, Joseph Piven, John Pruett, Jr.

[1]Washington University in St. Louis, [2]Washington University, [3]University of Minnesota, [4]University of Alberta, [5]University of North Carolina

Early deficits in social motivation have been hypothesized to constrain social learning, thereby leading to atypical development of social communication and autism spectrum disorder (ASD). Social motivation is heritable and associated with familial ASD liability; thus, characterizing brain-behavior relationships for social motivation in the first two years, when ASD emerges, may elucidate early neural underpinnings of ASD. Here, we a) tested whether correlations between social motivation and ROI-ROI functional connectivity (fc) were enriched within specific brain networks, b) characterized the directionality of fc-behavior relationships, and c) explored the behavioral associations of implicated ROIs based on published literature. Data were from the multisite Infant Brain Imaging Study (IBIS), a prospective study of infants at high (HL) and low familial likelihood (LL) for ASD, who were evaluated for ASD at 24 months. Participants had concurrent neuroimaging and behavioral data at 12 (n=92; nHLASD=8) and/or 24 months (n=97; nHLASD =15). Resting state functional MRI data were collected during natural sleep using gradient-echo echo-planar image acquisition on cross-site calibrated 3T Siemens TIM Trio scanners. Analyzed data included ≥ two 6.25-minute runs and 150 frames of motion-scrubbed data. 230 functionally defined ROIs were sorted into networks using the Infomap community detection algorithm on 12- and 24-month data (Fig. 1A). A social motivation composite was generated using items with strong face validity from multiple parent-report measures. Enrichment analysis identified networks and pairs of networks whose fc strongly correlated with behavior, p<.001, followed by a machine learning procedure for secondary validation. ROIs contributing to enrichment were examined in the Neurosynth database for associations with behavioral terms aggregated from scientific literature in older subjects. At 12 months, the anterior frontoparietal control-1-somatomotor-2 (aFPC1-SMN2) network pair showed significant enrichment (p=.0002), whereby contributory ROI pairs negatively associated with social motivation (Fig. 1B). This finding did not pass secondary validation. At 24 months, the posterior FPC-anterior default mode network-2 (pFPC-aDMN2) network pair showed significant enrichment (p=.0006) and passed secondary validation, displaying an overall positive association with social motivation (Fig. 1B). Neurosynth terms strongly associated with ROIs in both pFPC and aDMN2 reflected aspects of social and general cognition (Fig. 1C). These results indicate that the most strongly implicated networks associated with early social motivation included a task control network (FPC) and the DMN, for which differences have been observed at later ages in ASD. Future directions include investigating whether these early brain-behavior relationships correlate with long-term social affective outcomes, including in the IBIS sample, which is being followed through adolescence.

2-A-2 Developing a Normative Model of Uncinate Fasciculus White Matter Organization in Neonates: Associations between Deviations and Mood/Behavioral Problems at 18 Months

Alex Dufford[1]

[1]Northwestern University Feinberg School of Medicine

Objective: The uncinate fasciculus (UF) is a fronto-limbic white matter tract connecting the anterior temporal lobe to the orbitofrontal cortex via limbic regions (ref). Its maturation has been of interest as it has been shown to be sensitive to maternal stress (ref) and have aberrant connectivity in several neurodevelopment disorders (ref). However, understanding these individual differences, what is 'typical' versus 'atypical', is limited when inference can only occur at the group-level. In contrast, the normative modeling framework can be used to map individual differences at the level of a single participant in relation to a reference model. In this study, we develop a normative model of the organization of the uncinate fasciculus in the neonatal period using two diffusion indices fractional anisotropy (FA) and mean diffusivity (MD). We hypothesize that UF FA will have a gradual nonlinear increase as a function of scan age (between 32 and 44 postmenstrual age). Further, we hypothesize, greater deviations from the reference cohort for both FA and MD will be prospectively associated with greater emotional and behavioral problems at 1.5 years of age. **Methods:** Preprocessed data from the Developing Human Connectome Project (dHCP) was downloaded. Automatic tractography was conducted for the UF and mean FA and FD were calculated for each participant. Normative modeling was conducted using warped Bayesian Linear Regression (BLR) using the Predictive Clinical Neuroscience toolkit. BLR's were modelled using scan age, sex, and head motion as covariates. Model fit was assessed using several metrics including explained variance (EV), Rho (correlation between true and predicted responses), and pRho (p value for Rho). Emotional and behavioral problems were assessed using the Child Behavioral Checklist for Ages 1.5-5 (CBCL) around 1.5 years old (mean=19.47 months PMA, SD=2.47). We examined the prospective associations between deviation scores (Z-scores) and the CBCL Total Problems scale using a Pearson correlation. **Results:** Using a training set (n=496) and evaluating the fit of the BLR in the testing set (n=125) fits for the BLR for the left (EV=.47, Rho=.69, p<0.0001) and right UF FA (EV=.47, Rho=.69, p<.0001) as well as the left uncinate MD (EV=.39, Rho=.62, p<0.0001) and right uncinate (EV=.41, Rho=.64, p<0.0001) were significant. FA remained relatively flat until 37.5 weeks and gradually increased (see Figure 1a for warped BLR model and centiles of deviation). After 35 weeks PMA, MD showed a more drastic nonlinear decrease before leveling off around 45 weeks (see Figure 1b normative model, see Figure 1c for example of UF tractography). For the FA of the right UF, greater deviation scores in the positive direction (showing more mature patterns of FA) were associated with more emotional and behavioral problems in the 2nd year of life (r(94)=.25, p=.01, see Figure 1d). **Conclusions:** We developed a normative model for UF white matter organization as a function of scan age. This model maybe useful in determining typical versus atypical patterns of UF organization as a function of age and provides evidence that individual-level deviations are prospectively associated with emotional and behavioral problems.

2-A-3 EEG functional connectivity in infants with elevated and typical likelihood for Autism Spectrum Disorder

Christian O'reilly[1], Scott Huberty[2], Stefon Van Noordt[3], James Desjardins[4], Nicola Wright[5], Julie Scorah[2], Sara Jane Webb[6], Basis Team[7], Mayada Elsabbagh[2]

[1]University of South Carolina, [2]McGill University, [3]Mount Saint Vincent University, [4]Compute Ontario, [5]Columbia University Irving Medical Center, [6]Seattle Children's Research Institute, [7]Birkbeck, University of London

Many studies have reported that autism spectrum disorder (ASD) is associated with atypical structural[1] and functional[2] connectivity. To characterize the development of such atypicalities during the first years of life, we used EEG-IP[3], a high-density electroencephalogram (EEG) dataset pooled from two independent infant sibling cohorts. EEG was recorded at 6, 12, and 18 months of age in infants at normal (N=97) or high familial risk for ASD (HRA; N=98), determined by the presence of an older sibling with a confirmed ASD diagnosis. We computed cortical EEG sources using age-matched realistic head models[4] and assessed the functional connectivity between brain regions during resting-state using the corrected imaginary part of phase-locking values[5]. We conducted a detailed investigation of functional connectivity by first exploring categorical diagnostic group effects along with multiple factors that could influence this relationship, including age, biological sex, site, functional networks, and distance between communicating regions. Then, we evaluated correlations with functional connectivity using ADOS calibrated severity scores (overall, social affect, and restrictive and repetitive behaviors (RRBs) subscales) as a dimension within the HRA group. Overall, our investigations showed low regional specificity of the group differences in functional connectivity, potentially due to idiosyncratic patterns of atypical connectivity[6]. However, we observed a tendency for underconnectivity associated with familial risk and later ASD diagnosis. Although group analyses did not report clear and consistent effects, our dimensional analyses suggest different sex-specific trajectories between females and males within the HRA group. More specifically, we observed a statistically significant negative correlation between functional connectivity at 12 months and social affect for females (but not males) (p<0.03; Pearson's â´=-0.38) and for RRBs for males (but not females) (p=0.0046; Pearson's â´=-0.54). These results are consistent with sex differences in ASD observed in previous research and might reflect the higher resilience of females to ASD and support that a stronger alteration of the functional connectome is necessary for symptomatic expression of ASD in females.

1. Rane, P. et al. Connectivity in Autism: A review of MRI connectivity studies. Harv. Rev. Psychiatry 23, 223-"244 (2015). 2. O'Reilly, C., Lewis, J. D. & Elsabbagh, M. Is functional brain connectivity atypical in autism? A systematic review of EEG and MEG studies. PLOS ONE 12, e0175870 (2017). 3. van Noordt, S. et al. EEG-IP: an international infant EEG data integration platform for the study of risk and resilience in autism and related conditions. Mol. Med. 26, (2020). 4. O'Reilly, C., Larson, E., Richards, J. E. & Elsabbagh, M. Structural templates for imaging EEG cortical sources in infants. NeuroImage 227, 117682 (2021). 5. BruÃ±a, R., MaestÃº, F. & Pereda, E. Phase locking value revisited: teaching new tricks to an old dog. J. Neural Eng. 15, 056011 (2018). 6. Benkarim, O. et al. Connectivity alterations in autism reflect functional idiosyncrasy. Commun. Biol. 4, 1-"15 (2021).

2-A-4 Evaluating EEG markers of restricted and repetitive behaviors for toddlers with or without ASD

Haerin Chung[1], Carol Wilkinson[1], Wenkang An[1], Alex Job Said[1], Helen Tager-Flusberg[2], Charles Nelson[1, 3]

[1]Boston Children's Hospital, [2]Boston University, [3]Harvard Medical School

Background: Restricted and repetitive behaviors (RRBs) are one of the primary characteristics of the autism spectrum disorder (ASD). In typical development, repetitive motor behaviors appear early and decline after the first year of life. Across ASD, a greater intensity of all RRBs, even simple repetitive motor behaviors are seen across early childhood (Kim et al., 2010). Limited knowledge is available concerning the neurophysiological substrates associated with RRBs early in development. ASD has been characterized by differences in neural connectivity (Ecker et al., 2013; Johnson, 2017) and an imbalance between excitation and inhibition (see Rubenstein & Merzenich, 2003) in the neural level. Recent findings suggest that increases in frontal-central connectivity are associated with RRBs in ASD in early childhood (Haartsen et al., 2019). However, it has not yet been studied whether abnormalities found in E/I balance may account for intensity of RRBs. **Objectives:** With the goal to replicate and extend previous findings, we aimed to investigate the relation between severity of RRBs and EEG (Connectivity, E/I balance) across 4 groups of infants (1) no developmental concerns at 12 months (Low Likelihood-no_ASD), (2) infants with an older autistic sibling (Sib-no_ASD), (3) elevated 12-month screening scores (Screener-no_ASD) on the (CSBS), (4) infants with an ASD outcome. **Methods:** We calculated alpha (7-8Hz) debiased-weighted phase-lag-index (dwPLI) from resting-state EEG collected at 12 months as an index of functional connectivity. We applied FOOOF to calculate the aperiodic exponents as an index of E/I balance. At 24 months, RRBs were assessed via the Repetitive Behavior Scale-Revised parent report questionnaire. Associations between EEG and RRB were assessed using linear regression with EEG and outcome group as factors, and sex as covariates. **Results:** First, ASD group showed higher RRB scores than LL, sibling-noASD, and screening-noASD at 24 months [$F(1,3) = 18.3$, $P < 0.001$]. Next, we did not find evidence of a group level difference in frontal-central dwPLI [$H(3, n=163) = 2.21$, $P = 0.53$] nor aperiodic exponents [$H(3, n=161) = 4.63$, $P = 0.2$] at 12 months. Interestingly, we found an interaction between EEG and outcome groups in predicting RRBs, with the interaction resulting from the ASD group (frontal-central dwPLI [Adj_R2= .29, $F(8, 124) = 7.7$, $p < .001$] and posterior exponents[Adj_R2 = .27, $F(8, 123) = 7.19$, $p < .001$]. Replicating prior findings, there was a positive relation between frontal-central connectivity and RRB, such that higher frontal-central connectivity associated with more RRBs (rho= .4, p=.07; Figure 1). We also observed a significant, negative relation between the aperiodic exponent and RRBs, only in the ASD group. Lower exponent, indexing higher E/I imbalance, was associated with more RRBs (rho= -0.43, p=.06). **Conclusion:** The finding that higher frontal-central connectivity and lower aperiodic exponent was associated with more RRBs in ASD highlights the potential of these measures as neural markers of RRBs. We further plan to explore change in trajectory of these EEG correlates over the course of the first year to fully understand the development of neurophysiological mechanisms underlying behavioral manifestations in ASD.

2-A-5 Lateralization of activation in the superior temporal gyrus for speech processing in sleeping infants is predictive of their language skills in kindergarten: a task-based fMRI study.

Jin Wang[1], Ted Turesky[2], Megan Loh[1], Ja'kala Barber[1], Victoria Hue[1], Escalante S. Elizabeth[2], Adrian Medina[1], Nadine Gaab[2]

[1]Harvard University, [2]Harvard Graduate School of Education

Using functional magnetic neuroimaging (fMRI), prior studies have observed that infants already exhibit left-lateralized brain activation in the superior temporal gyrus (STG) for speech sentence processing even during sleep. Using electroencephalogram (EEG), other studies have found that electrophysiological responses to oddball speech sounds in infancy are prospectively associated with language and literacy outcomes at preschool and school age. However, EEG does not provide spatial accuracy for brain function and the speech sounds in those studies were limited to a few syllables. Little is known about whether brain activity in STG localized by task-based fMRI for speech sentence processing, a more naturalistic task, in sleeping infants is associated with subsequent language outcomes. To address this gap, the current study involved 59 3-12-month-old infants who underwent fMRI while listening to forward- versus backward-speech during natural sleep. Of these, 25 were subsequently assessed on language skills in preschool/kindergarten. We observed that neither the amplitude of brain activation in the bilateral STG nor standardized behavioral measures were associated with subsequent language skills in kindergarten. However, the left-lateralization index of brain activation in STG consistently predicted various aspects of language skills, including expressive language, receptive language, and phonological awareness. Overall, our findings provide the first evidence suggesting that brain indices evoked by language tasks in sleeping babies during fMRI can be a useful tool and may be more sensitive than behavioral measures in predicting later language skills.

2-A-6 Evoked brain responses to repetition, deviance, and omission of tactile stimuli in a sequence in premature neonates

Anne-Lise Marais[1], Victoria Dumont[1, 2], Marie Anquetil[1, 3], Anne-Sophie Trentesaux[4], Nadege Roche-Labarbe[1]

[1]University of Caen Normandy, [2]INSERM / UNICAEN, [3]Normandie Université, [4]Caen University Hospital

Sensory prediction (SP) is the ability to anticipate future stimulations on the basis of previous sensory inputs, a core feature of cognitive development. It optimizes cognitive resources and regulates sensory processing through repetition suppression (RS) when a stimulus becomes irrelevant. Impaired SP could be a key to understanding the emergence of Neurodevelopmental Disorders (ND). NDD are associated with somatosensory deficits, and authors proposed that altered SP and RS may be early mechanisms leading to cognitive impairments found in autistic or attention deficit syndromes. In prematurely born infants, who have an increased risk of NDD, recent studies also revealed altered RS and SP, supporting this hypothesis. The aim of this work is to describe the evoked brain responses to somatosensory stimulus repetition, deviance, and omission in premature neonates with different degrees of prematurity, hence different risks of subsequent NDD. Using 128-channel electroencephalography we measure the event-related brain activity of preterm neonates at 35 weeks of corrected gestational age (GA) during a tactile oddball/omission paradigm. The protocol contains 290 trials: 200ms-long vibrations that feel like moving up or down the forearm. The first and last 40 stimuli are identical (standards) and used to assess RS. In between, stimuli are organized in 30 contiguous blocks of seven stimuli, containing five standards, one deviant (vibration direction is reversed), and one omission each, in pseudo-random order. To date we have acquired 45 usable data sets, aiming at 90, i.e., 30 in each GA group: early prematurity (birth before 30 weeks GA), moderate prematurity (between 30 and 33 weeks GA), and late prematurity (after 33 weeks GA). Preliminary results show RS in the somatosensory cortex of early and moderate preterms. We do not observe RS in late preterms but their response to standards is lower than in other groups at all times of the protocol. More analysis is necessary to determine whether this is due to a much quicker RS across repetitions, suggesting the benefit of being born closer to term,

or a constant low response with no repetition effect. Deviant stimuli elicit a positive mismatch response in the somatosensory cortex of early preterms, and a negative one in late preterms. The response of moderate preterms stands in between. In the frontocentral area, results show a mismatch positivity in early preterms and negativity in moderate and late preterms. Therefore, the morphology of this marker appears directly linked with neurodevelopmental risk. A very similar pattern is observed on the post-omission standard (the first standard stimulus presented after an omission), indicating that both deviance in nature and deviance in timing elicit a mismatch response that varies with NDD susceptibility. The frontal area also showed activity depending on the group during the omitted stimulus time itself, showing that a prediction was formed in all three groups. These results provide evidence of sensory prediction and top-down regulation of somatosensory cortex activity in premature neonates, and it shows that the associated brain activity, measured at the same corrected gestational age for all neonates, differs depending on their degree of prematurity at birth. Future investigations will be necessary to determine if this is due to GA at birth itself, or to post-natal exposure to adverse events.

2-A-7 Gut microbiome associated with neuro-affective development during infancy.

Nicolas Murgueitio[1], Cathi Propper[1], Alexander L. Carlson[2], Robert A. Quinn[3], Margaret Sheridan[1], Martin Styner[1], Rasmus M. Birn[4], Rebecca Stephens[1], W. Roger Mills-Koonce[1], Sarah Short[4], Rebecca Knickmeyer[3]

[1]University of North Carolina at Chapel Hill, [2]University of California, San Diego, [3]Michigan State University, [4]University of Wisconsin-Madison

The microbiome is a complex ecosystem associated with neuro-affective development across species. Studies show associations between the microbiome and individual differences in non-social fear, negative affect, and internalizing symptoms. Additionally, the microbiome has been linked to changes in affective neural structural and functional development. These include differences in hippocampal and amygdala structure. However, most of these studies have used 16s sequencing, which is limited in its capacity to identify microorganisms. The present study uses random forest (RF) regressions to explore associations between the gut microbiome composition, neural structures that support affective development, and affective behaviors in infancy. Infants (n=88) completed a 3T MRI scan and provided fecal samples at 2 weeks of age. Bilateral volumes for amygdala, hippocampus, insula, and anterior cingulate cortex (ACC) were estimated using UNC Niral and Royal Alberts pipelines. Fecal samples were sequenced using Whole Genome Sequencing (WGS) which has a heightened capacity to identify species and improved accuracy of detection compared to 16s. At 6 months, infants and their mothers participated in a home visit and completed the Still-Face Paradigm. Infant affect and behaviors were coded, including negative affect and self-regulation (e.g., actions taken by infants to sooth themselves). RF regressions were built to explore the predictive capacity of genera on neural structures (i.e., total amygdala, hippocampus, insula, and ACC volumes), and behaviors. Models were specified using 501 trees and significance was determined after permutation (n=1000). The microbiome predictive capacity showed adequate fit and was significant for the insula (r^2=9.97, p=.004; *Figure 1*), negative affect during the Still Face Episode (r^2=4.39, p=.01), and lack of self-regulatory behaviors during the Reunion Episode (r^2=2.4, p=.04) models. Percent increase in mean square error (MSE) was used to calculate the importance score of each genus and identified the top 10 genera for each significant model (*Figure 2)*. Moreover, bivariate correlations were conducted to assess the directionality of the association between each outcome and their top 10 identified genera. A negative association between the insula and *Veillonella* was established (r=-.27, p=.05). Positive associations between negative affect and *Pasteurella* (r=.49, p<.001), *Phoenicibacter* (r=.53, p<.001), *Leucobacter* (r=.49, p<.01), *Weizmannia* (r=.52, p<.001), *Faecalibacterium* (r=.51, p<.001), *Flavonifractor* (r=.26, p<.05), *Leptotrichia* (r=.52, p<.001), *Leifsonia* (r=.44, p<.001), *Clostridium* (r=.30, p<.05), and *Brevibacterium* (r=.42, p<.01) were also found. Finally, a negative association between lack of self-regulatory behaviors and *Buttiauxella* was established (r=-.27, p<.05). In this work, the early microbiome is shown to have significant associations with co-current insula structure and later affective behavioral development. Moreover, this is a first step towards understanding the role of the microbiome on neuro-affective development and could ultimately inform future work into psychiatric disorders. Future work will focus on associations between the microbiome and resting-functional connectivity, as well as structural and neural pathways by which the microbiome influences behavioral development.

B - Effects of Early Exposures on Neurodevelopment

2-B-8 Association between visual working memory looking behaviour and brain function in caregivers and infants

Aimee Theyer[1], Sobana Wijeakumar[1], Christina Davidson[1], Ghada Amaireh[1]

[1]University of Nottingham

Objectives: Cognitive development in children is guided by social interactions with their caregivers. It is not fully understood how attentional control in caregivers might impact their child's ability to sustain and shift attention, and ultimately, detect change in the world around them. In the current study, we aimed to investigate how caregivers' looking behaviours and underlying fronto-parietal engagement during visual working memory (VWM) processing was associated with their infant's looking behaviours and corresponding brain function. **Methods:** 86 infants (mean: 250.6 Â± 35.8 days) and 80 caregivers (mean: 33.25 Â± 4.37 years) took part in the study. To assess looking behaviours, both infants and their caregivers were separately presented with versions of the preferential looking VWM task. In this task, two side-by-side flashing displays of coloured shapes are presented; on one side, one shape randomly changes colour during each flash and on the other side, the colours of the shapes remain the same. For the infant version, VWM load was manipulated by presenting 1 (low), 2 (medium) or 3 (high) shapes and for the caregiver version, VWM load was manipulated by presenting 4 (low), 6 (medium) or 8 (high) shapes on each side. Two measures were extracted for the caregivers and infants: change preference (CP) scores, a measure of the participants ability to detect the changing display and switch rate (SR), a measure of how frequently the participant switched between the two displays. Functional near-infrared spectroscopy was used to record functional brain activity. Image reconstruction was used to transform channel-based neuroimaging data into voxel space for further analyses. Linear mixed effects modelling was used to examine the association between the behavioural and brain data. **Results:** For both caregivers and infants, CP scores decreased with increasing VWM load. In both groups, CP score at the low load was greater than CP score at the medium and high loads. Linear mixed effects modelling revealed that load, caregiver CP scores and infant SR significantly predicted infant CP scores. Specifically, caregivers with higher CP scores raised infants with higher CP scores who also switched less frequently between displays. Brain analyses in the caregivers revealed that greater CP scores were associated with left middle frontal gyrus suppression, consistent with previous findings from our group showing an inverse association with CP scores and left frontal activation. Brain analyses in the infants showed a significant interaction between caregiver CP scores and activation in the left superior parietal

lobule, a region associated with VWM maintenance. Collectively, our findings suggest that caregivers might be achieving greater VWM performance by suppressing their left frontal cortex to suppress distraction away from the task. This mechanism might also be useful in how they interact with their infants to lead to robust activation in parietal areas important for VWM development. **Conclusions:** These findings indicate that caregiver looking dynamics and ability to detect change contribute to their infant's VWM development. Our findings shed insight on the understanding of mechanism(s) through which caregiver looking dynamics and attentional allocation might influence infant cognitive development.

2-B-9 Pre-pregnancy BMI, prenatal inflammation, and infant frontostriatal connectivity

Claudia Lugo-Candelas[1], Parinaz Babaeeghazvini[1], Jonathan Posner[2], Cristiane Duarte[3], Glorisa Canino, Catherine Monk[1]

[1]Columbia University, [2]Duke University, [3]CUIMC

Prenatal maternal adiposity may be associated to heightened risk for inhibitory control deficits in offspring, particularly for attention-deficit/hyperactivity disorder (ADHD)[1,2]. Animal research suggests that the increased intrauterine inflammation seen in maternal obesity may alter central dopamine signaling in offspring, which in turn could impact impulsivity-related circuitry implicated in ADHD[3-5] (e.g.,ventral striatum-orbitofrontal cortex functioning).However, more human studies on the mechanisms of transmission are needed. We thus examined the influence of prenatal maternal Body Mass Index (BMI) on frontostriatal circuits in infant offspring; and offspring's ADHD symptoms at two years of age. We also preliminarily examined whether maternal inflammation during pregnancy was associated with frontostriatal circuitry in offspring, aiming to begin to elucidate possible transmission mechanisms. Our sample consisted of 42 mother-infant dyads (22 males) part of the NIH Environmental Influence on Child Health Outcomes Boricua Youth Study, a two-generation epidemiological cohort of Puerto Rican families. Pregnant participants reported pre-pregnancy BMI and a subset (n=12) provided saliva samples to index prenatal inflammation. Sleeping infants underwent rsfMRI scans at Â¬Â¬Â¬Â¬Â¬Â¬Â¬Â¬Â¬46.99 post menstrual age (in days) on 3T GE scanners. Parents reported on children's behaviors at ~24 months via the Child Behavior Checklist. fMRI analyses were implemented using SPM12[6] and CONN[7]. Images were slice time and motion-corrected, coregistered with the anatomical scan, indirectly segmented[8] into gray matter, white matter, and CSR, normalized to an infant template brain[9], resampled (at 2mm isometric voxel), smoothed, and band-pass filtered (0.008-"0.09 Hz). Correlation of the resting-state BOLD time series was computed using the following ROIs: putamen, caudate, and orbitofrontal cortex. Analyses controlled for infant's postmenstrual age at scan, maternal age at pregnancy, and offspring sex. Statistical comparisons will be controlled for using the false discovery rate. Greater maternal pre-pregnancy BMI was associated with increased positive connectivity between the right putamen and a cluster in the right precentral gyrus (x=34, y=-04, z=28; *p*fdr = 0.0136). In turn, prenatal maternal CRP levels was associated with decreased connectivity between the right putamen and a cluster covering the right precuneus (x=10, y=-64, z=14; *p*fdr=0.0020) and increased connectivity between the left putamen and the left precentral gyrus (x=10, y=-24, z=68; *p*fdr=0.0475). However, neither prenatal maternal BMI nor offspring brain connectivity were associated to ADHD or emotion reactivity when children where 2 years of age (*ps*>.05). Our study is in line with research showing disruptions (increases and decreases[10-16]) in connectivity in inhibitory control circuits in children associated with inhibitory control deficits, particularly in the functional connectivity of the putamen and precuneus. However, our study did not find that rsfMRI at 2 months of age significantly predicted ADHD symptomatology. Studies need to further examine this association in childhood, where ADHD symptoms tend to arise, leverage larger samples, and examine interactions with offspring sex.

2-B-10 Longitudinal effects of prenatal alcohol exposure on visual structural neurodevelopment over infancy (pre-registered report)

Emma Margolis[1], Niall Bourke[2], Michal R. Zieff[3], Thandeka Mazubane[3], Bokang Methola[3], Tembeka Mhlakwaphalwa[3], Nwabisa Mlandu[3], Reese Samuels[3], Simone Williams[3], Khula Study Team[4], Daniel Alexander[5], Derek Jones[6], Steve Williams[2], Kirsten Donald[3], Laurel Gabard-Durnam[1]

[1]Northeastern University, [2]King's College London, [3]University of Cape Town, [4]Khula Study Team, [5]University College London, [6]Cardiff University

Background/Objective: Globally, 9.8% of pregnant people endorse alcohol use during their pregnancy, with prenatal alcohol exposure affecting neurodevelopment in over 59 million individuals. Prior literature using dichotomous categorization of alcohol use and/or samples with heterogeneous substance exposure has significantly limited knowledge of how the timing and level of alcohol exposure specifically impact human neurodevelopment. Additionally, limited studies index neurophysiological changes over the infant windows in which rapid development occurs.This study addresses these key gaps by focusing on structural brain changes supporting visual development over infancy. Over the first six postnatal months, rapid functional development of the primary visual cortex through sensitive periods supports dramatic changes in visual capabilities. Structurally, myelination acts as a -œbrake- on this plasticity and -œlocks in- prior visual learning with consequences on sensory functioning lasting across the lifespan. Occipital lobes are thus largely myelinated by 5-6 months. Animal model literature and human histology studies suggests that myelination is impacted by prenatal alcohol exposure. While human neuroimaging studies have shown prenatal exposure influences myelin in children 5 years and older, it is important to measure when myelin is developing to understand how and when these differences come to be. **Methods:** We will address this question using longitudinal data from an ongoing project with 330 families recruited from an informal settlement in Cape Town, South Africa. In this sample, 73 mothers endorsed alcohol use at any point in pregnancy without comorbid substance use. We will test how timing and level of prenatal alcohol exposure impact early postnatal neurodevelopment to support emerging visual abilities by tracking myelination in the visual cortex from 3 to 6 months of age. T1- and T2-weighted images were collected with a 3T scanner during natural sleep at both timepoints. We will use the T1- and T2-weighted MRI myelin mapping technique to measure cortical myelin with traditional volumetric images. These data have been collected and we are in the process of data analysis, which will be completed by the FIT'NG conference. **Hypothesis:** We expect that increased exposure to alcohol prenatally will result in decreased change in myelination in the visual cortex from 3 to 6 months, as indexed by T1/T2 ratio values. **Proposed Analyses:** We plan to analyze dose-related changes across trimesters by modeling the change in structural indices of myelin integrity from 3 to 6 months (while controlling for myelination at 3 months) as a function of the number of weekly drinks in each trimester using multiple regression. Maternal age at infant birth, education, income, and depression scores will be considered as potential covariates of drinking scores. **Impact of the Study:** This research has the potential for far-reaching impacts to improve the lives of pregnant people and their children globally. The study design allows us capture outcomes over the spectrum of possible prenatal alcohol exposure with increased ecological validity and accuracy.

This work can be used to inform recommendations and guidelines as to how best support prenatal and postnatal development. Future work can explore factors that buffer against the effects of prenatal alcohol exposure on structural measures established in this study.

2-B-11 Maternal daily executive functioning and visual working memory in infants

Ghada Amaireh[1], Aimee Theyer[1], Christina Davidson[1], Line Caes[2], Sobana Wijeakumar[1]

[1]University of Nottingham, [2]University of Stirling

Objective: Maternal executive functions play an integral role in shaping cognitive and socio-emotional function in children. Most research has focussed on understanding this association in toddlerhood or early childhood. Thus, it is unclear whether maternal cognitive behaviours influence neurocognitive development as early as the first year of life. In the current study, we investigated how maternal daily cognition was associated with visual working memory function (VWM). **Methods:** 86 infants (Mage = 250.6 days, SD = 35.8), (Female =42) and 88 caregivers (Mage=33.47, SD 4.48) participated in the study. To assess self-reported daily executive functioning in mothers, the behaviour rating inventory of executive function - adult version questionnaire was administered. We conducted an exploratory factor analysis on the questionnaire data; this analysis produced two key factors -" (1) organization and regulation, composed of planning, organization, initiation, working memory, task monitoring, shifting and emotional control, and (2) response monitoring, composed of inhibition and self-monitoring. Infants' VWM was measured using a preferential-looking task. In this task, two flashing displays of coloured shapes were presented side-by-side with one side displaying a change in colour in one shape whilst the colours of the items on the other side remained the same. VWM load was manipulated by presenting 1 (low load), 2 (medium load) and 3 (high load) items. The ability to detect and stay fixated on the changing side or change preference score (CP score) was used as a VWM performance measure. Functional near-infrared spectroscopy was used to measure brain function in the infants as they engaged with the task. Image reconstruction techniques were used to move channel-based neuroimaging data into voxel space. Linear mixed effects modelling was used to associate behaviour and brain function. **Results:** Our findings revealed that greater CP scores at the medium load was associated with greater maternal response monitoring. Our brain findings revealed that both maternal executive function factors selectively engaged activation in regions of the fronto-parietal network in infants. Greater maternal organization and regulation was associated with greater activation in the right superior parietal cortex in infants, a region linked to robust VWM performance. This ability was also associated with suppression in the middle and right temporal cortex in infants, regions important for suppressing distraction to maintain focus on VWM processing. Response monitoring engaged frontoparietal regions associated with CP scores in infants. Concretely, in mothers with high response monitoring, greater CP scores were associated with left middle frontal gyrus suppression, whereas in mothers with low response monitoring, greater CP scores were associated with left middle frontal activation -" this evidence is consistent with findings from our previous work showing an inverse association between CP scores and left frontal suppression, suggesting further support for a role in distractor suppression. **Conclusions:** Our findings contribute to the understanding of an under-explored area of research investigating the impact of maternal cognition on shaping very early neurocognitive development.

2-B-12 Processing infant directed speech in the womb

Kirsty Dunn[1], James Gavin Bremner[1], Tim Donovan[2], Vincent Reid[3]

[1]Lancaster University, [2]University of Cumbria, [3]University of Waikato

Infants show preferential attention to infant directed speech (IDS), or "motherese", over adult directed speech (ADS) from 4 months (Fernald, 1985; Werker & McLeod, 1989) and neonates increase their sucking rate when presents with IDS compared to ADS. Thus, as postnatal experience does not appear to be required to develop this preference, many theorise that we have a genetic predisposition for attending to the perceptual features associated with this type of speech; e.g. higher pitch, slower tempo, enhanced emphatic stress. Growing evidence, though, suggests that birth is not the starting point for learned experience. Using fetal heart rate (FHR), research has shown fetal discrimination of maternal vs non-maternal voices (Kisilevsky et al., 2009), and indicates a preferential response to speech over other sounds (Granier-Deferre et al., 2011). Here, we further test genetic predisposition for IDS and investigate fetal preferences in utero (before experience with communicative exchanges in the external world). Further, we address inherent confounds in comparing response to IDS with ADS and ask if this preference can be explained more simply by a response to perceptually more interesting sounds. To do this, we compare responses to a reverse version of the IDS sound where the lower-level perceptual features (e.g. volume and pitch) are matched with the exception of prosody. Following 60 seconds of baseline silence, 60 fetuses at 32-35 weeks gestational age (GA) were presented (order randomly generated) with a story in three conditions at 80dB accounting for 20bB attenuation; a) ADS, b) IDS, c) Reverse IDS. In the baseline period, a Kruskall-Wallis test showed there were no main effects of time on changes in FHR, $H(29) = 34.26$, $p = 0.23$ (Fig 1.).During the experimental period, a Kruskall-Wallis test showed a main effect of Time with higher FHR in the first half than the second half of the trial, $H(1) = 7.73$, $p = 0.01$ (Fig 2). This indicates fetal habituation to the sounds in all conditions. However, Kruskall-Wallis test showed a main effect of Condition, $H(2) = 6.32$, $p = 0.04$. Posthoc analysis using Dunn's test for multiple comparisons showed FHR in response to Reverse IDS was higher than for IDS, $p = 0.04$. No further comparisons were significant. Data are not explained by a genetic predisposition for a preference for IDS and indicate that the preferential response to IDS develops between 34 weeks GA and birth. Further, IDS and Reverse IDS sounds were equivalent in perceptual features with the exception of prosody. Thus, increased response to Reverse IDS cannot be explained by a simple preference for more perceptually-interesting stimuli. Thus, the preference for IDS in newborn infants is unlikely explained by lower-level processes and suggests a novelty preference for unfamiliar prosody. This suggests a role of the prenatal language environment on the processing of speech heard in utero. To make more comparable conclusions on the trajectory of response to IDS to postnatal literature, fetal behaviour using 4D Ultrasound imaging data for these participants is currently under analysis.

2-B-13 Differential patterns of cortical expansion in fetal and preterm brain development

Mariana Da Silva[1], Emma C. Robinson[1], Kara Garcia[2], Vanessa Kyriakopoulou[1], Logan Z. J. Williams[1], Anderson Winkler[3], M. Jorge Cardoso[1]

[1]King's College London, [2]Indiana University School of Medicine, [3]The University of Texas Rio Grande Valley

Introduction: Fetal cortical development is a highly dynamic process, characterised by emergence of cortical folds that facilitate increased surface area of the cortical ribbon [1]. In-vivo studies of brain cortical development have either relied on longitudinal data from neonatal development following preterm birth [2,3], or use cross-sectional data only, often focusing on specific anatomical landmarks or regions of interest (ROI) [4,5] to overcome dataset size limitations and differences due to natural cortical heterogeneity. In this work, we estimate vertex-wise patterns of cortical expansion from biomechanically constrained registration of longitudinal cortical surface data from 22 to 44 weeks post-menstrual age (PMA), and directly compare patterns of cortical expansion in utero to that seen in preterm neonates. **Methods:** We analysed cortical surface data from a total of 162 subjects acquired as part of the Developing Human Connectome Project (dHCP). Our dataset included 72 subjects born at term (GA at birth: 40.2Â±1.3 wk), scanned in utero (PMA at scan: 29.3Â±3.8 wk) and shortly after birth (PMA at scan: 42.2Â±1.4 wk) and 90 subjects born preterm (GA at birth: 31.0Â±3.4 wk) scanned shortly after birth (PMA at scan: 33.5Â±2.4 wk) and at term-equivalent age (PMA at scan: 41.2Â±1.5 wk). Anatomically constrained multimodal surface matching (aMSM) [6] was used to obtain point correspondence between pairs of cortical surfaces of the same individual, in order to calculate vertex-wise maps of cortical surface expansion (GSA). GSA maps were registered from the individual space to the 40-week neonatal template space for group analysis. FSL Permutation Analysis of Linear Models (PALM) [7] was used to model cortical expansion as a function of ages at scans, and age at birth, considering an exponential model of growth. For analysis, the fetal-neonatal dataset was divided into 2 groups, for subjects scanned in utero before and after 27 weeks; group 2 was used for comparison with the preterm dataset. **Results:** Analysis on the fetal-neonatal dataset showed significant regional differences in growth patterns over the course of development, with surface area growth rates being higher in the final weeks of the 2nd trimester in comparison to the 3rd trimester for regions around the central sulcus and the insular region, coinciding with the emergence of primary and secondary folding in this period ($p<0.05$). Global cortical growth rates did not differ between the preterm and fetal datasets, however comparison of relative spatial growth patterns revealed that preterm subjects exhibited higher relative expansion in the temporal and frontal poles, while fetal relative expansion was higher for the posterolateral parietal cortex ($p<0.05$). **Conclusion:** These results elucidate the spatiotemporal dynamics of cortical expansion and highlight neurodevelopmental differences that occur as a result of preterm birth. Future work will explore the use of non-linear models such as Gaussian Processes to further evaluate dynamic patterns of expansion.

References: 1. Budday 2015 DOI:10.3389/fncel.2015.00257 2. Garcia 2018 DOI:10.1073/pnas.1715451115 3. Fenchel 2020 DOI:10.1093/cercor/bhaa150 4. LefÃ¨vre 2016 DOI:10.1093/cercor/bhv123 5. Xu 2022 DOI:10.1523/JNEUROSCI.1285-22.2022 6. Robinson 2018 DOI:10.1016/j.neuroimage.2017.10.0377. Winkler 2014 DOI:10.1016/j.neuroimage.2014.01.060

2-B-14 What do we know about poverty and its effect on an infant's neurodevelopmental trajectory: An investigation into neuroimaging studies from the Global South (pre-registered report)

Nikita Ghodke[1], Aniruddha Walke[2]

[1]Ashoka University, [2]Deccan College Post Graduate and Research Institute

Lower Socio-Economic Status (SES) adversely affects the neurodevelopment of infants, as backed by research (Hurt et al., 2017; Noble et al., 2021, Renfree et al., 2022). In the past decade, studies have established a link between poverty with decreased size, differences in brain structure, cognitive impairments & concerns with overall growth of children (Merz et al., 2019). Conducting neuroimaging studies to explore the effects of poverty on brain development is essential for successful behavioral prediction, which in turn is essential to ensure early intervention & adversity prevention (Pollak et al., 2020). However, neuroimaging has not yet been fully used to inform research & policy formulation in this area of research which lies at an intersection of education, neuroscience, policymaking, ethics. An approach combining neuroimaging techniques as well as behavioral measures would hence help with a more holistic & nuanced understanding of the issue, contributing to more effective, long-term, & sustainable policymaking. Most of the studies, as cited above, have been looked at from the lens of poverty from the point of view of developed countries. Very few focused on poverty in the global South, that is low- and middle-income countries (Arbab et al., 2019), which may need to be observed keeping in mind geography-specific factors unique to the region. With these existing gaps in research, the aim of this paper is to explore nuances in how neuroimaging studies have, & still has, the potential to enhance our knowledge of the correlation between poverty & neurodevelopment in infants, especially in the context of the global South. This can help determine the notion & factors related to the phenomenon of poverty in the region & if there are similar or different concerns to bring about effective interventions. The goal is to form a map of what poverty & its potential effect has been around the globe specifically in the division of the less studied regions. This review follows the methodology of conducting a systematic literature search with a set of keywords (eg: Neuroimaging, infants, poverty, inequality, SES, etc) through PubMed, Google Scholar, & gray literature. The inclusion of all the relevant papers will help yield results in a comprehensive evidence map (Miake-Lye et al., 2016). Following an abstract screening of 78 papers & the full papers subsequently, 18 articles remained after applying pre-defined inclusion/exclusion criteria (e.g., the need to have focused on SES factors, etc). Next, there is an ongoing data categorization & extraction that will be completed. Such knowledge further by results, sample size, location, method, age group, & supporting information will be beneficial to understand the feasibility of conducting more neuroimaging studies, especially in the global south, & the significance of these studies. Each region has its challenges & defines what poverty constitutes with supporting factors that keep them under marginalized lines. The preliminary results found common themes within the global south regions like malnutrition, environmental factors (pollution, hygiene), stigma due to gender, etc as some factors that also contribute to the high-level impact on the infant's neurodevelopment. This study becomes essential in tapping into challenges & gives direction to empirical papers toward these gray areas when conducting studies in the global South.

2-B-15 Associations between prenatal exposure to stressful events, prenatal perceived stress, and infant amygdala–medial prefrontal cortex functional connectivity

Sanjana Ravi[1], M. Catalina Camacho[2], Kathryn Humphreys[1]

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

Fetal programming theory proposes that the intrauterine environment can alter the development of the fetus, including the brain, with long-lasting effects on the child (Barker, 2002). Given that the brain is particularly sensitive to environmental influences in utero, assessing what may influence the fetal environment is important for identifying mutable prevention and intervention targets. One possible candidate is prenatal stress, which has been associated with altered development and later psychiatric symptoms (Nazzari et al., 2020). Developing emotion regulation circuitry, including the amygdala-"medial prefrontal cortex (mPFC) connectivity, may be influenced by prenatal stress exposure. Indeed, prenatal stressful events have been found to be associated with decreased amygdala-"mPFC functional connectivity in human infants at age 1-month (Humphreys et al., 2020). However, measures assessing experiences of stress via stress checklists tend to include events that are predetermined to be -œstressful-□ for individuals without considering the circumstances surrounding the adverse event or individuals' perceptions (Smith & Pollak, 2021). Life events may not be perceived as equally noxious by all individuals (Vogel, 1985). Thus, the perception of stress may, above and beyond the number of stressful events, be a marker of the physiological impact of stress on the fetal brain. The present study aims to examine associations between prenatal exposure to perceived and objectively assessed stress and infant amygdala-"mPFC functioning connectivity. As part of an ongoing longitudinal study, pregnant individuals completed an initial session during their pregnancy involving questionnaires assessing prenatal stress. Crisis in Family Systems-"Revised (CRISYS; Berry et al., 2001) was used to assess 72 possible stressful events from the preceding six months. The 14-item Perceived Stress Scale (PSS; Cohen et al., 1983) was used to assess participants' perception of stress and their ability to cope with stressors. When their infants were approximately one month old, they completed 12-18 minutes of resting state functional magnetic resonance imaging (fMRI) during natural sleep. fMRI data will be processed in surface space and linear regression model will be used to characterize associations between prenatal exposure to stressful events, prenatal perceived stress, and amygdala-"mPFC network functional connectivity, covarying infant age at scan, sex, and motion.Preliminary analyses were conducted with N=67, MÂ±SD age=1.12Â±0.20 months; 55% male (usable data=9.67Â±2.40 minutes) in volume space and using an adult network atlas. Prenatal perceived stress was positively associated with infant amygdala-"mPFC functional connectivity above and beyond the variance explained by number of prenatal stressful events experienced ($\hat{I}^2$=0.28 [0.03, 0.54], p=.034).Preliminary result suggests that how pregnant individuals perceived stressful events may influence infant brain development, highlighting the potential importance of individual management of stress during this period of increased vulnerability for the pregnant person and their infant. This work has potential implications for prenatal interventions aimed at supporting pregnant individuals' mental health with a focus on stress coping and emotion regulation.

2-B-16 Prenatal stress exposure, newborn BNST, and infant temperament at 6 months

Yanbin Niu[1], Sanjana Ravi[1], M. Catalina Camacho[2], Benjamin Conrad[1], Joshua Hageman, Jennifer Blackford[3], Kathryn Humphreys[1]

[1]Vanderbilt University, [2]Washington University in St. Louis, [3]University of Nebraska Medical Center

Anxiety disorders impact a significant proportion of the population and lead to functional impairment (Essau et al., 2018). Cross-species research has identified the bed nucleus of the stria terminalis (BNST) as a critical neural substrate for anxiety phenotypes. The BNST is a small brain region with direct projections to the hypothalamus that drive the hypothalamic-pituitary-adrenal axis response to stress (Avery et al., 2016). Despite promising work on the BNST in human adults, no studies have examined this structure earlier than late childhood (Feola et al., 2022). This is particularly striking given: (1) rodent research highlighting the essential role of the BNST in infant learning (Chang & Debiec, 2016), (2) evidence that this region is susceptible to stress (Moriceau et al., 2004), including mild prenatal stress (Soares-Cunha et al., 2018), and (3) the prenatal period and early life represent a time of rapid growth of the BNST, suggesting this may be a potentially sensitive period for stress-effects on the BNST (Halladay & Herron, 2023). To address this gap in the developmental neuroscience of the BNST, we assessed perceived stress during pregnancy and at infant age ~4 weeks obtained high-resolution T1- and T2-weighted MRI, diffusion-weighted MRI, and approximate 10 minutes low-motion resting-state fMRI. The location of the BNST was traced on the University of North Carolina's infant newborn T2 atlas using the manual protocol developed by Theiss et al. (2017). The anatomically defined BNST masks allowed us to conduct analyses on BNST structural and functional connectivity. Infant temperament was evaluated at age 6 months using the Infant Behavior Questionnaire-Revised. Our current ongoing longitudinal sample consisted of 324 families, with 294 mothers completing stress assessments and 151 completing the 6-month IBQ-R. Of the infants, useable data has been collected from 106 with both T1- and T2-weighted, 80 DWI, and 106 rsfMRI. We are in the process of manually editing image segmentations and will complete our analyses prior to the conference. Our analytic plans and hypotheses are three-fold. 1) Estimate variation in BNST structural and functional connectivity. While it is unclear what connections will be identified at this age in development, prior non-human primate research (Oler et al., 2017) suggests we may observe both structural and functional connectivity between the BNST and other brain regions in infancy. 2) Examine the association between prenatal stress exposure and BNST connectivity in newborns. We hypothesize that maternal stress during pregnancy would predict newborn BNST connectivity with a subcortical network of stress-responsive brain regions including the amygdala, hippocampus, and hypothalamus. 3) Examine newborn BNST connectivity as predictors of infant temperament at 6 months.This multi-modal research will provide, for the first time, fundamental knowledge on human BNST development in early life. Findings will advance clinical theory on individual differences in responses to prenatal stress, and the neural basis of early emerging risk trajectories for anxiety. Furthermore, results may contribute to our mechanistic understanding of how prenatal stress rewires this brain region to confer risk for psychopathology. Broadly, this study has critical implications for prevention and interventions targeted early in life.

2-B-17 Infant neural oscillations in native and non-native stress cue-weighting

Zhen Zeng[1, 2], Liquan Liu[3], Varghese Peter[4]

[1]The Chinese University of Hong Kong, [2]MARCS Institute, WSU, [3]Western Sydney University, [4]The University of the Sunshine Coast

Sensitivity to speech rhythmic patterns facilitates its acquisition, from segmenting words to tracking hierarchical structures in natural speech (see Barajas et al., 2021 for a review), yet the extent to which the processing is contributed by phonological and auditory-general

processing is under discussion and debate. While some studies found that various adult language speakers tend to perceive sounds alternating in pitch and intensity as strong-weak and sounds alternating in duration as weak-strong (the iambic-trochaic law, ITL; Hayes, 1985; Nespor et al., 2008), other studies show that speech cue-weighting is more language specific when native speech rhythm does not align with the ITL (Zeng et al., 2022). Nevertheless, the developmental neural underpinning of the speech cue-weighting process in infancy is far from understood. Most of the infant EEG studies investigated event-related potentials (ERPs) where the polarity of the brain responses to signals at a given age have been inconsistently reported and interpreted (e.g., Friedrich et al., 2007; RagÃ³ et al., 2021; Weber et al., 2004). In particular, positive and negative mis-match responses were found cancelled out when signals are averaged at the group level (e.g., Kidd et al., 2018; Kooijman et al., 2009). Though limited, studies investigating infant neural oscillations suggest that neural oscillatory power at certain frequency bands index neural phonological sensitivity in cross-linguistic (Bosseler et al., 2014) and clinical (Nallet & Gervain, 2022) contexts. The theta oscillations, for instance, have been reported to indicate perceptual narrowing in 12-month-old English-learning infants (Bosseler et al., 2014). Compared to the ERP, time-frequency analyses permit investigation of relative power in dimensions of both time and frequency. Following the design of an adult cue-weighting study (Zeng et al., 2022), we investigated the neural oscillations in the stress cue-weighting of pitch, intensity and duration by English-learning and Mandarin-learning infants at 7-8 months (younger; English N = 15, Mandarin N = 15) and 10-11 months of age (older; English N= 16, Mandarin N = 16). We tested hypotheses of the language-specific and -general influences on cue-weighting. First, syllabic biases mostly in line with the ITL was found in younger and representations of more language-specific patterns were found in the older English-learning infants. In contrast, Mandarin infants did not show consistent syllabic bias. Second, we observed elevated responses to pitch cues by younger and older Mandarin infants but elevated responses to intensity cues in older English infants, in line with the language specificity reported in the adult population (Zeng et al., 2022). Interestingly, the younger English infants weighted pitch as the most important cue. Third, across age, we found elevated responses by older English infants but diminished responses in older Mandarin infants to stress cues in the theta band, pointing to perceptual narrowing, as similarly reported in Bosseler et al. (2014). These results provided detailed auditory neural profiles of stress-cue-weighting in English and Mandarin-learning infants and suggest that both the syllabic bias and perceptual hierarchy of necessary cues are in place in nonword processing in infancy.

2-B-18 Examining evidence for the intergenerational transmission of resilience: A 3-cohort infant neuroimaging study (Pre-registration)

Cassandra Hendrix[1], Lanxin Ji[2], Jocelyn Stanfield[3], Alexis Taylor[4], Patricia Brennan[3], Christopher Trentacosta[4], Moriah Thomason[1]

[1]New York University, [2]NYU Langone Health, [3]Emory University, [4]Wayne State University

Objective: A growing body of research has tied subjective and objective stress during pregnancy to neonatal brain development. Yet the potential interaction of subjective and objective stress in has been less studied. Indeed, many individuals exposed to objective stressors, such as neighborhood disadvantage, do not report high levels of subjective distress and instead display psychological resilience. Children and adults who experience adversity but who do not develop psychiatric symptoms have been reported to show increased connectivity of cognitive control networks, such as stronger frontoparietal connectivity. The goal of this project is to examine whether similar neural patterns can be detected in infants born to resilient mothers living in disadvantaged neighborhoods during pregnancy.**Methods:** We applied similar preprocessing methods to neonatal resting-state functional MRI (rsfMRI) data from three longitudinal birth cohorts in Atlanta, Detroit, and New York City respectively (n=122). Participant addresses were geocoded to quantify neighborhood disadvantage (Area Deprivation Index) during pregnancy. Mothers also completed measures of perceived stress, depression, and anxiety in each cohort, which were standardized and averaged to create a composite measure of subjective distress during pregnancy. Analyses will compare neonatal functional connectivity patterns between 3 groups: a resilient group with high neighborhood disadvantage but low maternal subjective distress (n=37), a vulnerable group with high neighborhood disadvantage and high subjective distress (n=37), and an advantaged group with low neighborhood disadvantage (n=48). Preliminary analyses confirm resilient and vulnerable groups are matched on neighborhood disadvantage ($t=1.52$, $p=0.14$), but differ on subjective distress ratings ($t=11.23$, $p<0.001$). Data for these analyses are collected, quality assured, and in the final stages of preprocessing. Group-level analyses have not yet been conducted. **Hypothesis:** Executive control networks will show stronger within and between-network connectivity in neonates of resilient mothers compared to neonates of vulnerable mothers. **Analytic Plan:** After preprocessing, ComBat will be used to account for site-related heterogeneity. Region of interest (ROI) parcels will be grouped into networks using a community detection algorithm, and we will calculate functional correlations of ROIs within a given network to represent within-network connectivity. Functional correlations between ROIs assigned to different networks will be used to derive between-network connectivity. One-way ANOVAs will be used to compare within and between network connectivity strength between groups, controlling for motion during the scan, number of resting-state functional volumes, infant age, and infant sex. Significance thresholds will be FDR-adjusted to correct for multiple comparisons. We will employ cross validation to assess replicability of in-sample effect sizes. **Implications:** The findings from this project hold potential to advance our understanding of individual differences in the cross-generation transmission of adversity, which is a potent factor that shapes child psychological and behavioral outcomes.

2-B-19 The association of maternal cortisol concentration during pregnancy and offspring white matter microstructure in one-month old neonates (pre-registered report)

Fiona O' Donovan[1,2], Martin Bauer[1,2], Katharina Pittner[1,2], Nora Moog[1], Jerod Rasmussen[3], Alice Graham[4], Damien Fair[5], Christine Heim[1], Sonja Entringer[1], Pathik Wadhwa[3], Hyagriv Simhan[6], Thomas O'connor[7], Martin Styner[8], Claudia Buss[9]

[1]Charité - Universitätsmedizin Berlin, [2]Charité – Universtitätsmedizin Berlin, [3]University of California, Irvine, [4]Oregon Health & Science University, [5]University of Minnesota, [6]University of Pittsburgh, [7]University of Rochester Medical Center, [8]University of North Carolina at Chapel Hill, [9]Institut für Medizinische Psychologie

Background: Maternal stress during pregnancy can alter the developmental trajectory and impact the physiological and psychological health of the fetus. Some of these changes are believed to be mediated by changes in the structure and functioning of the brain. Under conditions of high maternal stress during pregnancy, increased amounts of cortisol cross the placenta exposing the fetus to higher cortisol concentrations. Elevated maternal cortisol levels have been associated with offspring adverse health outcomes, cognitive delays, and behavioural problems. While maternal depression during pregnancy, a condition likely accompanied by an increase in cortisol concentrations, has been associated with alterations in white matter microstructure in infants and children in the limbic and

prefrontal regions of the brain, the association of variation in maternal cortisol concentrations during pregnancy with the development of offspring white matter microstructure has not been extensively studied in humans. Evidence for white matter integrity being susceptible to variation in glucocorticoid concentrations comes from preclinical work that has shown that oligodendrocytes and myelination are adversely affected by high levels of glucocorticoids. **Objective:** The aim of this project is to investigate the association of variation in endogenous maternal cortisol concentrations during pregnancy and the white matter microstructure in the corpus callosum (CC) and uncinate fasciculus (UF) in one-month old infants. **Hypothesis:** Higher maternal cortisol concentrations during pregnancy are associated with lower fraction anisotropy (FA) and higher axial diffusivity (AD) and radial diffusivity (RD) in the CC and UF in one-month old neonates. **Methods:** The study consists of 85 mother-infant dyads from across three sites, University of Rochester and Magee-Women's Research Institute & Foundation in the United States of America and CharitÃ© -" UniversitÃ¤tsmedizin Berlin, Germany. The same MRI scanner and imaging protocol was used at all sites. Diffusion weighted imaging was performed in the one-month-old neonates and pre-processed using DMRIPrep. The diffusion images were visually quality controlled in DMRIPrep and tensors were estimated using a weighted least square algorithm. FA, mean diffusivity, AD and RD profiles will be computed for each white matter tract. Every tract from each subject will be quality controlled using FADTTSter and subjects will be excluded from statistical analyses on a tract-by-tract basis if the individual profile has a low correlation to the average tract profile. Maternal saliva samples were collected three times a day, for at least one and up to four days, at one to three timepoints throughout pregnancy and harmonized across sites to measure cortisol diurnal profiles. Area under the curve with respect to ground, a measure of total cortisol output, was calculated at each trimester cortisol was measured during pregnancy for each participant. General linear models will be used to test if maternal cortisol concentration is associated with the microstructural profiles of the white matter tracts. All models will be adjusted for gestational age at birth, scan age, site and sex. Further covariates, including race and ethnicity, obstetric risk and socioeconomic status will be included in post hoc analyses. Better understanding of mechanisms could help inform intervention targets and therefore improve the developmental outcome of the neonate.

2-B-20 Does bilingual exposure protect against SES disparities in selective auditory attention? A fMRI study in young children (pre-registered report)

Gavkhar Abdurokhmonova[1], Ellie Taylor[1], Alexa Mcdorman[1], Junaid Merchant[2], Rachel Romeo[2]

[1]University of Maryland, College Park, [2]University of Maryland

Selective attention-"the ability to focus on relevant signals and manage distraction-"is a foundational executive functioning (EF) skill important for academic and socioemotional developmental outcomes (Stevens & Bavelier, 2012; Veer et al., 2017; Garon et al., 2008), and it undergoes protracted development within the first few years of life (Blakey et al., 2016). While the neural basis of selective auditory attention has been extensively studied in adults (Hillyard et al., 1973; Astheimer & Sanders, 2009), less is known about its development in children. Studies have argued that growing up bi/multilingual may -œslow down- the development of crucial cognitive skills (Hakuta, 1986; Peal & Lambert, 1962). There is also research showing that speaking multiple languages in early years of life promotes EF skills (Bialystok, 1999, 2011; Pliatsikas et al., 2020). However, studies of this so-called -œbilingual advantage- tend to be in participants from higher SES backgrounds. Thus, it remains unclear whether bilingualism may buffer against the negative effects of low SES on neurocognitive EF development. In this pre-registered study (https://osf.io/sxkat), we use functional magnetic resonance imaging (fMRI) to examine children's selective attention during a dichotic listening task, and investigate relationships with family SES, language experience, and EF performance. Specifically, we address three hypotheses:

1. At the group level, participants will exhibit increased activation during dichotic listening in auditory/language areas (bilateral posterior superior temporal gyrus and left inferior frontal gyrus) and posterior attention areas (bilateral anterior and posterior cingulate, precuneus/cuneus, and superior parietal regions).

2. Both SES and bilingual exposure will be associated with performance on EF tasks and activation in language and attention regions during dichotic listening. Specifically, higher SES (controlling for bilingualism) and greater proportion of bilingual exposure (controlling for SES) will be associated with higher EF scores, but the direction of effect on dichotic activation is not hypothesized. Greater activation could indicate greater task engagement, or less activation could indicate neural efficiency.

3. Language status (bilingual/monolingual) will moderate the relationship between SES and EF scores/dichotic listening activation, such that greater bilingual exposure will reduce the correlation between SES and (a) the magnitude of activation during selective attention, and (b) performance on EF tasks.

Participants were 44 children (55% male) aged 4-7 years (M=5.82 years, sd=.64) from diverse socioeconomic, racial/ethnic, and linguistic backgrounds. N=12 were bilingual, though all were native and fluent English speakers. Children completed assessments of EF and English language skills, as well as a dichotic listening task during fMRI, in which they were instructed to attend to a story told by a female voice (played in one year) and ignore a story told by a male voice (played in the other ear), with visual reinforcements. Analyses will investigate main effects of SES and bilingual language status, as well as their interaction, on the magnitude of activation during dichotic selective attention (versus binaural story listening) and performance on EF tasks. Results have implications for reducing SES disparities in EF development, especially for children from demographically and linguistically diverse backgrounds.

2-B-21 Characterizing the association between maternal stress during pregnancy and brain function via polyneuro risk scores for general cognitive ability in newborns - pre-registered report

Katharina Pittner[1,2], Fiona O' Donovan[1,2], Martin Bauer[1,2], Pathik Wadhwa[3], Sonja Entringer[1], Thomas O'connor[4], Lucille Moore[5], Gracie Grimsrud[5], Nora Byington[5], Damien Fair[5], Alice Graham[6], Jerod Rasmussen[3], Oscar Miranda-Dominguez[5], Claudia Buss[1]

[1]Charité - Universitätsmedizin Berlin, [2]Charité – Universtitätsmedizin Berlin, [3]University of California, Irvine, [4]University of Rochester Medical Center, [5]University of Minnesota, [6]Oregon Health & Science University

Maternal psychosocial distress during pregnancy has been shown to be associated with impaired cognitive development in infants and toddlers. This association is likely partially mediated by changes in brain development including resting state connectivity. Recent work has demonstrated that sample sizes in the thousands are required to detect robust and reproducible associations between complex phenotypes such as cognitive ability and brain-wide features. These sample sizes are not yet available in infant neuroimaging.

The polyneuro risk score (PNRS) method has been developed to leverage large sample sizes of population-based studies like the ABCD study. This method determines the associative strength (beta-weights) of each feature in a set of brain features (for instance, brain-wide resting state connections). These beta-weights are then applied to a new test data set and summed to calculate a PNRS for each subject. Previous work in the ABCD cohort has shown that the resting state PNRS for general cognitive ability explains between 15 and 21% variance. The aim of this study is to apply PNRS for general cognitive ability from the ABCD study to infant resting state data and test whether maternal psychosocial distress during pregnancy is associated with the PNRS for general cognitive ability. The infant data will be drawn from two infant cohorts with harmonized pregnancy assessments and scanning protocols. Resting state data from 100 infants is available. The PNRS from the ABCD cohort has been generated and the resting state data from the infant cohorts has been preprocessed. The next steps are to apply the beta-values from the adolescent ABCD sample to the infant cohorts and calculate the PNRS for each infant. Maternal psychosocial distress will be composed of self-reported stress (Perceived Stress Scale), anxiety (State-Trait Anxiety Inventory), and depressive symptoms (Center for Epidemiological Studies Depression scale) averaged across multiple time points during pregnancy. To combine stress, anxiety, and depressive symptoms, a latent distress score will be calculated. We expect that higher distress levels are associated with a lower PNRS for general cognitive ability.

2-B-22 The role of social disadvantage in cortical expansion from birth to age two (pre-registered report)

Lisa Gorham[1], Aidan Latham[1], Dimitrios Alexopoulos[1], Tara Smyser[1], Kara Garcia[2], Deanna Barch[3], Joan Luby[3], Barbara Warner[1], Cynthia Rogers[1], Christopher Smyser[1]

[1]Washington University in St. Louis, [2]Indiana University School of Medicine, [3]Washington University

Background: Between birth and age two, cortical surface area increases greatly. Emerging evidence suggests that surface area expansion may play a role in facilitating cognition, language, and mental health in childhood and adolescence. However, less is known about how the cortical surface develops in the first few years of life, and how clinical risk factors like social disadvantage may impact these developmental trajectories. Moreover, previous studies of surface area use an ROI or whole-brain approach or only look at one time point, which may not accurately demonstrate varied patterns of expansion across the brain. Anatomical multimodal surface matching (aMSM), an innovative technique which uses vertex wide point correspondence to create smooth maps of cortical expansion for each subject, offers a potential solution to this methodological problem. In this proposed study, we aim to use aMSM to study how cortical surface area expands from birth to age 2 in a sample of 83 neonates (as part of the broader eLABE cohort), as well as the association to variables like social disadvantage. **Analysis Plan:** Using aMSM, we created three dimensional maps of cortical expansion for each subject. We then averaged these maps across the 83 subjects to determine group wide areas of greater expansion, finding increased expansion in the inferior temporal, parietal, and occipital lobes across all subjects (Figure 1). Now that we have successfully computed individual-specific and group-wise maps of cortical expansion from birth to age two, we plan on conducting a number of analyses. First, we plan on using permutation analysis of linear models (PALM) software to determine how prenatal social disadvantage relates to cortical expansion regionally and globally. For these analyses, we plan on controlling for postmenstrual age at infant scan, birthweight, and time between the two scans, as these covariates are known to impact cortical surface area. Based on previous research, we hypothesize that increased social disadvantage will be associated with decreased surface area expansion in the frontal, parietal, and temporal lobes. Next, we plan on using PALM to examine associations between cortical expansion and psychiatric outcomes at age two, measured using the infant toddler social and emotional assessment (ITSEA) and the preschool age psychiatric assessment (PAPA). Finally, we will use PALM to examine associations between cortical expansion and cognition and language scores at age two, measured using the Bayley III. We hypothesize that increased surface area expansion will be associated with decreased rates of internalizing and externalizing symptoms on the ITSEA and PAPA and increased cognition and language scores at age 2 measured using the Bayley. For all proposed analyses, we will confirm regional specificity of effects using an ROI-based approach. **Implications:** Measuring cortical surface area expansion using aMSM will allow us to learn more about how the cortex develops during the critical neurodevelopmental window encompassing the first two years of life. Further, we believe we provide the first link between expansion using this metric and prenatal factors like social disadvantage. Such findings will be helpful for understanding the biological embedding of disadvantage on brain development and the potential role of these changes in psychiatric and neurodevelopmental outcomes.

2-B-23 Changes in the immune environment across pregnancy trimesters associated with the developing human functional connectome (pre-registered report)

Raimundo Rodriguez[1], Ezra Aydin[2], Manya Balachander[2], Thirsten Stockton[2], Catherine Monk[2], Bin Cheng[3], Bradley Peterson[4], Dustin Scheinost[5, 6], Marisa Spann[2]

[1]Yale School of Medicine, [2]Columbia University, [3]Columbia University Irving Medical Center, [4]University of Southern California, [5]Wayne State University, [6]Yale University

Objective: Maternal immune activation (MIA) during pregnancy is an example of an exposure prior to birth that influences later neurodevelopment. Typically, MIA measures are either collected only once during gestation or are averaged across collection time points to associate the average presence of some component of MIA to early neurodevelopment. However, MIA is known to be dynamic across pregnancy-"existing studies' use of MIA as a static temporal measure to assess offspring outcomes limits our understanding, potentially ignoring critical influences of MIA, periods of vulnerability, and its long term influence on offspring neurodevelopment. Therefore, we aim to explore the association between newborn functional connectivity and MIA during pregnancy as assessed by changes in 46 markers of activation between the second and third trimesters. This will build on existing analysis from the group exploring newborn functional connectivity and MIA in only the third trimester of pregnancy. **Methods:** For the MIA component, 74 healthy women underwent blood draws 34-"37 weeks into the gestation period. From this, 46 markers of MIA were assayed, including both innate (e.g., cytokines) and adaptive (e.g., IgG) markers. Each woman's markers are subdivided into second and third trimester blood draws to enable the comparison between two time points during pregnancy. Principal component analysis (PCA) was applied to the data across trimesters, enabling the reduction of the marker data for each woman to a single score for each trimester. For the functional connectivity component, 29 newborn infants between the ages of 2 to 6 weeks underwent MRI scans. The functional connectome edges will be correlated with the difference between scores in the third and second trimester, relating newborn functional connectivity to changes in MIA during pregnancy. **Implications:** Previous work has attempted to reveal associations between gestational MIA and early infant neurodevelopment, with the long-term goal of identifying how alterations in the maternal immune environment

impact later diagnosis of neurodevelopmental conditions. Additionally, early interventions to prevent such conditions may result from work stemming from these concepts. The proposed study builds on this previous work, eschewing the treatment of MIA as a static metric in favor of analyzing how changes in MIA between the second and third trimester relate to newborn neurodevelopment via the functional connectome. To the best of our knowledge, this study would be the first to examine the relationship between changes in MIA and the human connectome across pregnancy. Research involving improved temporal resolution of MIA may lead to improved intervention strategies. Following this logic, this study would aid in framing fetal exposure to MIA as a dynamic process, leading the way for future research to delve into the effects of high temporal resolution trajectories of MIA, and potentially assisting in developing intervention strategies targeting specific trimesters in pregnancy to aid offspring development.

2-B-24 Neural activity during statistical learning and associations with household chaos

Sarah Mccormick[1], Cara Bosco[1], Michal R. Zieff[2], Lauren Davel[2], Zamazimba Madi[2], Thandeka Mazubane[2], Bokang Methola[2], Tembeka Mhlakwaphalwa[2], Nwabisa Mlandu[2], Reese Samuels[2], Simone Williams[2], Kirsten Donald[2], Laurel Gabard-Durnam[1], Khanyisa Nkubungu[2], Khula Study Team[2,3]

[1]Northeastern University, [2]University of Cape Town, [3]Khula Study Team

Household chaos is a construct in psychological science that includes factors such as noise, crowding, routines, clutter, and predictability within a family's household and neighborhood environment. Reliably, when measured in relation to behavioral child outcomes, higher levels of household chaos have been shown to be associated with poorer performance on cognitive tasks and greater socioemotional and behavioral challenges for infants, children, and adolescents (Marsh et al., 2020 for a review). Comparatively, research on how household chaos, or the factors that comprise it, impacts infant and child brain development is very new but demonstrates observable effects at the neural level (e.g., Brito et al., 2021; Simon et al., 2022; Werchan et al 2022). This emerging work at the level of brain development has focused on chaos factors of noise and predictability of input, finding that children exposed to excessive noise show reduced cortical thickness (Simon et al., 2022) and the infants who experienced more predictable auditory input displayed increased sustained attention, behaviorally and neurally as early as 3 months of age (Werchan et al., 2022). In the proposed study, we seek to investigate how this aspect of the home environment, household chaos, might impact early auditory statistical learning indexed by EEG/ERP. Proposed study participants are 6-month-old infants (N = 250) drawn from a larger longitudinal study on infant development. Families were recruited for the larger study from an established pregnancy registry site at the Gugulethu Midwife Obstetrics Unit, located in Gugulethu, an informal urban settlement in the Cape Town metropole in South Africa. High-density (128 channels) EEG data was recorded in a dimly lit room while participants were seated on their caregivers' laps. Event-related potentials were recorded while children listened to a continuous stream of 3 -œtone -œwords-□ in which tone elements varied in transitional probability. -œTone-words-□ were presented in random order, where Tone 1 always predicted Tones 2 and 3 (transitional probability for Tone 3 = 1.0), but Tone 1 appeared randomly throughout. Parents completed a modified version of the short form Chaos, Hubbub, and Order scale (Matheny et al., 1995). Presently, data from the 6-month time point is expected to be completely collected by May 2023. All EEG files will be processed using the Harvard Automated Processing Pipeline for EEG (HAPPE), an automated preprocessing pipeline designed for infant EEG data (Gabard-Durnam et al., 2018) and the related HAPPE+ER pipeline for ERPs (Monachino et al., 2021). Household chaos scores are computed as an average of items collected on the questionnaire. Regression analyses will be run predicting amplitude and latency for components of the ERP generated in response to the tones task. Relevant controls will include gestational age and family SES. We expect to find that household chaos will be associated with amplitude differences in ERP responses to tone words, a marker of auditory statistical learning.

2-B-25 Associations between prenatal cannabis exposure and neonatal white matter microstructure (pre-registered report)

Shelby Leverett[1], Caleb Gardner[1], Jeanette Kenley[1], Tara Smyser[1], Ryan Bogdan[1], Arpana Agrawal[1], Christopher Smyser[1], Cynthia Rogers[1]

[1]Washington University in St. Louis

Objective: Alongside increasingly permissive laws and sociocultural attitudes towards cannabis, its use has also increased. This increase is mirrored in pregnant women; estimates suggest that past-month use has doubled, while daily-use has tripled. However, it remains unclear how cannabis exposure in utero affects the developing brain. Given that cannabinoid receptors are present in the developing brain from 5-6 weeks gestation, and that those receptors help guide normative developmental processes (e.g., axonal migration and synaptogenesis), it is crucial to address this gap. Here, we will examine whether prenatal cannabis exposure is associated with differences in white matter (WM) indices derived from diffusion weighted imaging data. **Hypothesis:** We hypothesize that, relative to unexposed neonates, neonates prenatally exposed to cannabis will exhibit reduced WM microstructural integrity across multiple domains throughout the brain. The strongest reductions are anticipated in WM tracts (i.e., cingulum, fornix, uncinate) connecting regions rich in cannabinoid receptors. **Study Design:** Women are recruited from pregnancy clinics in their first trimester. Women who self-report tobacco, alcohol, or other illicit drug use at screening are excluded. In each trimester, women complete self-reported cannabis use questionnaires and urinary drug screens (UDS) for cannabis and other substances. Case or control status is assigned based on self-report and UDS throughout the entirety of pregnancy. Diffusion MRI (dMRI) scans (TR/TE = 2500/79.4ms, 1.75mm3 voxels, 80 slices for whole brain coverage) are acquired from neonates (e.g., 40-46 weeks postmenstrual age). dMRI parameters have been extracted using DSI studio deterministic tractography.**Data analysis plan:** We will use DSI studio to generate along-tract derived estimates of fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD), radial diffusivity (RD), quantitative anisotropy (QA), and isotropic diffusion (ISO) for each of the tracts of interest (left and right where applicable): fornix, uncinate, cingulum (dorsal and ventral), corpus callosum, corticospinal tract, anterior limb of the internal capsule, inferior longitudinal fasciculus, and optic radiations. We will use independent component analysis to conduct a multivariate investigation of differences in each of the derived measures along the normalized length of the track between cases and controls. Other multivariate techniques will be used in exploratory investigations of whether the intensity of cannabis exposure and concomitant nicotine exposure moderate effects on WM microstructure. Multiple comparisons will be corrected with False Discovery Rate. **Study implications:** Results will deepen our understanding of how in utero cannabis exposure affects the developing brain. As such, this study will have important implications for clinicians and public policy makers alike in advising pregnant women who may consider using cannabis. This is particularly significant given the increasingly permissive attitudes towards cannabis use.**Progress to date:** We have collected information about prenatal maternal cannabis use in each trimester for 229 participants (N= 134 cannabis users, N= 95 controls), completed and preprocessed

usable scans of 118 neonates (76 cases, 42 controls). We anticipate being able to collect approximately 30 more neonatal MRIs and to complete all analyses before the conference.

C - Methods Development or Dissemination

2-C-26 EEGWISE: an EEG Workflow Improvement and Signal Enhancement toolbox for infant data.

Ran Xiao[1], Beth A. Smith[2], Holly Bradley[2]

[1]Emory University, [2]Children's Hospital Los Angeles

Introduction: Researchers in the field of pediatric EEG data are concerned about obtaining an adequate amount of artifact-free data. The infant EEG signal is contaminated by both experimental and participant artifacts. Manual artifact selection is time-consuming and subject to bias. Therefore, a standardized and automatic approach to the preprocessing of infant EEG data would facilitate the process for all researchers, regardless of EEG analysis experience, and allow for more accurate data comparisons across studies and institutions. A small number of publicly available pre-processing pipelines, such as HAPPE and MADE, have been made available to achieve greater standardization of infant EEG preprocessing. Inspired by these efforts, our toolbox, EEGWISE, aims to add several unique features to further enhance performance. **Toolbox:** EEGWISE has a GUI interface to make the pipeline more accessible and improve the user experience (see Figure 1). It offers both an autopilot model, a fully automatic hands-off experience, and a hybrid mode that allows more advanced users to make manual adjustments to the analysis. Like most other toolboxes, EEGWISE contains four major components that deal with artifacts through temporal, spectral, spatial, and source domains using independent component analysis (ICA). Users can choose from three machine learning-based artifact IC classification algorithms (i.e., iMARA, MARA, and ICLabel) that estimate the likelihood of artifactual IC components. We then designed an innovative approach for selecting the optimal operating point for the cutoff probability, which strikes a balance by maximizing the brain IC probabilities while minimizing the amount of information for rejection. EEGWISE also generates all intermediate results and figures, and provides a detailed report about the data quality after preprocessing. This report can improve the overall workflow by directing the user to data files that need attention for further cleaning. **Evaluation:** In this pilot study, we applied EEGWISE to 53 infant EEG files that had previously been manually preprocessed by an experienced neuroscientist. The manually preprocessed data files were compared to data files that had been preprocessed using EEGWISE in terms of information retention and the average probability of obtaining brain IC components. **Results:** Our results show that EEGWISE retains an average of 58.99% of the data, which is significantly longer ($p<<0.01$) than the manual process at 40.16%, and EEGWISE retains a mean brain IC probability of 92.94%, compared to 78.77% from the manual process ($p<<0.01$). **Discussion:** The preliminary results establish the potential of EEGWISE as an efficient pipeline for processing developmental EEG data. Our next step will be to compare EEGWISE to already established infant EEG preprocessing pipelines and make EEGWISE publicly available for use.

2-C-27 Adapting OPM-MEG to assess infant brain function during naturalistic social interactions (pre-registered report)

Claudia Carreno[1], Brittany Howell[1], Megan Evans[1]

[1]Virginia Tech

Naturalistic social interaction between caregivers and infants significantly contributes to infant brain development. Chestfeeding (including feeding at the breast or with a bottle) in particular is a naturalistic social interaction that exemplifies the bond between caregivers and infants. Human milk not only satisfies the nutritional needs for infants, but may act as a modality of communication for crucial information such as caregiver health (Ballard & Morrow, 2013). Disentangling this naturalistic social interaction may provide key insight into an understudied mechanism (i.e. human milk and chest feeding) of infant neural development. However, previous neuroimaging modalities are limited when studying dyadic interactions; current high resolution imaging hyperscanning methods (i.e., fMRI, SQUID-MEG) do not allow for direct engagement, and other techniques (i.e., fNIRS, EEG) lack the spatial resolution that stationary methods provide. To fill this gap within neuroimaging research, Optically Pumped Magnetometer - Magnetoencephalography (OPM-MEG) offers a new method of non-invasively studying infant brain function during dyadic interaction at a higher spatial resolution.

OPM-MEG has shown to be adaptable throughout the lifespan, but its application to infant research has yet to be explored. Current adult cap designs are not suitable for infant use as infants cannot support the weight of current rigid caps and flexible caps do not provide the rigidity necessary for robust data collection. Therefore, further development is necessary to optimize caps for caregiver-infant dyadic research. For this study, participants are fitted with a breathable bonnet attached to a custom 3D printed rigid OPM-MEG cap. Second generation QuSpin OPM sensors are secured into the cap, the magnetically shielded room is degaussed, and the nulling coils are engaged to minimize external electromagnetic fields. Data is collected using cMEG Acquisition software and sensors are managed through QuSpin. Participants included in this study are full term, typically developing infants with no prior birth complications between the ages of 3 to 8 months with their adult caregivers (18+). To date we have successfully collected OPM data from 7 enrolled infants accompanied by 8 caregivers with two caregiver-infant pairs undergoing a chest feeding session. Visual quality control of the data looks promising and future processing will provide empirical evidence to support utilizing this neuroimaging modality in caregiver-infant dyadic research. This poster will discuss the feasibility of OPM-MEG in infants during naturalistic social interaction, explore the adaptations in cap design, and protocols to optimize data collection.

Ballard, O., & Morrow, A. L. (2013). Human milk composition: Nutrients and bioactive factors. Pediatric Clinics of North America, 60(1), 49-74. https://doi.org/10.1016/j.pcl.2012.10.002

2-C-28 Scalp surface-based parcellation for longitudinal optical neuroimaging studies

Abigail Magee[1], Laura Pirazzoli[2], Sara Sanchez-Alonso[3], Katherine Perdue[2], Benjamin Zinszer[4], Charles Nelson[5], John Richards[6], Richard Aslin[7], Lauren Emberson[8], Adam Eggebrecht[9], Eileen Sullivan[10], Vikranth Bejjanki[11], Joseph Culver[1]

[1]Washington University in St. Louis, [2]Boston Children's Hospital, [3]Yale School of Medicine, [4]Swarthmore College, [5]Harvard Medical School, [6]University of South Carolina, [7]Haskins Laboratories, [8]University of British Columbia, [9]Washington University, [10]Harvard University, [11]Hamilton College

Introduction: Functional near infrared spectroscopy (fNIRS) provides an alternative to functional magnetic resonance imaging (fMRI) for studying brain function in settings where fMRI is not feasible. However, channel-based techniques require consistent array positions and scalp-cortex correspondences; and full reconstruction-based methods need participant-specific structural MRI or an appropriately

matched atlas for anatomical precision. Herein, we propose a parcellation technique that provides a scalp-based method for co-registration and analyses. **Methods:** The quadrilateral surface-based parcellation samples the scalp surface using the international 10/5 system on age-appropriate atlases. To account for spatial variation of the optical array (Fig 1), we incorporated an elliptical light model to calculate the parcel spatial mapping for each source-detector pair. The parcellation procedure provides a mapping from the fNIRS channels to parcels that contain contributions from multiple measurement channels (Fig 2a). This pipeline was assessed using array placement data from 6-, 24-, 36-, and 60-month-old (mo) infants (n=137,141,107,128, respectively). In this dataset, an electromagnetic localizer was used to identify participant specific EEG 10-20 and fNIRS optode locations. To assess spatial variability within the cohorts, we registered participant optode locations to the atlas 10-20 coordinate system and calculated the mean, median, and standard deviation between like optodes. To assess potential for the parcellation method to manage fNIRS array variability impact on measured brain function, we simulated brain-based perturbations in multiple locations within the field of coverage for each age group (n=10,167; 10,028; 8,789; 11,903 locations within the brain for the 6, 24, 36, and 60mo groups, respectively), and compared the group-based statistical t-values for each of the measurement-, parcellation-, and reconstruction-based analyses for each simulated activation (Fig. 2b). We report the max, mean, and standard deviation of the t-values across all simulations for each group to compare the resultant power enhancement of the parcel-based analysis strategy. **Results:** Following registration to the atlas 10-20 coordinate system, optode placements within cohorts had mean(std) distance of 11.00(6.06), 8.69(4.83), 11.59(7.39), and 8.98(6.33) mm between like optodes for the 6, 24, 36, and 60mo, respectively. The t-values for each brain-based perturbation is presented in the brain volume for each analysis strategy (Fig 2c). The maximum, mean, and standard deviation of the maximum t-values across all nodes for each cohort and method are listed in Table 1. By managing spatial variability in fNIRS cap placement, the parcellation strategy provides a clear and consistent improvement in statistical power over the simple measurement-based strategy. The gold standard reconstruction-based analyses provides consistently higher statistical power, as expected. **Conclusion:** Variability in fNIRS cap locations lead to differential sampling of brain function across a study cohort that must be considered in group-based analyses. The simulation results indicate that parcellation-based analyses manage optode placement variability without requiring the computational expense of reconstruction-based analyses, and significantly improves potential statistical power of group analyses for all investigated age cohorts in our sample.

2-C-29 Initiating Community-Engaged Research Projects with Child-Focused Partners: Reflections for Developmental Cognitive Neuroscientists

Ellie Taylor[1], Rachel Romeo[1, 2]

[1]University of Maryland, College Park, [2]University of Maryland

Historically, both developmental psychology and neuroscience research have disproportionately relied on convenience samples of participants, which in turn disproportionately represent WEIRD (western, educated, industrialized, rich, and democratic) populations (Henrich et al., 2010; Nielsen et al., 2017). Furthermore, traditional research methods position researchers as hierarchically above participants and often fail to honor the expertise and lived experiences of communities that may not be represented in a given research group. In contrast, community-based and community-engaged research methods position researchers and community members as equal partners in the research process, co-creating research questions, methods, and interpretations (La Scala et al., 2023), and these relationship-oriented practices disrupt hierarchical researcher-subject dynamics (Mikesell et al., 2013). However, this framework remains underutilized among researchers in more experimentally-dominated fields (e.g., psychology and neuroscience), which may be partially explained by the limited work explicitly outlining community-engaged research methodologies themselves (Taylor, Sinclair, & Romeo, in-preparation).

Accordingly, this project seeks to elucidate community-engaged research processes by presenting the case studies of two in-progress community-centered projects, each with district structures and aims, conducted in the Language, Experience, and Development (LEAD) Lab at the University of Maryland, College Park. The first project is a partnership with a Judy Center (a family-based resource hub for children aged 0-5 that is attached to Title 1 schools) that involves evaluating program successes, determining family engagement strategies and barriers, and disentangling whether learning delays are due to limited learning opportunities during the height of COVID-19 or are true developmental disabilities. The second project is a partnership with the Maryland State Libraries Youth Services team seeking to incorporate analyses of children's language environments into an existing early literacy program for expectant and new parents in the state. Both projects were jointly conceived with community partners, are being implemented by researchers and community stakeholders together, and ideally will yield greater impact due to community buy-in.

The authors will utilize these case studies as examples of opportunities for initiating community engaged projects, and to underscore the importance of translating research processes and findings for communities of children, families, and those who directly serve them. To truly understand the unique contexts that shape brain development, it is imperative that researchers (1) engage in diverse social contexts with integrity and cultural humility and (2) work to reframe a body of research that presents differential neurobiological patterns as deficits instead as adaptations that honor the strengths and assets of communities (Taylor et al., 2023). Finally, we will advocate for academics to consider their position in their university within larger surrounding communities and argue that relationship-oriented research practices can be a strategy to mitigate valid mistrust that communities, especially those who are multiply marginalized, may have in science and research (Smirnoff et al., 2018; Arredondo, 2021).

2-C-30 Development of Functional Systems In 0-2 year-olds

Jiaxin (Cindy) Tu[1], Michael Myers[1], Chad Sylvester[2], Evan Gordon[1], Timothy Laumann[1], Omid Kardan[3], Eric Feczko[4], Sydney Kaplan[1], Trevor Day[4], Oscar Miranda-Dominguez[4], Lucille Moore[4], Sooyeon Sung[5], Taylor Chamberlain[6], Damien Fair[4], Monica Rosenberg[7], Christopher Smyser[1], Jed Elison[4], Adam Eggebrecht[2], Muriah Wheelock[1]

[1]Washington University in St. Louis, [2]Washington University, [3]University of Michigan, [4]University of Minnesota, [5]Institute of Child Development, [6]Columbia University, [7]University of Chicago

The brain is organized into different systems that serve distinct functions in healthy adults, and are often used to understand brain-behavior associations. To conduct such brain-behavior research, the system models used to partition the brain should fit well to actual system-level divisions in the data. Several groups, ours included, have developed functional atlases with age-specific delineation of brain systems, but no prior research has benchmarked the improvement, if any, these system parcellations provide as models for

infant brain organization compared to their adult counterparts. Here, we assess the confidence(Yeo et al. 2011) of each spatial location belonging to its assigned system based on infant FC at 0-2 years old to measure the goodness of fit of the different adult and infant system parcellations.

We used the vertex-wise FC in 32k fsLR space from infants and neonates scanned during natural sleep from the Baby Connectome Project (BCP, 8-29 months grouped in 5 bins, Howell et al. 2019) and Early Life Adversity, Biological Embedding (eLABE, gestational age 38-45 weeks) datasets. Results from the Washu120 young adult dataset (Gordon et al. 2016) were also included as a comparison. We considered various systems-level parcellations developed from the adult (19-32 years, Laumann et al. 2015), infant (8-26 months, Kardan et al. 2022) and neonate (gestational age 38-45 weeks, Sylvester et al. 2022) FC . We used the silhouette index (SI; Rousseeuw 1987) as a measure of confidence of each spatial location belonging to its assigned system. The SI at each vertex i compares the mean intra-cluster distance and the mean nearest-cluster distance, where the distances were measured as 1-Pearson's correlation between functional connectivity maps from seed vertices and the clusters were the systems. The resulting SI lies between -1 and 1 and a high SI indicates that the vertex is well-matched to its assigned system compared to other systems. A high mean SI indicates that the data have been well-clustered.

First, we found that neonate, infant, and adult FC were all best represented by the system parcellation it is defined in (mean SI~0.2) and not by the system parcellation from other age groups (mean SI~0). Second, we found that the confidence for adult system assignments (mean SI) increased across ages from 9 to 25 months. Third, we found that the mean SI varied greatly across systems with three major patterns of development: 1) visual, motor, retrosplenial, salience, dorsal and ventral attention systems were adult-like (mean SI>0) by 1 year; 2) the default, parietal memory, and frontoparietal association systems were rapidly developing from one to two years; 3) the cingulo-opercular and auditory systems were the slowest to mature and remained far from adult-like (mean SI<0) in organization by 2 years old. Lastly, we showed that core regions previously reported to have a high consensus of adult systems across individuals (Dworetsky et al. 2021) highly overlap with the regions with SI>0 to adult systems in the neonate and infant data (~70-75% in overlap coefficient across two datasets).

In conclusion, we found that resting-state system organization can be very different across newborn, infancy, and adulthood stages. We also observed a diversity in developmental trajectory of different resting-state systems from 0 to 2 years old.

2-C-31 Characterization of the maturing metastable dynamics in the term neonatal brain at rest

Juliette Champaud[1], Mohammed Rupawala, Neelum Mistry, Tomoki Arichi[2], Lorenzo Fabrizi[1]

[1]University College London, [2]King's College London

Objective: Adults can execute a wide range of behavioural and cognitive functions through brain networks transiently segregating and integrating on a spatial and temporal scale 1,2. We can model these metastable brain dynamics using neural microstates, which are transiently stable electrical topographies derived from spatio-temporal patterning of electroencephalography (EEG) recordings 3. In a mature brain, four microstates reliably explain ~75% of resting brain activity 4, however we do not know whether this is the case in neonates when the brain is rapidly developing. To assess this, we tested whether neonatal functional brain activity can also be described by a distinct set of microstates and explored how this relates to age. **Methods:** We studied 20-channel EEG recordings from 57 healthy term (37.14-42.86 postmenstrual weeks, 54% female) neonates at rest and included a mix of vigilance states (active sleep, quiet sleep and awake) and recording positions (cot, skin-to-skin, held with clothes). Microstates were inferred from 120-150s EEG epochs (bandpass filtered with cut-off frequencies at 0.1 and 70Hz and down sampled to 128Hz) using an agglomerative hierarchical clustering algorithm 5 at subject and group level. Clustering was performed across all samples of the time series to extract topographies that accounted for most of the variance in the data. Topographies with opposite polarity were considered as separate microstates. **Results:** At a subject level, 7-25 microstates accounted for 70% of the EEG signal, with the number significantly increased with postmenstrual age (PMA) (r=0.32, p=0.01). Following further clustering, 7 dominant microstates explained 60% of the signal across subjects. Adult microstates A, B and D were visually identifiable in neonatal microstates 7, 6 and 3 respectively. The remaining 4 were denoted as neonatal specific microstates. **Conclusions:** Our results indicate that as in adults, neonatal brain activity is organised in metastable states which are already capable of transient segregation and integration. This metastable organisation, reflecting the functional status of cortical neural networks, evolves between 37- and 43-weeks PMA. The maturational changes in brain structure and function such as synaptogenesis, myelination and the growth of long intra- and interhemispheric cortico-cortical connections could explain the development of metastability observed during this short time span 6. As these processes are disrupted by conditions like preterm birth, characterising microstates could provide new insight into the pathophysiology of the associated adverse neurodevelopmental outcomes.

1. Tognoli, E. & Kelso, J. A. S. The Metastable Brain. Neuron 81, 35 (2014). 2. Iraji, A. et al. The spatial chronnectome reveals a dynamic interplay between functional segregation and integration. Hum Brain Mapp 40, 3058 (2019). 3. Pascual-Marqui, R. et al. Segmentation of brain electrical activity into microstates: model estimation and validation. IEEE Trans Biomed Eng 42, 658-"665 (1995). 4. Michel, C. M. & Koenig, T. EEG microstates as a tool for studying the temporal dynamics of whole-brain neuronal networks: A review. Neuroimage 180, 577-"593 (2018). 5. Rupawala, M. et al. A developmental shift in habituation to pain in human neonates. Current Biology 33, 1397-1406.e5 (2023). 6. KostoviÄ‡, I. et al. Neural histology and neurogenesis of the human fetal and infant brain. Neuroimage 188, 743-"773 (2019).

2-C-32 Examining dynamic functional connectivity during sleep in infants using high density diffuse optical tomography

Katharine Lee[1], Kelle Pammenter[2], Andrea Edwards[2], Julie Uchitel[1], Robert Cooper[3], Jem Hebden[3], Borja Blanco[1], Topun Austin

[1]The University of Cambridge, [2]Cambridge University Hospitals NHS Foundation Trust, [3]University College London

Background: Sleep is a critical factor in early brain development due to its impact on memory consolidation, synaptic plasticity, and neural network maintenance. High density diffuse optical tomography (HD-DOT) has been used to investigate static functional connectivity during active sleep (AS) and quiet sleep (QS) states in term-aged infants. Studies show that traditional static functional connectivity analysis of resting state networks may fail to capture the transitory nature of brain activation. Dynamic functional connectivity analysis bridges this gap by decomposing static connectivity networks into their fluctuating components. Co-activation pattern (CAP) analysis is a method of dynamic functional connectivity analysis proposed by Liu et al. (2013) for fMRI data. This approach

is promising for HD-DOT data since HD-DOT also examines hemodynamic changes in the brain as a proxy for measuring brain activity. **Objective:** Establish the suitability of CAP analysis for HD-DOT data by examining dynamic functional connectivity during AS and QS in term-born neonates. **Methods:** HD-DOT data was acquired from sleeping infants housed at Rosie Hospital (n=28, mean postmenstrual age = 40+3). These datasets were classified as AS or QS based on behavioural analysis of synchronized video footage. Seed nodes for central (including somatosensory and motor networks) and frontal networks were chosen based on correlation to nodes located in the regions according to an infant brain atlas. The top 25% of time points correlated with the seed network were selected for each participant. Frames at these time points were clustered using the K-means algorithm into k CAPs (k=[6,8]). CAP clusters were evaluated using Liu's -œconsistency- metric which measures intra-CAP spatial correlation. CAP presence in AS and QS datasets were then compared using a rank sum t-test to investigate CAP correlation with sleep state. **Results:** Our analysis found a robust effect in both the central and frontal networks. The mean consistency for k=8 analysis was 0.5Â±0.2 for both central and frontal networks, respectively. This result suggests the K-means algorithm performed well and effectively clustered the data into identifiable CAPs. Furthermore, CAP correlation with AS and QS revealed potential network-level differences between sleep states. One frontal network CAP was found to be significantly more present in QS than AS (p = 0.02). **Conclusion:** This work establishes the efficacy of the CAP approach in HD-DOT data analysis by
demonstrating an average internal consistency on par with that of Liu's study (weighted average of default mode network CAPs consistency = 0.26 for k=8). Moreover, the results highlight potential functional differences between AS and QS in newborns.

2-C-33 Hierarchical alignment of longitudinal infant brain tensor images

Kuaikuai Duan[1], Longchuan Li[1], Sarah Shultz[1]

[1]Emory University

Background: Registering longitudinal infant brain images is challenging, as the brain undergoes rapid change during infancy. Aligning images collected during the first postnatal months is particularly difficult, as the relative signal intensities of gray and white matter in anatomical MRI images reverse during this period. A related challenge is the difficulty associated with selecting a template that is equally representative of the full age range under investigation. **Objective:** To address these challenges, we developed a novel hierarchical tensor-based registration technique to iteratively and hierarchically register images to a sample-specific hidden common space. This approach has two key advantages: 1) tensor-based maps (unlike anatomical images) show consistent patterns of tissue contrast during infancy, thereby avoiding registration errors associated with changing image features; and 2) registration of images towards a hidden common space can yield a template that is optimally representative of and specific to the sample of interest, avoiding biases introduced by predefined templates. **Methods:** We developed and tested this registration scheme using 53 diffusion tensor images longitudinally collected from 27 typically developing infants (8 females) between birth and 6 months. First, the brain images were divided into homogeneous subgroups based on shared image features using Louvain clustering [1]. In contrast to grouping images by chronological age, this approach ensures that subgroups are as homogeneous as possible (in terms of image similarity), a critical step for ensuring minimal deformations during warping to a group-specific common space. Next, images were registered hierarchically, first within each subgroup and then pooled together iteratively to reach a hidden common space unbiased to any participant in the group. In each hierarchical level, standard (1-level) tensor-based registration was employed. Specifically, all tensor images were first aligned to a randomly chosen tensor map using 6 degrees of freedom (dof) rigid body transformation and averaged to generate the initial template. Then, all tensor maps were aligned to the initial template via 12-dof affine transformation and averaged to form the intermediary affine template. Lastly, all tensor maps were registered to the affine template using diffeomorphic registration (piecewise affine transformations). Registration results were compared against those obtained from traditional scalar-based (fractional anisotropy (FA)[2]) and non-hierarchical tensor-based registration (DTI-TK [3]). Registration accuracy was evaluated using the normalized standard deviation of FA (ÏƒFA) maps. **Results:** Our registration approach yielded improved accuracy (reduced variability) both globally (Figure 1A) and locally (Figure 1B) compared to non-hierarchical tensor-based and scalar-based registration. FA maps resulting from traditional FA-based registration showed greater variability relative to tensor-based methods, especially at the splenium of the corpus callosum, leading to less well-defined gyri and sulci boundaries (Figure 1B). Conclusions: By taking advantage of relatively small deformations in each registration step and less variable features in tensor maps in developing brains, our hierarchical registration framework can facilitate accurate alignment of developing brains and can be potentially applied to other imaging modalities.

2-C-34 Using Deep Learning Cortical Surface Reconstruction Methods on Infants: a Preliminary Study

Timothy Hendrickson[1], Eric Feczko[1], Lucille Moore[1], Martin Styner[2], Omid Kardan[3], Taylor Chamberlain[4], Brad Bower[5], Sally Stoyell[1], Sooyeon Sung[6], Monica Rosenberg[7], Christopher Smyser[8], Alice Graham[9], Jed Elison[1], Damien Fair[1], Essa Yacoub[1], Tabitha Martin[1], Anurima Mummaneni[7], Henrique Caldas[7]

[1]University of Minnesota, [2]University of North Carolina at Chapel Hill, [3]University of Michigan, [4]Columbia University, [5]PrimeNeuro, [6]Institute of Child Development, [7]University of Chicago, [8]Washington University in St. Louis, [9]Oregon Health & Science University

Introduction: 3D shape reconstruction using deep learning techniques is a burgeoning field. More recently, these techniques have been applied to the field of neuroscience, specifically to reconstruct cortical surfaces from volumetric 3D brain MRIs. Reconstructing cortical surfaces is an important step in handling brain MRI data as it is fairly well established that analyzing cortical data on a 2D surface is beneficial 1-"5. While deep learning cortical reconstruction techniques have been applied to adult MRIs, to our knowledge it has not been applied to infants. Here, we trained a model on infants from the Baby Connectome Project (BCP) 6 using CorticalFlow++7 to automatically reconstruct cortical surfaces from 3D volumetric MRIs. **Methods:** CorticalFlow++ was trained on 63 participants -" 46 within the training set, 8 in validation, and 8 in testing set -" from the BCP study. Model training required the 3D anatomical MRIs and the cortical surfaces produced from FreeSurfer 8-"10 -" which were treated as the pseudo ground truth surfaces. **Results:** Once the model was trained, the model was used to perform prediction on 8 test set participants. The predicted surfaces -" left (LH) and right (RH) pial surfaces and LH and RH white matter surfaces -" were compared to the pseudo ground truth Freesurfer surfaces to evaluate the model. Using 90% Hausdorff distance, it was revealed that all predicted surfaces were comparatively close to the pseudo ground-truth surfaces -" RH white: (Î¼ = 34.5, Ïƒ = 3.82); LH white: (Î¼ = 33.05, Ïƒ = 3.67), RH pial (Î¼ = 38.46, Ïƒ = 4.10), LH pial (Î¼ = 37.18, Ïƒ = 3.80). **Conclusions:** These preliminary results reveal that the trained model does well at predicting all surfaces, although it does slightly worse

at predicting pial than white surfaces. Subsequent project steps will involve incorporating data augmentation using SynthSeg 11 to improve model performance and generalizability.

2-C-35 Understanding light is key for conceptualising the prenatal visual system

Vincent Reid[1], Jessica Leov[1], Zac Isaac[1], Kirsty Dunn[2]

[1]University of Waikato, [2]Lancaster University

It has long been known that the uterus is a rich sensory environment although fetal vision has almost never been considered within this framework. Importantly, models of exogenous light penetration to the uterus indicate that it is not dark during development. Given this evidence for light in the womb, what does this mean for the development of the visual system across gestation? This submission contains no empirical data from the field but does draw on literature associated with fetal behaviour and presents a new monte carlo computational model of how light interfaces with different layers of maternal tissue. Our model uses Monte Carlo methods to simulate the dispersion, scattering, and attenuation of arbitrary light signals projected through maternal tissue. By modelling the physical processes and propagation of billions of photons through the multi-layered medium, we simulate the change from initial stimuli to eventual light signal present within the uterine environment. Further computational processing of the simulated data produced by the model offers a prediction of the levels of illumination present within the womb.

This work shows that there is sufficient light in the uterus to enable a visual experience by the fetus during the third trimester. The luminance levels within the uterus across gestation are currently not yet known. Importantly, animal models suggest that light is essential for the formation of the visual system, with recent developments in atypical opsin research pointing to the critical nature of light during the formation of the brain. There is also evidence that prenatal visual experience impacts upon postnatal visual capacities in animals and humans. For this reason, light should also be considered when indexing the formation of circadian rhythms. Current models suggest that the fetus acquires circadian rhythms via maternal constructs. Given that circadian rhythms are formed due to light entering the eye, we propose the presence of a direct pathway to the fetus, rather than mediation via the mother. Finally, the question of how light influences sensory development is explored, with the possibility that the fetal body and limb movements could serve as a fundamental stimulus within the uterus. As such, cross-modal processing, embodiment, and multisensory development are likely topics that require reappraisal during the fetal period given the implications of light in the uterus. We argue that understanding light is essential for conceptualising not just the prenatal visual system, but almost all aspects of early human development.

D - Neural Correlates of Early Cognitive and Emotional Development

2-D-37 Development of infant brain iron couples with resting-state neural activity during the first 150 days of life

Lanxin Ji[1,2], Youngwoo B Yoon[2], Cassandra Hendrix[3], Ellyn Kennelly, Amyn Majbri[1], Tanya Bhatia, Alexis Taylor[4], Moriah Thomason[3]

[1]NYU Langone Health, [2]New York University School of Medicine, [3]New York University, [4]Wayne State University

Background: Non-heme iron is a vital metabolic cofactor for many core processes of brain development including myelination, dendritogenesis, and neurotransmitter synthesis, and accumulates in the brain with age1, 2. However, little is known about brain iron development in the first 150 days of life and its association with neural activity. Here, we use two early infant MRI datasets and a multi-modal fusion technique3 to address this gap. **Methods:** Sixty-three infants (29 females) aged 22-"144 days of the Perinatal Imaging of Neural Connectivity (PINC) cohort are included in the present analysis. T2* maps were estimated by a maximum-likelihood fit function for TE-dependent exponential decay, and R2* values were calculated from the inverse of the T2* (1/T2*), where higher values indicate greater iron content. We conducted correlation analyses between age and the average R2* values across the whole brain and within six regions of interest (ROIs): caudate nucleus, globus pallidus, putamen, thalamus, hippocampus, and amygdala. We further preformed Linked Independent Component Analysis (LICA) to unmask associations between iron deposition and spontaneous neural activity, as measured by the Amplitude of Low Frequency Fluctuations (ALFF). This analysis interrogates shared component loadings across modalities. To validate our findings, we repeated these analyses in an independent dataset (n = 38, 20 females, 38-147 days) drawn from the COVID-19 Perinatal Experiences (COPE) cohort. **Results:** Brain iron accumulates rapidly with advancing age, as indicated by a significant age effect on both the whole-brain averaged R2* (PINC: $r = 0.75$, $p < 0.001$, COPE: $r = 0.61$, $p < 0.001$) and R2* within deep gray matter ROIs. LICA showed co-localization between iron and neural activity across brain regions (components shown in Figure 1), and a strong correlation between the global R2* and ALFF within the Default Mode Network (DMN). A significant correlation was also found between age and the average ALFF within regions identified by component 1 ($r = 0.56$, $p < 0.001$). **Conclusions:** This study is the first to identify a coupled developmental effect between global iron levels and neural activity within DMN. This raises intriguing questions about whether regions comprising the DMN, recognized as being areas of high metabolic energy demand, are relationally dependent on properties contributing to R2*, including widespread brain iron stores. This study invites opportunity to further explore chemical systems important for the emergence and patterning of the DMN in early human development.

References: 1. Hect JL, Daugherty AM, Hermez KM, Thomason ME. Developmental variation in regional brain iron and its relation to cognitive functions in childhood. Developmental Cognitive Neuroscience. 2018;34:18-26. 2. Larsen B, Olafsson V, Calabro F, Laymon C, Tervo-Clemmens B, Campbell E, Minhas D, Montez D, Price J, Luna B. Maturation of the human striatal dopamine system revealed by PET and quantitative MRI. Nature Communications. 2020;11(1):846. 3. Groves AR, Beckmann CF, Smith SM, Woolrich MW. Linked independent component analysis for multimodal data fusion. Neuroimage. 2011;54(3):2198-217.

2-D-38 Harsh intrusive parenting moderates the association between reward neural structure and surgency during infancy

Natalie Suchy[1], Nicolas Murgueitio[1], Cathi B. Propper[1], Sarah Short[2]

[1]University of North Carolina at Chapel Hill, [2]University of Wisconsin-Madison

Caregivers' parenting behavior and child temperament are both known to play important roles in socioemotional development. Maternal warm sensitivity has been linked to fewer behavioral problems, better emotion regulation, and more secure attachment, while young children of harsh intrusive parents appear to exhibit higher levels of internalizing symptoms, lower frustration tolerance, and respond more negatively to approach. Some studies suggest that neuroanatomical changes may accompany experiences with harsh intrusive parenting, including smaller amygdala, caudate nucleus, and putamen volumes. Prior research posits that temperament tends

to become stable across childhood, with many studies identifying associations between early profiles and later risk for psychopathology. However, there is also evidence of plasticity, particularly during the first years of life. It currently remains unclear to what extent neural development affects child temperament and whether experiences with caregivers moderate this relationship. The objectives of the present study were to examine associations between neuroanatomical volumes of structures implicated in reward learning (i.e., nucleus accumbens, caudate nucleus, and putamen) and negative reactivity (i.e., amygdala and hippocampus) at birth and infant temperament at 6 months; associations between parenting behavior and infant temperament; and whether there is evidence of an interactive effect between development of the structures of interest and parenting behavior on temperament. Neonates (N = 104) underwent a 3T magnetic resonance imaging scan at two weeks of age. Bilateral amygdala, hippocampus, putamen, nucleus accumbens, and caudate nucleus volumes were extracted jointly from T1- and T2-weighted images via the UNC MultiSeg pipeline with multi-templates and checked manually. At 6 months, mothers completed the Infant Behavior Questionnaire Very Short Form, a measure of temperament, and participated in a free play activity with their child; videos were later coded for parenting behaviors, and composites representing maternal warm sensitivity and harsh intrusiveness were created. Regression analyses revealed that larger putamen and accumbens volumes were each significantly associated with higher levels of surgency (B = .906, p = .014 and B = .893, p = .016, respectively). In models including putamen, accumbens, and caudate volumes, all three indicated a significant direct effect of harsh intrusive parenting on surgency (B = .357, p = .046; B = .42, p = .016; and B = .364, p = .043, respectively). Moreover, harsh intrusive parenting moderated the effect of accumbens volume on infant surgency (B = -.394, p = .015). No significant associations were found with maternal warm sensitivity or amygdala and hippocampal volumes. Interestingly, these results contradict initial predictions that maternal harsh intrusiveness would be associated with infant negative affectivity. Results suggest that observed infant surgency is influenced by early development of reward-related neural structures (i.e., putamen and accumbens), and that the effects of accumbens volume on surgency are amplified in the context of harsh intrusive parenting. Though more research is needed to understand potential mechanisms underlying these correlations, these findings add to evidence of the complex interplay of individual and environmental factors that contribute to child temperament.

2-D-39 Neural Correlates of Uncertainty monitoring in Preschool Children: An Event-Related Potential Study

Sonja Hunter[1], Christopher Gonzales[2], Simona Ghetti[2], Lindsay Bowman[2]

[1]University of California Davis, [2]University of California, Davis

Metacognition is an essential ability that is positively associated with several developmental outcomes such as academic success, emotional regulation and problem solving (Kuhn,2021). Historically, metacognitive abilities in children were thought to be extremely limited or non-existent. Research suggests that children as young as 3 years of age can engage in uncertainty monitoring a kind of metacognition that involves deciphering when one is sure or unsure in their own answer(Lyons & Ghetti, 2013). While this research demonstrates that uncertainty monitoring is present in early childhood and develops with age, open questions remain about the mechanisms that support uncertainty monitoring development. Neuroscience research can shed light on these open questions, but the neural correlates of preschool children's uncertainty monitoring abilities are currently little explored or understood. The present study adopts the event-related-potential (ERP) approach to examine the neural correlates of uncertainty monitoring in 3 to 5-year-old typically developing children. ERPs can provide a valuable window on uncertainty monitoring neural correlates because there are several ERP components with established functions that are relevant for uncertainty monitoring. Specifically, the N2 component has been associated with conflict monitoring, which is the ability to detect conflicting information (Espinet et al.,2013). The N2 has been shown to increase in amplitude when there is more conflict present in a task, and detection of this conflict has been posited as an important aspect of performance monitoring (Zelazo,2015). Additionally, the error-related negativity (ERN) component has been associated with realization that one has made an error (Holroyd & Coles,2002). Research shows that ERN component amplitude corresponds to the degree of perceived error (Arbel & Emanuel,2011), and error detection represents a likely fundamental aspect of calculating one's level of certainty in the accuracy of a response. Thus, the N2 and ERN are candidate component processes underlying uncertainty monitoring. The present study represents the first investigation of these components in an uncertainty monitoring task administered to children ages 3-5 when uncertainty monitoring is first developing. Preschool children will have their ERPs recorded while they complete an uncertainty monitoring task in which they have to find a hidden target in a pair of degraded images. Adapted from the original behavioral task (Lyons & Ghetti, 2013) which demonstrated that preschool children can consistently rate their uncertainty on these kinds of trials. We will examine whether children's ERP amplitudes for ERN and N2 change as a function of children's reported uncertainty monitoring ratings in order to gain insight into the conflict and error-monitoring processes that may contribute to children's uncertainty monitoring abilities. Data from 34 adults demonstrates that our novel task indeed elicits the N2 and ERN components that differ in amplitude as a function of adults' uncertainty ratings (Figure 1). Preliminary data from 10 children show a similar set of N2 and ERN components that have visually distinct amplitude as a function of children's uncertainty ratings (Figure 2). Data collection is ongoing. Results will be presented on a larger sample, and implications for mechanisms underlying children's uncertainty monitoring development will be discussed.

2-D-40 Developmental changes in frontal alpha power during infancy as predictor for executive functioning (pre-registered report)

Berit Hartjen[1], Garrett Greaves[1], Charles Nelson[1]

[1]Boston Children's Hospital

The EEG alpha rhythm is the dominant oscillation in both the resting and active brain but is also highly correlated with a variety of cognitive functions, including visual attention, emotion regulation, working memory, and inhibitory control. All these functions are known to be part of the executive functions (EF). The development of EF begins during infancy and is critical for cognitive control of behavior in childhood, adolescence, and adulthood. However, little is known about the neuronal correlates that promote optimal development of EF. In the infant EEG literature higher baseline frontal alpha power (6-9Hz) is indicative of greater brain maturation and furthermore associated with performance on tasks thought to require the frontal lobe during infancy. On this basis, we aim to predict EF from developmental changes in frontal alpha power in infancy. We are currently recording electroencephalogram (EEG), collecting the Infant Behavior Questionnaire (IBQ-R), and conducting a battery of EF tasks (e.g., A-not-B, reverse categorization, spin the pots, and glitter wand task) in infants between 6 and 24 months of age. By September, we will have longitudinal EEG and EF data

from around 120 infants. Around 15 infants will have been seen at least at two of four time points between 6 and 24 months (enabling longitudinal within-subjects analyses) and around 30 infants will have been seen at each time point (i.e., 6,12,18, and 24 months). Preliminary between-subjects results from 64 infants (6 months: n=19, 12 months: n=19, 18 months: n=18, 24 months: n=8) indicate a significant development of resting state frontal low (6-9Hz) and high alpha (9-12Hz) power spectral density (PSD) between 6 and 24 months (ANOVA low frontal alpha: $F(3,60)=18.05$, $p<0.001$ / ANOVA high frontal alpha: $F(3,60)=25.17$, $p<0.001$). Bonferroni corrected post hoc t-tests specify a significant increase from 6 over 12 to 18 months in frontal high alpha PSD and a significant increase from 6 to 12 months in frontal low alpha PSD (ps<0.01), whereas we do not find any significant differences between 18 and 24 months for frontal low or high alpha PSD (see Figure 1A). We have correlated these EEG data with the factors of the IBQ-R that was collected at 12 months. The factors of this parent report measure the following three dimensions of temperament: positive emotionality/surgency, negative affectivity, and orienting/regulation. Interestingly, neither 6 nor 12 months frontal low or high alpha PSD was significantly correlated with any IBQ-R factor. However, the increase in frontal high alpha PSD from 6 to 12 months is significantly positively correlated with the IBQ-R factor surgency ($R=0.8$, $p=0.02$ - see Figure 1B). In conclusion, frontal alpha power increases between 6 and 18 months and this increase is positively correlated with surgency. Prior to the FIT'NG conference in September, we plan to consolidate this development of alpha power within-subjects (after more data have been collected) and use these trajectories to predict performance in our EF tasks.

2-D-41 Movies reveal the fine-grained organization of infant visual cortex

Cameron Ellis[1], Tristan Yates[2], Michael Arcaro[3], Nicholas Turk-Browne[2]

[1]Stanford University, [2]Yale University, [3]University of Pennsylvania

Movies may prove to be a powerful tool for studying the earliest developing minds by increasing engagement relative to traditional tasks. However, the spatial specificity and functional significance of movie-evoked activity in infants remains unclear. Here we studied 15 infants aged 5-"23 months while they attentively watched movies during fMRI. We asked what organizational properties of the visual system, if any, can be resolved with movie-watching data. We found distinct functional profiles of visual areas: Movies evoked similar activity in homotopic brain areas across hemispheres, but dissimilar activity between areas within hemispheres, especially between the dorsal and ventral streams. Moreover, we found that visual maps -" typically defined using time-intensive retinotopic mapping -" can be predicted moderately well (a) from data-driven analyses (i.e., independent components analysis) of movie-watching data from individual participants and (b) from the movie-watching data of other participants mapped into a common low-dimensional embedding (i.e., functional alignment). Together, these results suggest that the structure of the infant visual system scaffolds the processing of dynamic, naturalistic information and that fine-grained cortical organization can be discovered from movie data.

2-D-42 Dissecting neural correlates of affective and cognitive empathy in preschoolers: an fNIRS study

Chiara Bulgarelli[1], Paola Pinti[2], Emily Jones[2]

[1]Birkbeck College, [2]Birkbeck, University of London

Introduction: Empathy is fundamental for bonds and social interactions (Bernhardt, 2012). As failure of empathy might evolve into antisocial behaviour (Frick, 2009), understanding the mechanisms behind its development is fundamental for efficient early interventions. There is an extensive literature on empathy in adults, highlighting two main components of empathy, an affective one (i.e. sharing others' feeling) and a cognitive one (i.e. understanding others' feeling) (Shamay-Tsoory, 2011), supported by different brain networks (Decety, 2006). However, how and when these two components mature is still not well understood, and investigating their neural correlates while this skill is still developing might clarify how the developing brain processes these two components. Toddlerhood is the appropriate age to study the development of empathy, as from 2 years, preschoolers differentiate emotions originated from themselves and others (Amsterdam, 1972), which is a fundamental ability for empathy (Lamm, 2016). Tasks used so far to assess the development of empathy might not be appropriate to dissect which empathic component matures first. Most of the previous works assessed empathy towards adults or a doll, but investigating empathic reactions towards other children would more realistically resemble preschoolers social interactions. Moreover, the assessment of cognitive empathy has often been confused with the one of perspective-taking - which are two different skills (Stietz, 2019) - and relied only on children's verbal skills, but this might confound assessments of developmental ordering. Instead, investigating the neural underpinnings of the development of empathy towards other children can show changes in the brain that underpin social behaviours, and show markers of empathy regardless its verbal or behavioural manifestation. **Methods:** We designed a new block-design task in which 50 3-to-5-year-olds were presented with 8 emotionally salient and 8 neutral scenarios, with situations taken from naturalistic observations of children in a nursery (Bulgarelli, 2023). Contrary to other previous tasks, both empathic components were tested in each emotionally salient scenario. Each scenario showed an emotionally salient or emotionally neutral event (affective empathy vs. neutral fact). After each scenario, the participant was asked to reflect on the character's feeling or reason for action (cognitive empathy vs. cognitive reasoning). During this task, we recorded neural activations from frontal and temporoparietal regions, known to be engaged in empathy in adults (Decety & Jackson, 2006), using functional near-infrared spectroscopy (fNIRS). **Expected results and conclusions:** Data analysis is ongoing. We expect to dissect different neural networks for affective and cognitive empathy, possibly mapping the adult ones. Finding stronger neural correlates for one component of empathy over the other, might elucidate which empathic component develops first. While gender differences in empathy have been documented in adults (Christov-Moore, 2014), whether they root in childhood in unclear, therefore we will explore neural differences between male and female preschoolers.This works provides the first systematic investigation of neural correlates of empathy in preschoolers, proposing a new task that can be used by other researchers in the field and opening up new avenues to further explore the development of empathy.

2-D-43 Establishment of an EEG hyperscanning paradigm to investigate maternal-newborn neural dynamics during skin-to-skin and stroking touch in the first days of life

Grace Kromm[1], Kelle Pammenter[2], Andrea Edwards[2], Mohammad Adnan Azam[3], Victoria Leong[3], Topun Austin

[1]University of Cambridge, [2]Cambridge University Hospitals NHS Foundation Trust, [3]Nanyang Technological University

Affectionate touch is one of the most fundamental aspects of the human experience, beginning at the very start of life. The sensory pathway for affectionate touch is anatomically segregated, primarily transmitted by unmyelinated, slow-conducting C-tactile (CT)

afferents optimally activated by gentle stroking at 1-10 cm/s. In the neonatal period, skin-to-skin and stroking touch tune long-term somatosensory development, autonomic reactivity, social cognition, and bonding; however, neonatal neural processing of CT-targeted touch is not yet well understood. This work is part of a larger study, Brain Activation in Mother and BabY (BAMBY), which aims to interrogate the neural underpinnings of touch-mediated maternal-newborn interaction by recording brain activity with simultaneous or hyperscanning electroencephalography (EEG). For the present submission, we aimed to establish an EEG hyperscanning paradigm at the neonatal cotside across CT-targeted and non-CT-targeted touch. We applied EEG hyperscanning to study 29 term-born newborns and 29 mothers. Of the 29 dyads, refinement of the paradigm was undertaken with 14 dyads, and the full study was undertaken with 15 dyads. Refinement of the paradigm involved adjustment of paradigm design/length and development of a stroking touch speed-tracking method. Our refined paradigm compares neural dynamics across touch context and touch mechanism in a 2x3 factorial design. For touch context, mothers and infants are skin-to-skin (social) or separate (nonsocial). For touch mechanism, the infant receives touch across the back that activates the CT afferent pathway optimally (slow stroking, ~1-10 cm/s), suboptimally (fast stroking, ~20 cm/s), or minimally (static hand). Touch conditions are of 3-minute duration with alternating 3-minute periods of rest. We record two synchronised video streams: one to track behaviour and arousal state and one to track stroking speed using an open-source QR marker (ArUco) and custom algorithm. Within the 15 dyads recruited to the full study, 13 infants tolerated at least one touch condition (7 male, 6 female; average 39+1 weeks gestation, 3 days old). Maternal-newborn hyperscanning EEG was recorded at 500 Hz on LiveAmp wireless amplifiers with actiCAP electrodes (Brain Products) at 10-20 system locations F3, Fz, F4, C3, C4, P3, Pz, and P4 (Cz reference, Fpz ground). Recruitment to BAMBY and additional analyses are ongoing. Stroking speed was calculated across stroking touch conditions. Stroking speed (M Â± SD) was 5.1 Â± 2.4 cm/s in the social + CT-optimal touch condition (n = 12), 20.3 Â± 5.2 cm/s in the social + CT-suboptimal touch condition (n = 11), 3.4 Â± 1.6 cm/s in the nonsocial + CT-optimal touch condition (n = 6), and 18.2 Â± 7.2 cm/s in the nonsocial + CT-suboptimal touch condition (n = 6). All individual CT-optimal stroking touch conditions were in the 1-10 cm/s range, and all individual CT-suboptimal touch conditions were above this range. In conclusion, we have established and refined an EEG hyperscanning paradigm at the neonatal cotside across types of gentle touch that differentially activate the CT afferent pathway. Pilot analyses of maternal-newborn neural synchronicity and of newborn neural processing of CT-targeted and non-CT-targeted touch are currently underway. We hope these results will help elucidate the role of CT afferents in early bonding and brain development as well as help characterise the beginnings of the mother-child inter-brain network.

2-D-45 Edge-centric control theory applied to neonatal structural connectivity in term and preterm neonates predicts cognitive and social outcomes at 18-months

Huili Sun[1,2], Dustin Scheinost[1,2]

[1]Wayne State University, [2]Yale University

The brain undergoes extensive development during infancy to gain future cognitive and social skills. However, it remains unclear if brain structure at birth can predict these future skills. Network control theory is a promising framework for studying brain development. The controllability of structural networks is associated with cognitive outcomes in infants and adolescents. We have recently extended network control theory to assess the controllability of specific structural connections (or edges). Edge controllability better predicts cognition in adults compared to traditional controllability measures. We investigated whether edge average controllability (eAC) and edge modal controllability (eMC) can predict developmental outcomes in neonates. eAC measures each edge's ability to drive nearby brain state transitions. eMC measures each edge's ability to drive distant brain state transitions. We then generalized these models to preterm neonates at high risk of poor neurodevelopmental outcomes. We applied edge-centric network control theory to structural connectomes of 530 neonates (448 terms, 82 preterms) from the developing Human Connectome Project. Term neonates were scanned at birth. Preterm neonates were scanned twice at birth and term-equivalent age. 349 term and 63 preterm neonates underwent cognitive testing (BSID-III) and autism risk screening (Q-CHAT) at 18 months old. Standard DWI preprocessing was performed. Structural connectivity for each subject was constructed with the 90-node infant atlas based on the quantitative anisotropy between any two nodes. We calculated eAC and eMC and used Connectome-based Predictive Modeling (CPM) to predict BSID-III and Q-CHAT scores from eAC and eMC. Prediction models controlled for sex, brain volume, and head motion. We first trained 10-fold CPM models to predict the BSID-III and Q-CHAT scores from the term neonates. Edge controllability predicted BSID-cognition (eAC: r=0.19, p<e-3; eMC: r=0.18, p<e-3) and language (eAC: r=0.22, p<e-4; eMC: r=0.20, p<e-3) scores, but not BSID-motor scores. Edge controllability also predicted Q-CHAT scores (eAC: r=0.24, p<e-5; eMC: r=0.22, p<e-4). Using the pre-trained model on term infants, we predicted Q-CHAT scores (eAC: r=0.31, p=0.013; eMC: r=0.27, p=0.030) in preterm infants. We used edge-centric network control theory and CPM to predict 18-month outcomes from neonatal structural connectivity. Edge controllability predicted later individual cognitive and social abilities. Overall, edge-centric network control theory holds promise as a brain-based marker of future developmental risk.

2-D-46 Neural Correlates of Tactile Attention in Infancy

Kaitlyn Campbell[1], Nicholas Scheri[1], Melissa Horger[1], Valentina Parma[2], Peter Marshall[1]

[1]Temple University, [2]Monell Chemical Senses Center

Study Objective: The study objectives center on identifying the various event-related-potential (ERP) components that are elicited by a passive tactile oddball paradigm in infancy, and relating the amplitude of these components to individual differences in infant temperament and motor development. **Methods:** As part of a larger study, infants and their parents completed several questionnaires and tasks, such as the Infant Behavior Questionnaire for temperament (IBQ), the Bayley Motor Scale, the Early Motor Questionnaire (EMQ), and completed EEG collection during a passive oddball task in the somatosensory modality. The EEG task was designed to elicit the somatosensory mismatch negativity (sMMN) using tactile stimulators placed on their thumb, middle, and pinky fingers of the infant's right hand. The tactile stimulators were connected via a tube to a pneumatic stimulator that inflated a membrane and resulted in a tap sensation felt by participants. The infants were outfitted with a lycra 32-electrode cap. The task paradigm included stimulation to the middle finger 80% of the time with the other 20% of trials being split between the thumb and the pinky (little) finger. **Planned Analysis:** We will use the HAPPE+ER low-density EEG pipeline to clean data and then ERP components to middle finger stimulation will be identified via a principal component analysis (PCA). Results from the PCA will inform ERP component peak latencies and topography. The component amplitudes will be the mean amplitude in the specific time ranges. The chosen ERP components will most likely include

P50, N80, N140, sMMN, and Nd. We will analyze variable relationships using multilevel modeling using restricted maximum likelihood estimation to investigate relations of the Bayley Motor Scale, the IBQ, and the EMQ with the specific component amplitudes. Results will be available prior to the conference. **Conclusions:** This study will add to the tactile attention literature in infancy by examining ERP components from a tactile oddball paradigm in relation to individual differences in infant motor development and temperament. The developmental literature on tactile attention is generally limited, so the study's results will shed light on influences on somatosensory ERP components in infancy.

2-D-47 Study Protocol: A Natural History of Cognitive Impairment Following Perinatal Brain Injuries

Noah Trapp[1], Melisa Carrasco[1], Kimberly Cuevas[2]

[1]University of Wisconsin, [2]University of Connecticut

Objective: Cognitive disabilities and executive dysfunction are common following perinatal brain injuries (PBIs). The natural history of cognitive impairment and executive functioning (EF) following PBIs has not been established. We here present the protocol for an observational, prospective, single center natural history feasibility study of cognitive and EF development in children with the four more common types of perinatal brain injury: hypoxic ischemic encephalopathy, premature-related white matter injury, and premature-related germinal matrix hemorrhage and intraventricular hemorrhage. The study will specifically evaluate the role of a) resting/baseline EEG and b) attentional control as biomarkers for early detection of cognitive disability following PBIs. **Methods:** Participants (with and without PBI) will be recruited to this study. Patients will complete study visits at 6, 12 and 24 months of age. The Capute Scales and the Bayley Scales of Infant and Toddler Development will be administered during study visits and participants will complete a battery of assessments involving various aspects of executive function. Spectral power will be extracted from resting EEG recorded over frontal regions of the scalp when infants are 6, 12, and 24 months of age; multilevel modeling will be utilized to assess change over time between risk groups in the delta, theta, alpha, and beta frequency bands. The infants will also complete the Puppet Task, specific for studying emerging infant attention. **Results:** The feasibility study is designed to investigate whether it is possible to recruit and retain PBI participants for this longitudinal study. Feasibility issues include development of a recruitment strategy that is sensitive to the needs and medical limitations in the PBI population, PBI study visit participation, PBI retention in the study, as well as acquisition of quality behavioral and EEG data from participants with PBIs. The results of the study will inform the development of a larger trial in the future. The establishment of early biomarkers for identification of PBI patients at higher risk for cognitive disability will help streamline resources for patients with greater cognitive deficits. Potential theoretical implications of the role of perinatal pathology on the development of EF will be considered. **Conclusions:** Data collection is ongoing; however, preliminary data for 3 study participants demonstrate that our protocols are feasible for the study of early biomarkers of cognitive and EF development in young infants. Pilot data from both the healthy controls and patient participants will be presented.

2-D-48 Exploring the link between the neural correlates of processing facial emotion in infancy and prosocial behavior at 3 years of age

Renata Di Lorenzo[1], Wenkang An[1], Michelle Bosquet Enlow[1], Charles Nelson[1]

[1]Boston Children's Hospital

Prosocial behavior has been associated with school performance and psychological well-being1,3. Thus, supporting prosocial behavior at an early age is critical to enabling children to reach their full potential later in life. To do that, it is essential that we identify the factors contributing to individual differences in prosocial behavior in the first years of life. One factor possibly affecting prosocial behavior is facial emotion processing. Extracting emotional information from faces provides infants cues to help them learn about the environment and develop social skills. Previous research indicates infancy as a critical period for facial emotion processing4. Crucially, one fNIRS study showed that 7-month-olds' brain responses to fearful faces predicted prosocial behavior at age 14 months2. While this evidence suggests a link between infant facial emotion processing and later prosocial behavior, more research including a wider age-range is needed to clarify this relationship in the first years of life. In the current study, we correlated EEG/ERP recorded from three groups of infants tested at either 5-, 7-, or 12-months during passive watching of fearful, happy, or angry faces with prosocial behavior data obtained at age 3 years. Specifically, we computed mean amplitudes of face-relevant ERPs (N290, P400 indexing early visual and Nc attentional processing) separately for each infant group and facial expression; while prosocial behavior was operationalized as the amount of time a child waited prior to helping an experimenter who was having difficulties completing a task5 (hereafter prosocial latency). We hypothesized that prosocial behavior at 3 years would be related to infant ERPs. Analyses suggest that more negative Nc amplitude to angry faces at 7 months was associated with shorter prosocial latency at 3 years (r=.46, p=.03). No other association reached statistical significance. This result supports our hypothesis indicating a link between infant (attentional) facial emotion processing and prosocial behavior at 3 years. Our finding aligns with the fNIRS study linking 7-month-olds brain responses to facial emotions with prosocial behavior at 14 months2, suggesting that this relationship may persist into 3 years. Ultimately, this evidence highlights the importance of supporting social emotional development in the first year of life.

References: 1. Guo, Q., Zhou, J., & Feng, L. (2018). Pro-social behavior is predictive of academic success via peer acceptance: A study of Chinese primary school children. Learning and Individual Differences, 65, 187-194. 2. Grossmann, T., Missana, M., & Krol, K. M. (2018). The neurodevelopmental precursors of altruistic behavior in infancy. PLoS biology, 16(9), e2005281. 3. Ladd, G. W., Birch, S. H., & Buhs, E. S. (1999). Children's social and scholastic lives in kindergarten: Related spheres of influence? Child Development, 70, 1373-"1400

4. LeppÃ¤nen, J. M., & Nelson, C. A. (2009). Tuning the developing brain to social signals of emotions. Nature Reviews Neuroscience, 10(1), 37-47. 5. Warneken, F., & Tomasello, M. (2006). Altruistic helping in human infants and young chimpanzees. science, 311(5765), 1301-1303.

2-D-49 White matter properties and ERP responses to faces in infants

Stefania Conte[1], Mariana Uvalle[2], John Richards[2]

[1]The State University of New York at Binghamton, [2]University of South Carolina

Important changes in how infants process faces occur in the first year of life, with adult-like neural responses starting to occur around 12 months of age. Similarly, several brain structures undergo critical changes that sustain the development of functional responses.

In the current study we investigated the relationship between structural and functional aspects of face processing in typically developing 12-month-old infants. Brain functional responses were recorded through event-related potentials (ERPs) from 20 infants (n = 7 females; n = 3 Asians; n = 3 African Americans) while presented with intact and scrambled images of faces and objects. Intact stimuli were equated for low-level visual properties, including color spectra and shape. Scrambled stimuli were obtained by applying a Fourier phase randomization procedure to the intact images. N290 amplitude and latency values were analyzed over occipito-lateral channels (Figure 1a). Diffusion-weighted volumes were obtained from 10 infants (n = 3 females; n = 2 Asians; n = 2 African Americans). Multi-shell diffusion data was acquired on a Siemens Prisma 3T, along 137 directions, during natural sleep. All volumes were corrected for Eddy current and susceptibility induced distortions using FSL tools. Fractional anisotropy (FA) values were calculated across white matter voxels using a diffusion tensor approach. Additionally, sixteen white matter fiber bundles were reconstructed using probabilistic tractography (Figure 1b) and investigated for their FA properties. Linear mixed models were performed on amplitude values at the peak of the N290 component. Results showed more negative N290 responses to intact faces than all remaining trial types ($t(5733) > -7.67$, $p < .001$), as well as right lateralized N290 responses for face stimuli only (intact: $t(5733) = 6.97$, $p < .001$; scrambled: $t(5733) = 3.66$, $p = .006$). We found shorter N290 responses for scrambled than intact objects ($t(610) = 2.84$, $p = .024$), whereas all remaining comparisons were nonsignificant ($p > .150$). Average FA values in the right dorsal cingulate (rCBD) showed significant negative correlations with the N290 amplitude activity, specifically in response to intact faces ($r = -.35$, $p = .003$), indicating that more negative N290 were related to higher average FA values in this tract. For none of the reconstructed tracts the relation between the average FA and N290 latency was significant (ps > .19). Overall, these preliminary results show that controlling for low-level stimulus properties helps isolating the neural response specific to faces, which shows signs of right lateralization at 12 months of age. Across all considered tracts, the right dorsal cingulate was the only white matter bundle to show a relation with the N290 activity recorded on the scalp. In particular, increased FA seemed to be related to more negative N290 amplitudes in response to intact faces, but not all remaining conditions. Microstructural properties of the rCBD were not related to the latency of neural response. This structural-functional relationship may be interpreted in light of the role of the cingulum bundle in the early development of socioemotional skills.

E - Other

2-E-50 Predicting fMEG manifestations of fetal spontaneous neural activity using premature EEG.

Alban Gallard[1], Benoit Brebion, Katrin Sippel[2], Amer Zaylaa, Yael Fregier, Hubert Preissl, Fabrice Wallois, Sahar Moghimi

[1]Groupe de Recherches sur l'Analyse Multimodale de la Fonction Cérébrale, [2]Helmholtz Center Munich at the University of Tuebingen

Evaluation of normal and pathological fetal brain development is a very challenging and complex task. Fetal magnetoencephalography (fMEG) has been developed to investigate brain activity at the earliest stage of development. A lot of effort has been made to better analyze evoked responses, but the study of spontaneous activity remains challenging due to the complexity of the extraction and of the analysis of fetal brain signals. It also lacks of a model to predict what the fMEG manifestation of spontaneous neural activity look like. However, a large body of electroencephalography (EEG) studies has characterized the spontaneous neural activity in premature neonates at different gestational ages. The EEG in premature babies is dominated by discontinuous occurrence of bursts of complex activities. In this study, 10 EEG recordings in preterm at gestational age 28 to 31 weeks and 10 fMEG recordings at gestational ages 34 to 37 weeks has been used with Cycle Generative Adversarial Network (CycleGAN) to propose a transfer function for prediction of spontaneous neural activity in fMEG, based on our knowledge in premature EEG. Toward this, first fMEG data were filtered (0.5-25 Hz) and then preprocessed to remove the artifacts corresponding to the cardiac activity of the mother and that of the fetus, using orthogonal projections. Then, the bursts of spontaneous activity in fMEG and premature EEG were detected using the non-linear energy operator (NLEO) algorithm. Next, unpaired matrices consisting of 5s windows of bursts of activity in fMEG and EEG, pooled over all subjects, were used to train a CycleGAN, to transfer the burst of spontaneous activity in EEG into bursts in fMEG. For each population, 80% of the burst windows were used for training and 20% for testing the model. The detection for the premature EEG were accurate as confirmed through visual inspection by one clinician (FW); only the short periods with debatable burst were not detected. In fMEG, the NLEO algorithm can detect inter-bursts as bursts and bursts as inter-bursts. So, the threshold of the algorithm has been chosen higher to reduce the number of inter-bursts detected as bursts. The point of this choice is to have the minimum inter-burst for the CycleGan. Then, the transformed data has been visually inspected in the CycleGAN.

2-E-51 Ultra-high field fMRI exploration of cortical depth specific functional activation in the neonatal brain

Jucha Willers Moore[1], Elisabeth Pickles[1], Philippa Bridgen[1], Alena Uus[1], Raphael Tomi-Tricot[2], Daniel Cromb[1], Paul Cawley[1], Beya Bonse[1], Jennifer Almalbis[1], Anthony Price[1], Enrico De Vita[1], Maria Deprez[1], Sharon L Giles[1], A David Edwards[1], Jo V Hajnal[1], Jonathan Polimeni[3], Shaihan Malik[1], Tomoki Arichi[1]

[1]King's College London, [2]Siemens Healthcare Limited, [3]Harvard Medical School

In recent years, MRI studies have provided marked discoveries on brain development across the perinatal period. Cortical development is particularly complex and protracted, with rapid changes in functional connectivity and tissue maturation; laying a framework that subserves cognitive function across the lifespan. Ultra-high field 7 tesla (T) functional MRI (fMRI) provides even greater insight due to significant gains in SNR, allowing studies with greater spatial specificity. In adults, this enables studies of activity localised to cerebral cortical depths and layers. [1] 7T fMRI data acquisition has not previously been done in neonates, and this level of spatial detail could provide a new wealth of fundamental insight about how function first develops in the cortex. To explore the feasibility of acquiring high-resolution fMRI at 7T in neonates to explore cortical depth specific patterns of resting-state network blood oxygen level dependent (BOLD) activity. fMRI data were acquired from 3 neonates (36+4, 41+4, 42+3 weeks post-menstrual age at scan) in natural sleep using a Siemens 7T system (MAGNETOM Terra, Siemens Healthcare, Erlangen, DE) using a 1TX-32RX Nova Medical (Wilmington, MA, USA) head coil. Conservative SAR estimation was used to mitigate the increased risk of temperature instability in neonates. [2] BOLD-weighted whole brain fMRI data were acquired using a GRE-EPI sequence over 8m 2s with parameters: 1mm isotropic resolution; TE/TR: 43ms/3210ms; 78 slices, 125mm FoV, 1.06ms echo spacing, dual-polarity GRAPPA 3 [3], simultaneous multi-slice 2. T2-weighted images were acquired in 3 orthogonal planes and reconstructed to 0.4mm isotropic resolution using SVRTK. [4] Tissue segmentation and surfaces were generated using the developing Human Connectome Project structural pipeline. [5] fMRI data were pre-processed, including rigid body motion correction, high-pass filtering (cut-off 100s), slice timing correction and IC denoising using FSL. [6] ICA resting state

network estimation was performed in each subject and projected onto the pial, mid-cortex and white matter surfaces using Connectome Workbench. [7] Resting state networks were identified in all 3 infants with similar spatial distribution to those described at 3T, but with greater spatial localisation, following the anatomy of cortical gyri. Localisation of an exemplar (sensorimotor) network to the pial, mid-cortex and white matter surfaces demonstrated that 7T fMRI can delineate depth specific activation patterns in neonates with a trend towards more dispersed activation and higher network statistics on the pial and mid-cortical surfaces in comparison to the white matter boundary (Fig. 1). We demonstrate the increased spatial resolution and SNR gained using 7T fMRI in neonates and provide pilot data exploring cortical depth specific activity in the developing cerebrum. The results here differ to those previously seen in a preterm neonate where greater z-statistics were seen on the white matter surface. [8] This may suggest that BOLD activation changes across cortical depths during maturation, and demonstrates that cortical depth fMRI analysis in neonates using ultra-high field MRI can provide deeper insight into how functional connectivity and network organisation emerges.

1. Polimeni et al 2010 2. Malk et al 2021 3. Hoge et al 2016 4. Kuklisova-Murgasova et al 2012 5. Makropoulos et al 2018
6. Smith et al 2004 7. Marcus et al 2011 8. Arichi et al 2023

2-E-52 Neural mechanisms for translating short-term perceptual changes in infancy into long-term developmental changes

Zahra Abolghasem[1], Lauren Emberson[1], Tora Chen[1], Aleksandra Dopierala[1]

[1]*University of British Columbia*

As an infant experiences the world, their perceptual system adjusts to their newly acquired experiences. An emerging line of work, including from our team, has demonstrated that infants can quickly and flexibly adjust their perceptual systems to the environment, but only for a brief amount of time. However, it is unclear 1) how to prolong these short-term perceptual adjustments to (ultimately) give rise to developmental changes in perception and 2) what learning and neural mechanisms are involved in prolonging these adjustments in early development. Previous research on perceptual learning in adults has found that dispersed training procedures, that reactivate the memory of the initial experience, have been tied to long-lasting perceptual changes, and that the frontal lobe is involved in the early stages of the learning-induced perceptual change but less involved once learning has taken place. In order to investigate if the mechanisms are operating in infants, we will first establish a training procedure to investigate whether reactivating the initial learning experience can support long-term retention of perceptual changes in 7-month-olds. We will use a multi-session paradigm where, during the first session, two audio-visual cues will predict one direction of motion (leftward or rightward) on 80% of trials. The motion will elicit smooth pursuit eye movements, specialized, involuntarily eye movements that track motion at its direction and velocity, which provide a trial-by-trial measure of motion perception. Following the first session, four additional brief training sessions will be conducted weekly to reactivate the memory of the initial learning experience. As a sign of long-term perceptual change, the cues alone should elicit smooth pursuit eye movements without re-exposure. We will then adapt the training procedure for use with fNIRS in a pre-post design among an experimental learning group and a non-learning control group. The study will measure frontal lobe responses (anatomical regions localized using MR co-registration) and motion sensitive visual cortex (determined using functional localizers) in the first and last (5th) sessions to investigate the role of the frontal lobe in the long-term retention of perceptual changes. This pre-registered research will provide insight on the mechanisms that translate day-to-day experiences into the development of perceptual systems.

F - Sensitive Periods and Brain Plasticity

2-F-53 Development of supratentorial and infratentorial compartments of the human brain from infancy through early childhood

Sahar Ahmad[1], Yifan Li[1], Wenjiao Lyu[1], Jinjian Wu[1], Pew-Thian Yap[1]

[1]*University of North Carolina at Chapel Hill*

The human brain is divided into two compartments: (i) the supratentorial compartment that lies above the tentorial cerebelli; and (ii) the infratentorial compartment that is located below the tentorial cerebelli. The supratentorial compartment houses the cerebrum that is responsible for vision, memory, executive functions, etc., and the infratentorial compartment contains the cerebellum and the brainstem that are responsible for movement and coordination. Common disorders associated with the supratentorial compartment are hydranencephaly, lissencephaly, and ventriculomegaly and with the infratentorial compartment are macrocerebellum, chiari malformation, Dandy-Walker syndrome, and cerebellar hypoplasia. Malformed compartments during infancy and childhood can cause long-term problems in memory, cognition, behavior, and motor control. Developmental charts of these brain compartments are important for the early detection of abnormalities. Here, we study the volumetric changes of the infratentorial and supratentorial compartments from birth through 5 years of age. We used T1-weighted and T2-weighted MRIs from the UNC/UMN Baby Connectome Project (BCP) and implemented a deep learning segmentation method. We randomly selected 7 subjects for manually annotating the supratentorial compartment (including the cerebral gray matter, cerebral white matter, lateral ventricles, third ventricle, cavum septum pellucidum, and the extra-axial cerebrospinal fluid) and the infratentorial compartment (including the cerebellar gray matter, cerebellar white matter, fourth ventricle, brainstem, and the extra-axial cerebrospinal fluid). The segmentation network (nnUNet) with these annotations was applied to segment 141 new subjects. These predicted segmentation maps were pooled with the manual annotations to retrain the segmentation network. The retrained network was applied to segment all available data. Volumetric growth trajectories of the two compartments were obtained via generalized additive mixed model (GAMM) fitting (Figure 1). The infratentorial compartment grows faster (increases by 270% in the first year) compared to the supratentorial compartment (increases by 132% in the same period). This is in line with the general pattern of brain functional development, i.e., motor skills mature earlier than memory and cognition.

2-F-54 Estimating chronological age from resting EEG power in children aged 2-36 months

Winko An[1], Aprotim Bhowmik[2], Charles Nelson[1], Carol Wilkinson[1]

[1]*Boston Children's Hospital, 2 Zucker SOM at Hofstra/Northwell & Columbia University*

Background: The early years of life witness substantial anatomical and functional changes in the brain. These dynamic changes are believed to lay the foundation for more complex cognitive processes and give rise to changes in neural oscillations that can in turn be

recorded non-invasively at the scalp surface (EEG). Our recent study, based on a large-scale EEG dataset, revealed a robust association between chronological age and various EEG power spectrum measures (e.g., aperiodic offset, alpha peak frequency, beta periodic power). Expanding on these findings, the present study aimed 1) to train a computational model capable of accurately predicting chronological age using EEG measures and 2) to identify features that play a crucial role in this prediction. **Methods:** We utilized resting-state EEG data from the same dataset, consisting of 938 recordings obtained from 467 typically developing (TD) children aged 2 to 36 months. We computed a set of power measures using spectral parameterization and principal component analysis. These measures served as features to train several regression models for age estimation; the model performance was assessed through 5-fold cross-validation. Importantly, we analyzed the feature importance using Shapley Values. This analysis explained which EEG features contribute more to the model prediction, hence their stronger association with age. **Results:** Among the different models examined, the multilayer perceptron (MLP) demonstrated the highest performance, yielding an R2 value of 0.85 and a mean absolute error (MAE) of 87.83 days only 8% of the age range of the participants (1091 days). The MAE of the other models ranged from 114.6 to 132.2 days [XGBoost (R2 = 0.75; MAE = 114.6), LASSO (R2 = 0.70; MAE = 130.0), Random-Forest (R2 = 0.68; MAE = 132.2)]. Among the extracted features, the periodic power in the low-alpha (6-9 Hz) and low-beta (12-20 Hz) frequency bands exhibited higher mean absolute Shapley Values (>115.0 days) compared to the remaining features (<55.0 days), signifying their significance in model prediction. Moreover, the values of these two features demonstrated strong correlations with age across all individuals (low-alpha: Spearman's r = 0.44, p = 9.76E-58; low-beta: Spearman's r = 0.45, p = 7.86E-59). **Conclusion:** This study demonstrated the effectiveness of computational models in capturing age-related information from EEG power measures, thus enabling accurate estimation of chronological age. Future studies will further examine the performance of this model on predicting the age of children with neurodevelopmental conditions, which holds the promise of informing potential distinctions between typical and atypical brain development during early life.

2-F-55 Deep Regularizers for High-Resolution Reconstruction for fetal structural MRI

Daniel Sobotka[1], Gregor Kasprian[1], Georg Langs[1], Roxane Licandro[1]

[1]Medical University of Vienna

Study's objective: Imaging a fetus is challenging, due to its constantly changing position and movements, which consequently can cause blurring and imaging artifacts. Thus, a main focus in creating suitable imaging protocols lies in shortening the acquisition time to reduce the impact of motion while imaging. High resolution reconstruction is an essential preprocessing step in Magnetic Resonance Imaging (MRI) of the fetal brain with the aim to fill up gaps of missing image information after correcting for fetal movement and maternal breathing. In this work we hypothesize that generative adversarial networks (GANs) can improve the reconstruction process in comparison to state-of-the-art regularizers by combining the generative task with an estimation routine for brain tissue segmentation. **Methods:** Here, we propose a novel technique to estimate deep regularizations based on generative adversarial networks. The network's input consists of 2 slices which represent the source of interpolation within the volume. Our proposed approach predicts a high-resolution reconstruction of the fetal brain volume between the provided input slices. We introduced a second stream for segmentation prediction in the generator of the GAN to optimize the training of the image reconstructions. According to literature it was demonstrated that these can improve, without focusing on obtaining perfect segmentations in this work, but providing the network not only reconstructed ground truth, but also segmentation based information in the training phase. The loss function of the generator incorporates a style, perceptual and reconstruction term for image similarity assessment and a cross entropy term for determining predictive segmentation performance. Whole volumes are reconstructed iteratively by providing consecutive slices within the volume, consequently doubling the resolution level of the output. **Results:** Our test dataset consisted of 31 axial neurotypical structural 1 mm isotropic fetal MRI with corresponding brain tissue segmentations from white matter + subplate from the Medical University of Vienna (mean gestational age 27.32 with 4.59 std). To simulate in-vivo acquired data in the clinic, we resampled the volumes to voxel spacing 1x1x3 mm. Further, we predicted slices between consecutive inputs of voxel size 1x1x1.5 mm. 5-fold leave-one-out cross validation was performed, where for each run the model was trained on 30 datasets and evaluated on the leave out dataset. We compared our approach with reconstruction techniques using state-of-the-art first-order Tikhonov (TK1L2) and total variation (TVL2) regularizers. Our approach increased peak signal-to-noise ratio from 40.545 (TK1L2) and 41.340 (TVL2) to 41.626 and reduced mean squared error from 6.739 (TK1L2) and 5.995 (TVL2) to 5.630. **Conclusion:** We demonstrate the proposed framework's ability to improve reconstruction performance in a simulated setup, outperforming state of the art regularizations. We were able to obtain these results with a small training dataset. For future work we plan to collect more training data to even more increase the reconstruction performance of the network and also will extend the network for individual slice thicknesses and resolution levels.

2-F-56 Considerations for estimating functional topology and topography in highly sampled individual infants

Julia Moser[1], Sanju Koirala[1], Thomas Madison[1], Robert Hermosillo[1], Lucille Moore[1], Alyssa Labonte[2], M. Catalina Camacho[2], Michael Myers[2], Chad Sylvester[2,3], Damien Fair[1]

[1]University of Minnesota, [2]Washington University in St. Louis, [3]Washington University

Resting state fMRI (rs-fMRI) allows one to investigate functional brain topology and topography which can be used as indicators for healthy brain functioning and development. Such brain functional organization is highly individual-specific and can be reliably detected on a single subject level given sufficient amounts of data. This need for large amounts of data for individual precision functional mapping poses a particular challenge for infant neuroimaging. In fact, there is still uncertainty as to the amount of data required for characterizing brain functional organization in individual infants. The present work leverages a precision functional mapping case study to showcase the amounts of data needed for a reliable characterization of individual functional brain organization in infants, which can hopefully be used to guide precision functional imaging in this age group.We acquired rs-fMRI data from a neonate over five consecutive days. This specific infant showed very low motion across days and retained 98% of their data at a framewise displacement threshold of 0.3mm, resulting in a total of 210 minutes of high quality data, making it an ideal example case to study reliability of calculations of network topology and topography. We investigated reliability of network topology by correlating vertex-wise and parcellated functional connectivity matrices of various intervals of a split-half of the data to the half treated as ground truth (100 minutes from 16 runs). In addition, we compared the normalized mutual information (NMI) of networks generated by template matching (TM) for the same

intervals of data. The correlation of parcellated functional connectivity matrices from both split-halves stably estimated network topology with about 1h of low motion data. Interestingly, the vertex-wise correlation of functional connectivity maps did not reach a plateau within the 100min of available data. Increasing the smoothing kernel for calculating dense functional connectivity maps (from 1.7 to 3) flattened the curve at around 90 min but still did not show a clear plateau. TM allowed us to detect all major adult networks in both split-halves of the data. The split half NMI for 100 min of data was 0.66 which is comparable to what has been previously published for adult precision imaging subjects. Unlike in adults where a plateau of NMI values for TM was reported for 20 min of data, NMI only reached a plateau after adding up data to around 60 min of the available 100 min. These examples showcase the importance of spatial scale when looking at the reliability of metrics estimating functional topology and topography in infants. Spatial smoothing or summarizing areas into parcels or networks helps increase the signal to noise ratio (SNR) of infant rs-fMRI data and enables description of individual specific functional brain organization. The plateau at 60 min for networks and parcels is an amount of time that is based on our experience achievable in individual infants. When attempting to take a more fine grained look, techniques to increase SNR ratio like NORDIC (NOise reduction with DIstribution Corrected PCA) thermal noise reduction can be utilized. Larger amounts of data will however still be required. Future work can take a more detailed look at smoothing parameters and create a function to determine the -œsweet spot- between time, spatial precision and reliability of individual functional connectivity matrices.

2-F-57 Dynamics of infant white matter maturation from birth to 6 months

Sarah Shultz[1], Benjamin Risk[1], Warren Jones[1], Longchuan Li[1]

[1]Emory University

Background: During infancy, white matter tracts undergo rapid myelination, establishing the structural foundation for functionally organized brain networks. As white matter tracts mature rapidly and asynchronously, the consequences of disruptions to these pathways are likely to be dynamic and temporally specific. Longitudinal, temporally-precise quantification of trajectories of white matter pathways during infancy is therefore a necessary first step towards understanding how deviations from typical trajectories can lead to disability. Here we present results from what is to our knowledge the largest longitudinal study to date (129 time points from 79 typically-developing infants) of white matter development from birth to 6 months. **Objectives:** 1) to model growth and change rate trajectories of major white matter tracts; and 2) to examine the impacts of sex and gestational age at birth on the dynamics of white matter development. **Methods:** Participants were 79 typically-developing infants (mean(SD) gestational age = 38.7(1.8) weeks, 31 female). Data were collected from each infant at up to 3 randomized time points between birth and 6 months. Eleven white matter tracts were identified using probabilistic tractography (Figure 1A). Generalized additive mixed models (GAMMs) were used to model growth and change rate trajectories of fractional anisotropy (FA), medial diffusivity (MD), axial diffusivity (AD), and radial diffusivity (RD). **Results:** Most tracts had their maximum change rates at birth, with rate of growth beginning to stabilize around month 5 (Figure 1). Some tracts exhibited large changes in growth rates over time (e.g., CCb), while a few tracts exhibited smaller dynamics (e.g., Fx). Despite most participants being full term or early term births, gestational age had a significant effect on whole-brain white matter growth trajectories ($p<1e-05$ for FA, MD, AD, and RD), with longer gestation associated with higher FA and lower diffusivity measures (MD, AD and RD). Additionally, there was a significant interaction between gestational age at birth and chronological age for FA ($p=0.005$), resulting in growth curves that were closer together as age increased, indicating a possible -œcatching-up- effect among infants born at younger gestational age (Figure 2). FA was initially higher in females than males, and then became nearly equal, while MD, AD, and RD tended to be higher in males than females throughout the first six months (main effect uncorrected $p=0.03$, $p=0.01$, $p=0.04$, respectively) although the 95% simultaneous confidence bands were broadly overlapping (Figure 2). **Conclusions:** We show that the dynamics of white matter maturation are time-varying, asynchronous, and linked to infant gestational age at birth and sex. Our results reinforce growing evidence that the impact of gestational age on brain development exists on a continuum, even across the spectrum of early term and full term births, and provide the first ever demonstration of the effect of gestational age on change rates of white matter development during the first 6 postnatal months. Future work should examine whether accelerated maturational trajectories associated with shorter gestation are adaptive and serve a compensatory role, or whether they represent an adverse response to stress associated with premature exposure to the ex-utero environment.

2-F-58 Twin-twin transfusion syndrome: exploring differences between donor and recipient brain morphometry in twin fetuses that underwent fetoscopic laser surgery (pre-registered report).

Marisa Spann[1], Ezra Aydin[1], Noelle Breslin, Xuejun Hao, Lynn Simpson, Chia-Ling Nhan-Chang, Alexis Maddocks, Dustin Scheinost[2, 3], Russell Miller

[1]Columbia University, [2]Wayne State University, [3]Yale University

Background: Twin-twin transfusion syndrome (TTTS), is a rare but serious condition affecting 10-15% of monochorionic-diamniotic twin pregnancies[1]. It occurs when there is imbalance of blood flow across vascular communications that exist along the surface of a shared twin placenta. The resulting condition involves a -œdonor- twin who loses blood (resulting in hypovolemia, oliguria, and growth restriction) to a -œrecipient- twin (resulting in hypervolemia, polyuria, and potentially cardiovascular failure), placing them both at risk of death and other adverse outcomes. Over the past few decades, fetoscopic laser surgery (FLS) has become established as the standard of care for treatment of early-onset, advanced stage TTTS, achieving survival rates superior to amnioreduction or expectant management.[2] Post-treatment neurodevelopment is a key pediatric outcome measure of the success of a fetal intervention. Existing literature reports long-term major neurodevelopmental impairment after FLS ranging from 4-18%, and encompassing areas of motor and cognitive delay, as well as bilateral blindness or deafness[3]. However, clinical predictors of birth and neurodevelopmental outcomes are unclear. Quantitative fetal MRI can provide intermediate observations on brain development that may predict birth outcomes. To date, limited studies have utilized MRI to gain more insight into birth outcomes[4,5]. **Aim**: Here we propose to assess in utero total intracranial volume in this novel cohort, exploring differences between -œdonor- and -œrecipient- twins in relation to prenatal characteristics and birth outcomes (e.g., gestational age at birth, birthing complications, stage of TTTS at diagnosis) characteristics. Our hypothesis is that smaller differences in total intracranial volume between fetal pairs will be a measure of improvement in the donor twin and will be associated with improved birth outcomes. **Sample**: Since 2007, 220 patients underwent FLS. 144 of these patients had post-laser fetal MRI with 112 cases having both twins survive. **Analysis plan**: Manual segmentation will be used to extract the fetal

brain from surrounding tissue. Total intracranial volume will be calculated as the sum of cerebral spinal fluid (CSF), white matter, and gray matter. Differences in total intracranial volumes between twin pairs will be calculated. Linear models will be used to associate these differences in volume with birth outcomes (APGAR score, gestation age at birth, NICU stay length). Fetal age, fetal sex, and time from FLS will be controlled for. **Summary**: To date, information regarding brain development of TTTS offspring is lacking. We aim to explore potential full and regional volumetric brain differences between donor and recipient fetuses diagnosed with TTTS, and how this is related to prenatal characteristics and newborn outcomes. This proposed analysis will help inform our future work collecting pre- and post-postnatal MRI's from TTTS pregnancies undergoing FLS, observing pre- and post-FLS surgical differences on brain development.

2-F-59 How much of the cortex is devoted to various functional networks at different ages?

Sanju Koirala[1], Julia Moser[1], Robert Hermosillo[1], Lucille Moore[1], Thomas Madison[1], Oscar Miranda-Dominguez[1], Eric Feczko[1], Alyssa Labonte[2], M. Catalina Camacho[2], Alice Graham[3], Nico Dosenbach[4], Steve Nelson[1], Theodore Satterthwaite[5], Jed Elison[1], Chad Sylvester[4], Damien Fair[1]

[1]University of Minnesota, [2]Washington University in St. Louis, [3]Oregon Health & Science University, [4]Washington University, [5]University of Pennsylvania

Objective: A longstanding objective in neurocognitive research has been to subdivide the human brain into a mosaic of anatomically and functionally distinct areas to understand how the brain segregates and integrates information. The discovery of resting state functional MRI (rsfMRI) has led to the characterization of human brain organization based on the co-activation patterns of brain areas. However, such network organization is created by spatially coregistering data across multiple individuals which assumes homogeneity in brain organization and obscures meaningful subject-specific features. Recent work using Precision Functional Mapping (PFM) techniques have rendered unique insights into individual functional brain network architecture, revealing idiosyncratic network topography such as individual variation in functional network size (i.e., how much cortical real estate is taken by each network). Such variation in individual topography has been shown to relate to individual differences in behavior such as cognition and motor skills. However, it is not known when individual variation emerges over development. **Methods**: In this study, we aim to examine whether the surface area of functional networks differs between three different age groups: neonates, adolescents, and adults. We utilized functional neuroimaging data from the Adolescent Brain and Cognitive Development study (n=6000) and the Midnight Scan Club precision imaging study (n=10) to derive adolescent and adults individual network maps using Template Matching. For neonates, we derived individual network maps from extended acquisitions of neonatal resting state fMRI data (n=8, duration: 80-200 minutes). **Analysis**: In our analyses, we will calculate the mean total surface area for each group. As neonates have less gyrification than the other two groups, we hypothesize that the mean total surface area will be smaller for neonates compared to adolescents and adults. We will also calculate the proportional surface area for each individualized network in each age group. Using the large sample from ABCD, we will create a distribution of proportional surface area for each network and examine potential age effects based on where the network size for neonates and adults fall within this distribution. We hypothesize that the relative proportion of the cortex devoted to each network at different age points will vary. **Implications**: Taken together, our study will provide important insights into age-related changes in individual-level functional network topography, and open opportunities to investigate how such changes in functional network topography relate to emergence of various behaviors in health and disease.

2-F-60 Individual differences in functional networks in neonates and toddlers (pre-registered report)

Ursula Tooley[1], Cynthia Rogers[1], Christopher Smyser[1], Tara Smyser[1], Ashley Nielsen[1], Aidan Latham[1], Jeanette Kenley[1], Dimitrios Alexopoulos[1], Barbara Warner[1], Joshua Shimony[1], Jeffrey Neil[1], Joan Luby[1], Chad Sylvester[2], Deanna Barch[2], Caterina Gratton[3], Ally Dworetsky[3]

[1]Washington University in St. Louis,[2] Washington University,[3] Florida State University

Introduction: Cortical organization is known to vary across individuals, with adults showing specific topographic deviations from the group-average functional network patterns in studies with sufficient data to estimate networks in individuals (Gordon et al.,2017; Mueller et al.,2013). One line of work in this domain terms these areas of focal difference -œnetwork variants-□: brain areas where an individual's pattern of functional connectivity differs markedly from the group average pattern of connectivity. Network variants show trait-like qualities: they are stable in individual adults, heritable, and predict differences in behavior (Seitzman et al.,2019; Dworetsky et al.,2023). Here we propose to investigate the development of network variants in neonates and toddlers. **Methods:** We will leverage a large longitudinal sample of neonates and toddlers with resting-state neuroimaging data, with data collected at birth (n =319, mean age = 41 wks, SD =1.5 wks, mean gestational age =38 wks), two years (n = 114, mean age =2.12 yrs, SD = 0.16 yrs), and three years (n = 80, mean age =3.19 yrs, SD = 0.29 yrs). To contextualize potential network variants and distinguish maturation from individual differences, we will first examine developmental change in group average connectivity patterns, delineating brain areas that show differences in cortical connectivity patterns between birth, two, and three years. To examine individual network variants during early development, we will capitalize on a subset of participants with >21 min of high-quality resting-state data after motion censoring (2-9 5.6-min runs, 72 slices,2 mm3 voxels, TE =37 ms, TR = 800 ms, MB factor = 8) at the birth, two year, and three year timepoints (n =2). Additionally, we will use 5 highly sampled precision babies with > 150 min of high-quality resting-state data at birth to examine the development and reliability of network variants during the first weeks of life. As previously, network variants will be examined by computing the similarity between the individual and group average correlation matrices (other details following Seitzman et al.,2019).
Predictions: Developmental changes in whole-brain connectivity patterns between birth and two years will be predominantly in primary sensory areas and the medial hubs of the default network, and changes between birth and two years in average connectivity patterns will be larger than changes between two and three years. We predict that network variants within individuals will be relatively stable between ages two and three years. Precursors to network variants will be visible at birth, but will not be as extensive as later network variants at ages two and three years. **Discussion:** Functional brain circuitry undergoes the most rapid developmental change and is most plastic during the first years of life. Our results will yield important insight into the maturation of and individual differences in functional network architecture during this critical developmental period.

FIT'NG Exhibitors

The 2023 Annual Conference is being supported by the following sponsoring companies, some of whom have exhibits at the conference. Please show your appreciation for their support by learning about their products and services, and for those with exhibits, make time to visit with them while you are at the conference.

Brain Vision

Brain Vision offers cutting-edge research solutions for neurodevelopment research including EEG, tES, TMS, EEG/fMRI, fNIRS, eye tracking, and more. We have solutions specifically designed for pediatric populations and have experience combining the multiple modalities often applied in this field. Brain Vision's Scientific Consultant team comprises research scientists from the neuroscience field with a thorough understanding of your experimental needs. We have offices in the U.S. and Canada, as well as international partners. Reach out to us (info@brainvision.com) or visit our website (www.brainvision.com) to learn more about how our solutions can help you achieve your research goals! Visit us at our exhibit booth!

brainvision.com

Mindware Technologies

Since 2001, MindWare Technologies Ltd. has been the leading provider of hardware and software solutions for psychology, psychophysiology, and broader life science research. Our wealth of domain knowledge and years of experience have allowed us to develop innovative data collection equipment and the industry gold standard data analysis software, all of which are built on a foundation of peer-reviewed scientific research. As your partner in research innovation, we will help you stay one step ahead. Whether you study life or social science, child or adult behavior, neuroscience or psychophysiology, MindWare will be there. Our technology, integration, training, and unparalleled support ensure your research success. MindWare provides an array of physiological data collection devices, integrations with additional third-party data collection devices, and analysis software. Most commonly MindWare is used for the collection and analysis of EKG (for Heart Rate Variability), Skin Conductance, Impedance Cardiography, Blood Pressure, and Electromyography. We also provide complete laboratory design with comprehensive start to finish installations, analysis conducted by our trained professionals, in-person workshops/seminars, and much more!

mindwaretech.com

NIRx

NIRx Medical Technologies, LLC is a leading provider of comprehensive solutions for functional near-infrared spectroscopy (fNIRS) research. Our non-invasive and user-friendly fNIRS technology enables the measurement of neural activity in the cortex and large-scale cortical networks, providing insights into the neural mechanisms underlying perception and cognition. Our complete range of research solutions includes a versatile multimodal hardware platform, advanced online and offline analysis software, expert technical and scientific support, and comprehensive training programs. We are dedicated to supporting fNIRS researchers through our offices in Orlando, New York, and Berlin, Germany. Whether you're investigating changes in neural activity during development, researching disorders and their treatments, or exploring new applications in neuroscience, NIRx has the expertise and solutions to help you achieve your research goals. For more information, please contact us at +49 308 1453 5990 (EU), (+1) 321-352-7570 (US/Canada), or email us at consulting@nirx.net. Visit us at our exhibit booth!

nirx.net

TracInnovations

TracInnovations is a Danish company established in 2015, focusing on innovative solutions for image-based diagnosis and treatment. TracInnovations has developed the Tracoline system, which is an MRI Markerless Motion Tracking System that records patient's head movements during brain scans. The system is used for MRI neurology within research to enable Retrospective and Prospective Motion Correction. Visit us at our exhibit booth!

tracinnovations.com

FIT'NG Sponsors

THANK YOU TO OUR SPONSORS!