



**SPRING 2020:** NEWS FROM THE UNIVERSITY OF MINNESOTA

# Gunnar Lab for Developmental Psychobiology Research



## Greetings from Professor Megan Gunnar:

The Gunnar Lab research team studies stress and its regulation and the impact of early life adversity on children's development. This is our annual newsletter informing you who have been in our studies about our progress and results. We began this newsletter before the coronavirus became a pandemic. However, it seems now more than ever that understanding how children cope with stress and the physiology that translates psychological stress to changes in brain and body are important topics. We know that many of you are coping with a lot of stress

right now. If you are not suffering from financial shocks, you are likely working at home while managing children who you are now suddenly home schooling. For those of you who are working in health care or other essential services, you are our heroes. These are unprecedented times.

As you have probably heard, the UMN made the decision not to have students return after spring break. Instead, spring break was extended two days to give the faculty time to scramble to put our teaching on-line. Beginning on March 18, we were back up and running on-line. Those teaching large classes had videotaped their lectures and posted them and devised class activities that students could do on-line. Those teaching smaller classes were connecting on Zoom and sharing their screens so student could see their slides. It has been a big adjustment for students and faculty. We worry deeply about our students who live alone and are very isolated. We also worry about those for whom being at the University

in the dorms was a safe place to be. Finally, we worry about our international students who cannot get home and the UMN is working diligently to try to get students who were studying abroad back home to their families. All face-to-face research projects are on hold, which means many of the Gunnar Lab studies are not collecting data right now. However, we are still contacting families, gauging interest in the various studies we are running, and collecting names to be re-contacted and scheduled once we can actually see participants.

We know that you are juggling a myriad of new duties or old duties that need to be done in a new way. We are collecting information that might be helpful to families and sharing those links on our Facebook page: <https://www.facebook.com/IAPumn/>

Again, thank you to all the families who have taken part in our research. We hope you find these stories about our research interesting.

*Regents Professor Megan Gunnar*

# How early life experiences can shape the immune and the gut microbiome

By Brie Reid

Inside our bodies and on our skin, trillions of microorganisms from thousands of different species coexist together and help our human body function. We call all these microorganisms the “microbiome.”

“Picture a bustling city on a weekday morning, the sidewalks flooded with people rushing to get to work or to appointments. Now imagine this at a microscopic level and you have an idea of what the microbiome looks like inside our bodies, consisting of trillions of microorganisms (also called microbiota or microbes) of thousands of different species.”

(Quote from Harvard TH Chan School of Public Health)

environmental exposures can change our microbiome’s composition. This change can either be good for our health or could increase our risk for disease. The microbiome, especially the gut microbiome, is important to immune system development and the communication between our brain, our immune system, and our microbiome during development may influence our mental and physical health later in life.

Understanding the role of the gut microbiome in health and disease is at the forefront of neuroscience and psychiatry research. In this study, we examined the diversity and composition of the gut microbiome using in fecal samples from adolescents adopted internationally as infants and toddlers into the United States from institutions (orphanages) and adolescents reared in their birth families in the United States. We found that exposure to early life adversity resulted in microbiota-immune changes that persisted into adolescence.

Each person has their own unique microbiome: it develops over time as we grow up and experience the world around us. Our microbiome is influenced by environmental and genetic factors. As we grow, what we eat and

We found compositional differences in the amount of type of microbes in the guts of adolescents adopted from institutions and those born and raised in Minnesota all their lives. Everyone had the same type of microbes, but

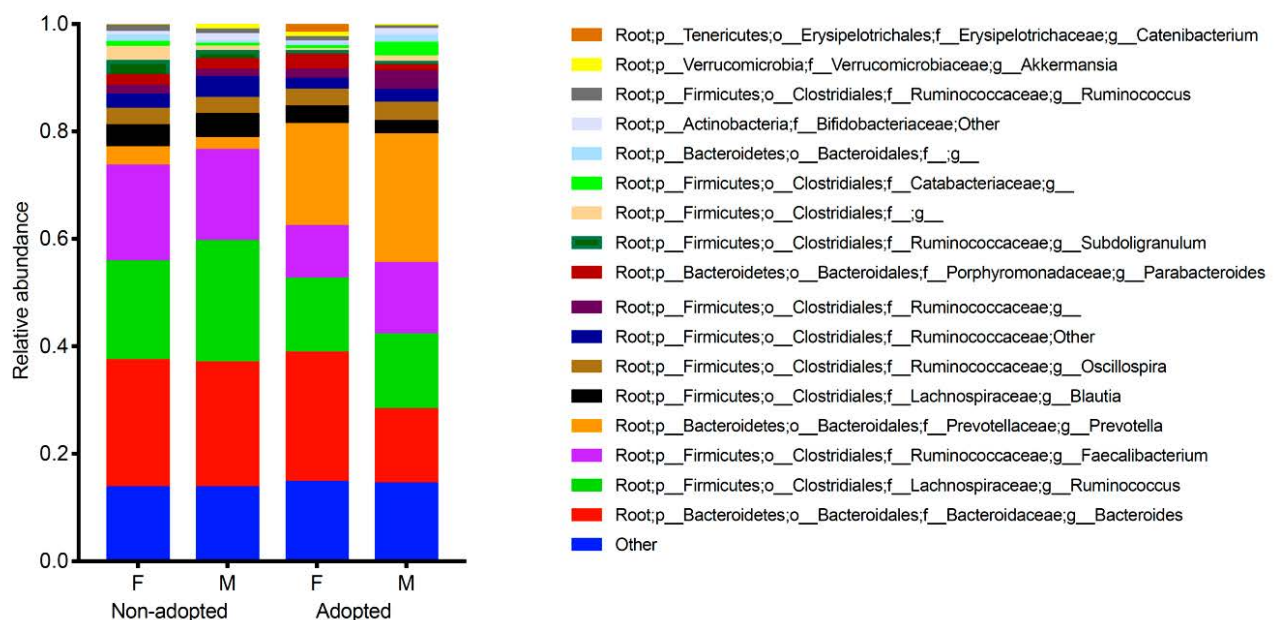


Figure 1. Compositional differences of the microbiome in each group of adolescents.

they differ in how many of each they had. This is called Beta diversity.

You can see these compositional differences (Beta diversity) in Figure 1 and Figure 2. Figure 1 shows the compositional differences of the microbiome in each group of adolescents, and is broken down by sex. In Figure 2, every column of colors represents one person's microbiome. We look at compositional differences by comparing the taxa (types of microbes) represented between individuals and groups through the blocks of color in the columns. For example, notice how there is a greater abundance of *Prevotella* in the adopted adolescents compared to the non-adopted adolescents (shown in orange). *Prevotella* is an abundant bacterial taxa that has been previously associated with diet but also with infection. We also found that several bacterial taxa including *Bacteroides* and *Coprococcus* were also higher in adopted youth.

Three things are noteworthy. First, your gut microbiome reflects what you eat. Since these adolescents were

adopted as infants and toddlers, they were eating diets similar to the non-adopted comparison adolescents. Yet, their microbiota look different from our comparison adolescents. This suggests that, as found in animal studies, there might be an early period when the basic pattern of our gut microbiome gets established. Second, the adolescents in this study came from many different countries and probably did not have the same early diet. So, it is likely something other than diet shaped their gut microbial diversity patterns. The particular taxa (types of microbes) that are more prevalent in the adopted adolescents are associated with stress. Thus, it is possible that stress is what is similar across the adopted youth. Even though they come from different countries, the stresses associated with being raised in an institution may be what is contributing to similarities in adopted youth's microbiome. Third, Figure 1 is the average. In Figure 2, you can see each individual and it is pretty clear that the average is a fairly good reflection of most of the participants, even though the adopted adolescents came from different countries and parts of the world.

Last year we told you that when we studied these adolescents, plus a number more who were part of our [Immune Study](#), we found that their immune systems also revealed a signature of their early experiences. Notably, their T-cells, which are the part of the immune system that searches out and destroys invaders, were more likely than those of non-adopted youth to be tagged with a protein called CD57. This protein gets attached to T-cells that have done a good deal of "battle" and are beginning to get "too old to fight" (T-cells go through a life cycle like we do). This doesn't mean that the adopted youth could not fight off infections, but rather that their T-cells told a story of having had to fight more when they were younger than the T-cells of the non-adopted youth. This makes sense because institutions are places where children are exposed to many pathogens. Indeed, nearly all of the adopted youth carried evidence of exposure to one common pathogen, CMV (which causes cold sores), while only a few of the non-adopted youth did.

*Microbiome, to page 5*

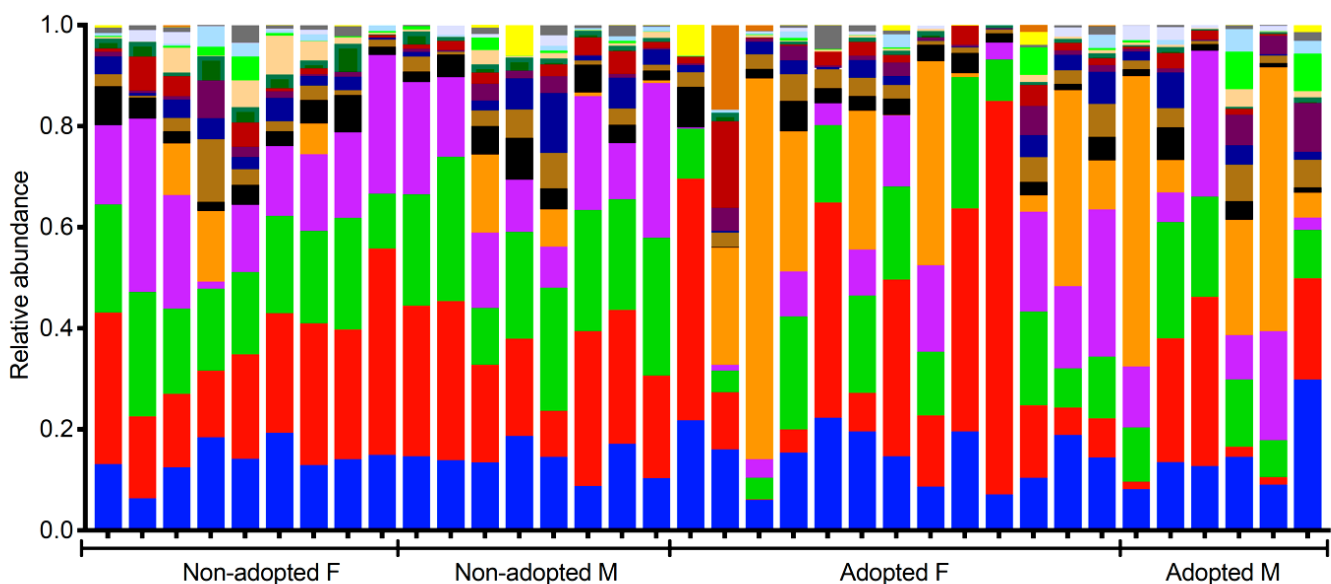


Figure 2. Every column of colors represents one person's microbiome.



# Can You See What I See?

By Emmy Reilly, Milena Cornejo, and Shanna Mliner

**J**oint attention, a child's ability to follow the gaze or point of another person to an object, is an important early skill that helps children develop language and other social skills. Joint attention develops in the 2<sup>nd</sup> year of life, beginning when the child first looks where someone is pointing. For example, an adult might say "Look, Anna" and point, and the child looks at the right spot. Once fully developed, the child will only need to see the adult turn their head and look, and they will also look. Psychologists have studied the development of joint attention for a long time because it is foundational for language development. For example, a father points to a ball and says, "that's a ball." If the child can't join his attention with his father's the child can't associate the word "ball" with the ball. Joint attention capabilities develop over the toddler period, and as joint attention develops it reveals the child's growing understanding that other people have minds and that humans can have a meeting of the mind, which is what joint attention allows.

Our collaborator on this project, [Dr. Jed Elison](#), designed a new, more natural way to measure infant joint attention skills during play. We wanted to see whether we could use this measure in pediatric primary care clinics. The play-based joint attention task went very well in the clinic



and we see a wide range of joint attention skills in this setting. Also, as we expected, we saw an association between the number of words an infant understands and their joint attention score.

Some developmentalists argue that joint attention development is not affected by your experiences. However, we know that factors like family education and income are strongly related to language development and might also be related to joint attention, the skill that helps children learn words. The families who participated in the Toddler and Attention Study came from a range of economic and

educational backgrounds. Just under half of the families would be considered living in or near poverty (150% or less of the federal poverty index). When we examined the association between family income and joint attention we found that the most affluent families had toddlers who were more oriented to joint attention than other children. Indeed, as you can see in Figure 3, joint attention gets better with age, but it also tracks family income as a percentage of the federal poverty level (FPL).

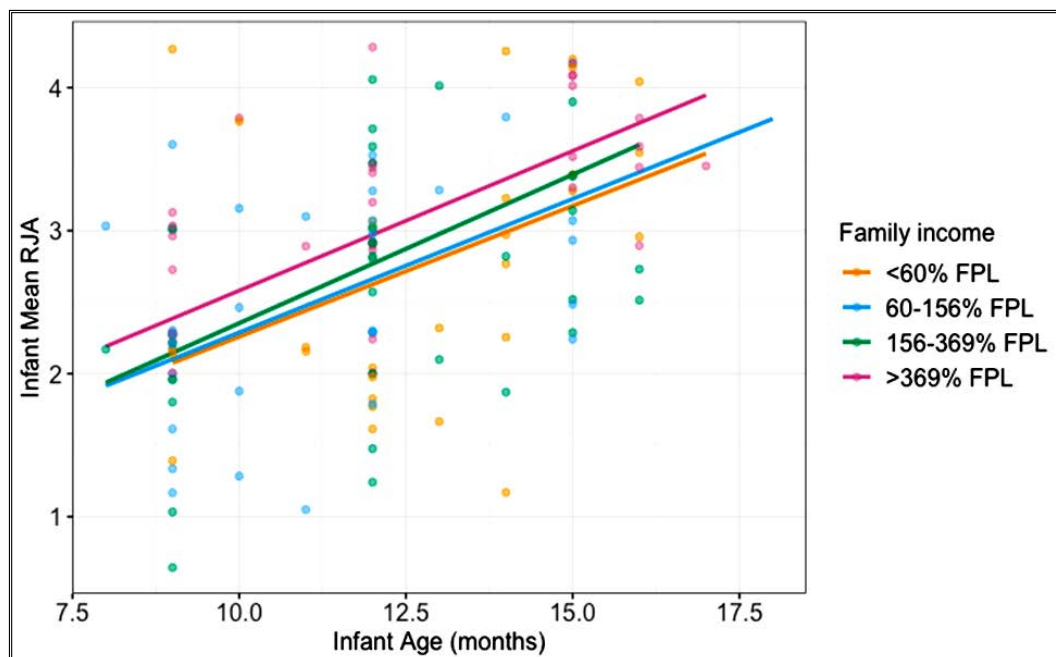


Figure 3. We found that joint attention gets better with age, but family income also plays a role.

Children in low and middle-income families have similar joint attention scores, only children in the most wealthy families had higher scores. This finding is important because, again, it argues that opportunity and educational gaps have their origins long before kindergarten and preschool. We can already see the outlines of Minnesota's serious achievement gap by the time children are 18 months of age.

We also wanted to know whether we could capture the infant's joint attention ability from a tablet game, because this would be much easier to do at pediatric primary care clinics around the country than the interactive play assessment. For the tablet game, infants watched a video

of two cartoon characters named Joseph and Maria point and look at different objects on the screen while we measured the infant's eye movements. Although all infants paid less attention to Joseph and Maria towards the end of the video, we found an association between how consistent infants were in demonstrating their joint attention skills during the play assessment and how often they looked at Joseph and Maria, (shown in Figure 4). This suggests that we are on the right track in developing a tablet tasks (and maybe ultimately an app) to measure joint attention outside of a research lab, in places where many children could be screened for problems that might impede their language and social development.

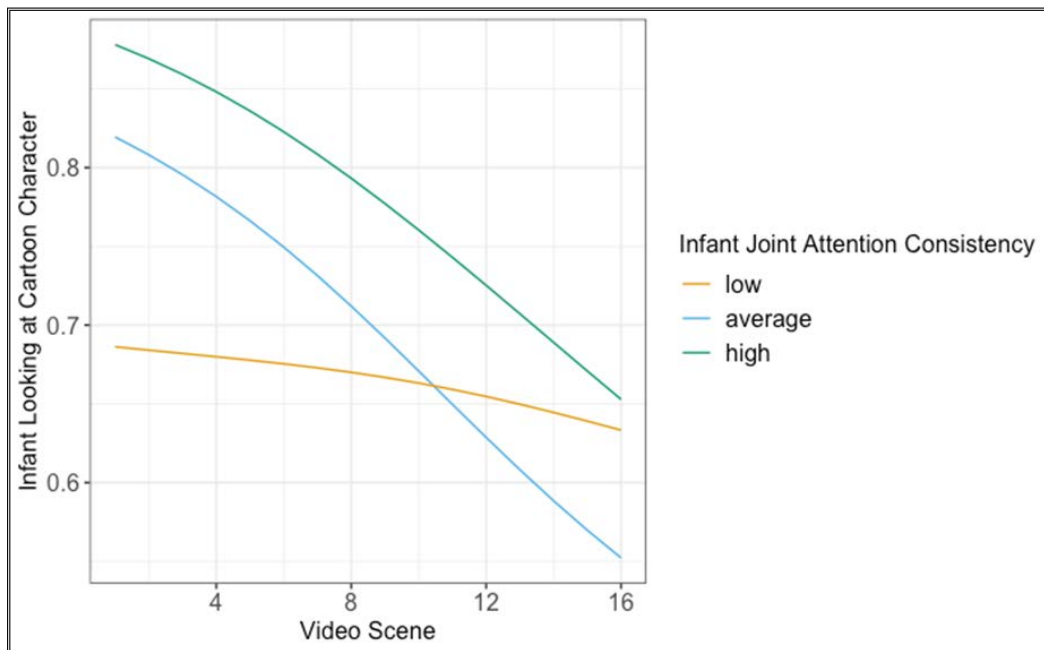


Figure 4. Infants who paid more attention to the cartoon characters in the tablet task were more consistent in demonstrating their joint attention skills during the play-based floor task at their pediatric well-child visits.

### Microbiome, from page 3

Animal studies show that the gut microbiome helps shape the immune system. So we were interested in whether our T-cell findings were related to our microbiome results. We found that they were. The ratio of T-cells tagged with CD57 protein was associated with a certain elements of the gut microbiome. One of the associations was with a bacteria, *Alistipes*. This is interesting because *Alistipes* has been suggested to play a role in microbe-immune interactions that influence risk of stress-related outcomes.

What does all this mean? First, it means we need to do

more research to check that our findings are solid. There were only a few participants in this microbiome study because it was what we call a pilot study. A pilot study is a small study where we see if there is something there to study in the first place. Now we need to do a larger study, and for that we will need to write a grant. Second, no one yet really knows what the health implications are of different patterns of microbes in your gut. More than likely the pattern we see in the adopted youth has its minuses and pluses. Third, it reinforces all of the findings we are obtaining that say that the first year or so of a child's life matters. At the same time, we need to remember that in many ways, the youth in our studies who were adopted from orphanages and other institutions are doing remarkably well. Thus early matters, but so does later.

# Preschool Attention Study

By Milena Cornejo, Emmy Reilly, and Shanna Mliner



1) whether we could administer the MEFS during a well-child visit, 2) whether it is acceptable to parents, and 3) whether child scores on the MEFS are the same during a pediatric well-child visit as they would be in the research lab.

We are meeting children and their families when they come in for the regular pediatric well-child visit. At a convenient point during the visit, we administer the MEFS. The children in the study are between 2 and 5 years old and

we are tracking many of them across 3 years to see how their MEFS scores develop.

In Figure 5, you can see the range of MEFS scores from the children during our first round of clinic sessions. We found that the average scores in the clinic (44.7) are a bit lower than the measure's average (50). This probably means that interpretation of the scores will need to be adjusted because a well-child pediatric visit is not the typical calm setting in which the MEFS task is usually administered. So far, we have completed the first year of this study and are excited to see how children's EF skills improve in the second year of this study.

**E**xecutive function (EF) is a set of mental skills including working memory (keeping things in mind), cognitive flexibility (changing strategies to solve problems if the old strategy stops working) and inhibitory control (what you need to be able to play Simon Says, for example). Neural systems allow EF to develop early but it takes until adulthood for EF to be fully developed. These skills are critically important to school and life success. Therefore, it would be good to catch children who are delayed in these skills early, because these skills can be trained and strengthened.

To catch children early we need to catch them where they are at. One thing that most children experience are the pediatric well-child visits. Would it be possible to test children's EF skills quickly during a pediatric well-child visit so we could identify children who would need help in building their executive function skills? [Stephanie Carlson](#) and [Phil Zelazo](#), professors in the Institute of Child Development at the University of Minnesota, have created a tablet task that takes about 5 minutes to administer and assesses executive function. It is called the Minnesota Executive Function Scale (MEFS). We designed the Preschool Attention Study in partnership with Children's Minnesota to see

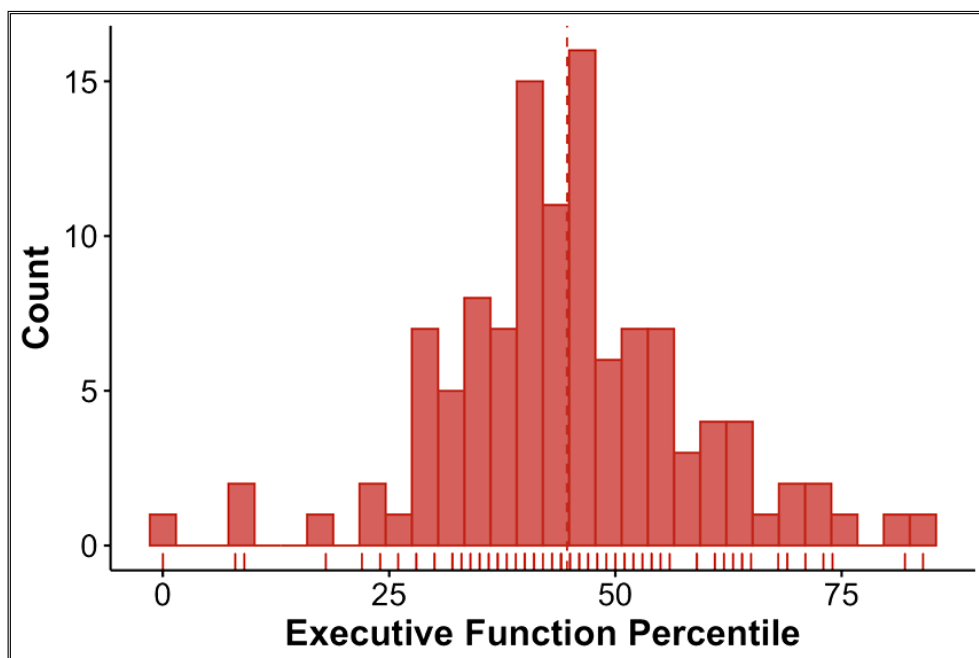


Figure 5. Range of MEFS scores of children ages 2 through 5 participating in the Preschool Attention Study.

# Adoption Conversations in the Family, Adoptive Identity, and Mental Health

By Sohee Irene Lee and Mariann Howland

**R**esearch has suggested that adopted children may be at higher risk for mental health difficulties, even though they are adopted into supportive families. Among the unique challenges that adoptees encounter are (1) finding their adoptive identity, (2) their personal thoughts and feelings about their adoption and (3) how that fits into their understanding of themselves. Open adoption-related conversations in the family may help adoptees feel more comfortable about their adoptive status. To our knowledge, no research has considered whether these adoption-related factors are associated with mental health symptoms among previously-institutionalized, internationally-adopted youth.

This study, led by undergraduate student Sohee Irene Lee, looked at relationships between adoption communication openness in the family, adoptive identity, and internalizing (i.e., depression and anxiety) and externalizing (i.e., aggression, defiance) symptoms among 36 previously-institutionalized adopted youth.

All participating youth were internationally adopted from institutions at a young age. At the time of participation, youth were between 11 to 21 years of age. Twenty-two were female and 14 were male. These youth originated from 13 different countries (33% from Russia, 28% from

China, 11% from India and the rest from a range of countries). Participation involved an online questionnaire completed by these young people.

We found that higher levels of adoption communication openness in the family were associated with lower levels of internalizing symptoms (shown in Figure 6). Also, higher levels of adoptive identity (degree of exploration and commitment to one's adoptive status) were associated with lower levels of externalizing symptoms (shown in Figure 7).

Because all measures were collected at the same time, we are not able to conclude that open adoption conversations and adoptive identity lead to better mental health outcomes (the relationship could also go in the other direction, with less mental health difficulties promoting more open adoption-related conversations in the family and adoptive identity). These findings suggest that improving open communication about adoption in the family may support the adoptive identity and mental health of adopted youth. These findings have implications for developing possible interventions, such as increasing the frequency of open, adoption-related conversations in the family.

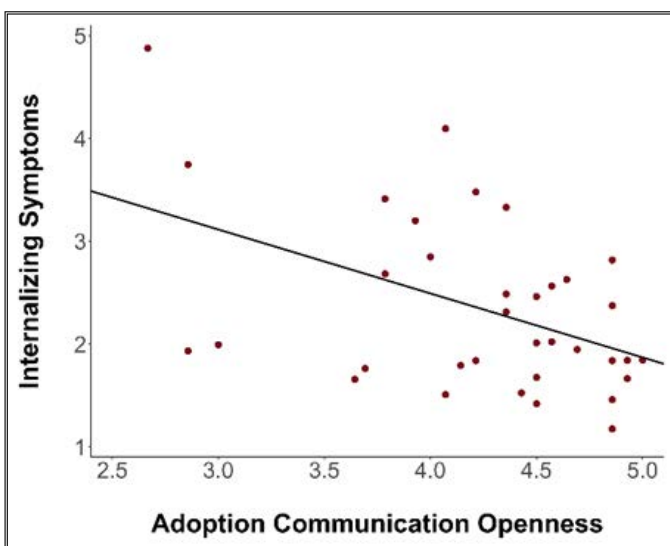


Figure 6. Youth experiencing more open communication about adoption in their families experienced less internalizing symptoms.

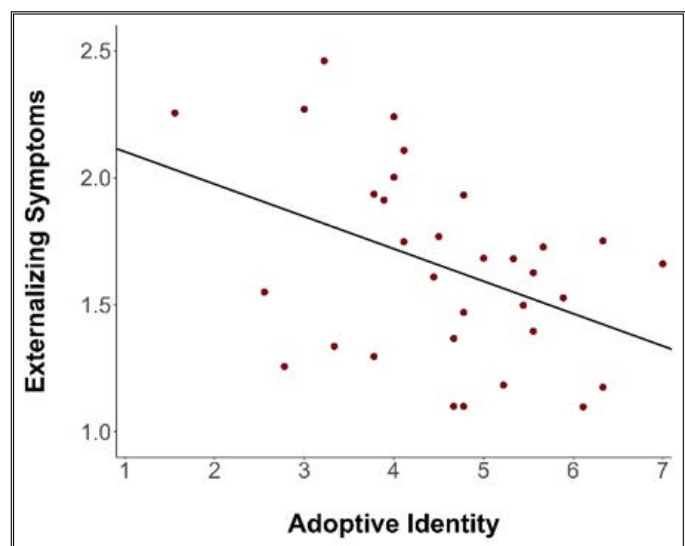


Figure 7. Youth with higher level of adoption identity experienced lower externalizing behaviors.



# How Do Early Life Stress and Current Life Stress Influence Adolescents' Physical Growth?

By Danruo Zhong

A previous study ([Reid et al., 2017](#)) from our group found that children who spent their early life in institutional care (e.g., orphanages) have a higher risk of growth stunting at the time of adoption. But the good news is that once they were placed with warm and well-resourced families, most children rapidly caught up to normal height and weight, although they remained shorter and thinner than children born and reared in Minnesota for at least several years after adoption.

Puberty, however, brings another rapid period of growth. In an early study of children adopted from Romania into England, at puberty previously institutionalized youth grew less than other youth and thus ended up even shorter relative to others by the end of the pubertal growth spurt.

We wondered whether this would be true of children adopted from less dire circumstances than those children who first came out of Romanian institutions in the 1990s. Stress slows growth quite literally. Stress hormones reduce the production and power of the growth hormone system. This is probably because when you are experiencing stress and threat it is not the time to put energy into growth. Thus we wondered whether youth who were experiencing more stress might show less of a pubertal growth spurt.

To answer these questions, we examined data from a study we conducted on puberty and its relations to children's functioning. In this study, we had children who were 7 to 14 years at the beginning of the study and then we

assessed them at yearly intervals for several years. Each time we saw them we assessed their pubertal development and their height, weight and weight-for-height or body mass index (BMI). Roughly half of the children had been adopted internationally from institutional care and half were born and raised in their birth families here in Minnesota. We did not find any group differences in linear (height) growth, as seen in Figure 8. Previously institutionalized (PI) youth were shorter at the beginning of the study and they remained shorter but growing at the same rate as comparison non-adopted (NA) youth. Stress was not related to linear growth for either group.

All of the statistically significant differences were in BMI. At visit one, the previously institutionalized (PI) youth were thinner than the comparison non-adopted (NA) youth (see Figure 9), but over this pubertal period their BMIs increased more rapidly. By the third visit, two years after, there was no significant difference between the groups. What this may mean is that if this continues into adulthood, a history of early institutional care may put the person at risk for being overweight. To know this, though, we will need to conduct a study of adults who were adopted from institutional care as infants and young children.

As for stress during the pubertal period, here we found that it was associated with more rapid increases in BMI for both groups of youth. This last finding is rather striking because, for the most part, the youth in this study were not experiencing high levels of stress. Yet even in this range, stress was associated with increasing BMI.

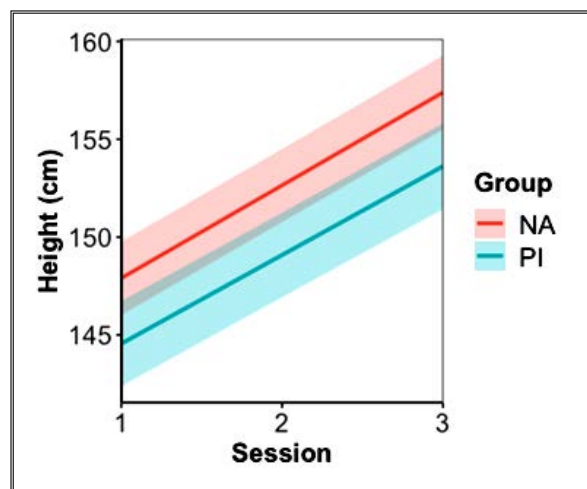


Figure 8. There were no differences in linear growth, even though PI children started the study shorter in stature, they were growing at the same rate as the NA group.

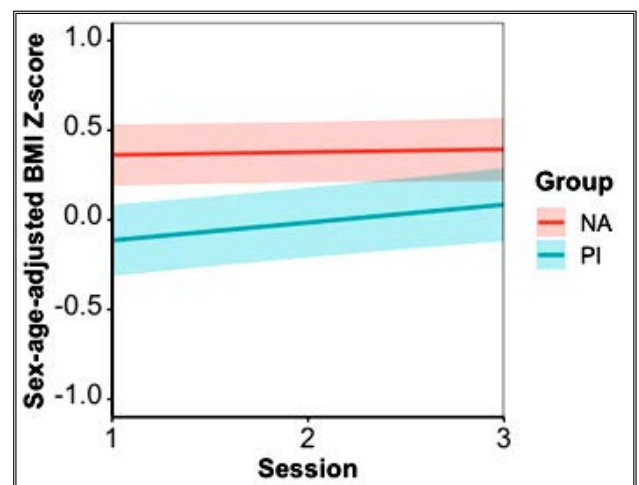


Figure 9. BMI differences between previously institutionalized and non-adopted youth during pubertal development.



# An Update: Data Collection for the Women and Infants Study of Health, Emotions, and Stress (WISHES)

By Colleen Doyle

For the past three years, the Woman and Infants Study of Health, Emotions, and Stress (WISHES) has been collecting data to learn more about how women experience and cope with stress during pregnancy, and how stress might impact fetal and later infant development. To do this, we have enrolled 115 women and followed them and their developing children from early in pregnancy through the first few months of life. Enrollment was completed in January 2020, and we are currently working on finalizing data collection with active participants.

From a research perspective, *prenatal stress* is an umbrella term that can encompass many experiences that

drive us “N.U.T.S.” in that they are *Novel, Unpredictable, Threatening to our survival or our sense of self*, and they foster a *Sense of lacking control*. This can include frustration with daily hassles, coping with uncertain or difficult life circumstances, and managing symptoms of anxiety or depression. Any pregnant woman can experience stress when she has more things coming at her than she can manage.

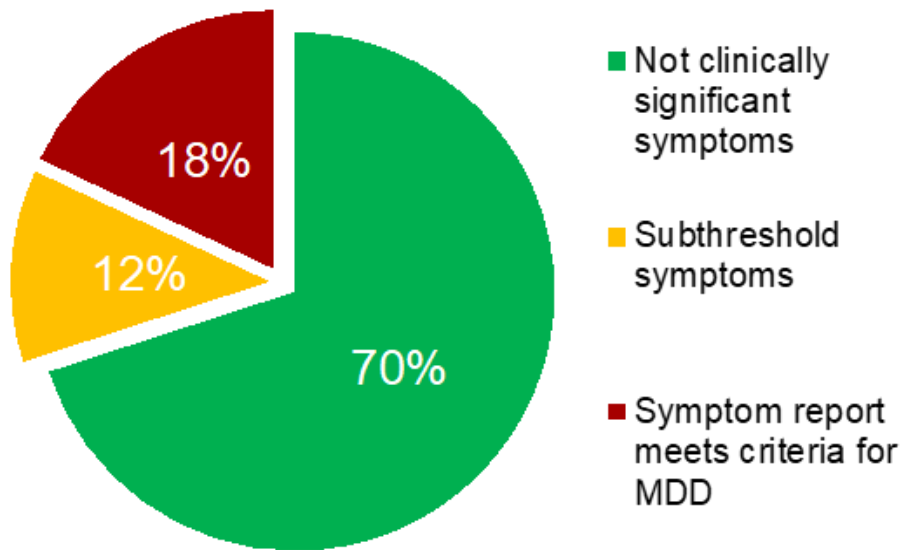
A growing body of research has linked different levels of prenatal stress experiences to both positive and negative outcomes for women and their developing children. The mechanisms that link women’s experiences during pregnancy to long-term child outcomes are complicated



and not completely understood. However, recent research suggests that prenatal stress might influence child outcomes by impacting the *in utero* environment that helps shape brain development before birth. Some central research goals of the WISHES Study are to: (1) Understand what “prenatal stress” looks like across



## Depressive Symptoms



pregnancy when measured by self-report questionnaires and by levels of a stress hormone, cortisol, taken from collected samples of hair strands; (2) Examine the influence of prenatal stress on fetal development, as measured by fetal heart rate and fetal heart rate variability (FHR, FHRV) which are two well-established indices of central nervous system development; (3) Test whether cortisol levels are associated with self-report measures of stress, or whether cortisol levels may mediate or explain any associations between self-reported stress and differences in fetal development.

To help us address these goals, participants complete questionnaires on stress, emotions, and health behaviors 5 times during pregnancy and 1 time after pregnancy. At 3 time points during pregnancy and 1 time point following pregnancy, women also provide a small hair sample, which allows us to measure cortisol production during pregnancy. Cortisol is a hormone that helps our body cope and respond in challenging situations. During pregnancy, cortisol also helps mature fetal tissues, such as the lungs, and may impact the development of the central nervous system and brain. At 4 time points during pregnancy, women also complete fetal monitoring sessions, which involve placing electrodes on the woman's belly to measure her baby's resting heart rate with fetal electrocardiograph methods. We look at fetal heart rate because it is a "downstream" marker of fetal brain maturation; as central nervous system development unfolds during pregnancy the brain increasingly controls the heart, and in turn resting heart

rate patterns show expected patterns of organization and change. Therefore, by measuring changes in resting fetal heart rate during pregnancy we are able to understand how prenatal experiences may play a role in setting up different trajectories of brain development.

To date, 95 women and their children have completed all visits and we are nearing the end of data collection! As data collection is ongoing, we are not yet able to report on any significant findings. However, preliminary results continue to

show that at enrollment, 18% of participants report clinically significant levels of depression or anxiety, meaning these levels of symptoms are impacting their day-to-day functioning and meet criteria for diagnosis and treatment of major depressive disorder or generalized anxiety disorder. This preliminary finding aligns with prevalence rates reported by previous studies examining these types of prenatal stress. Our preliminary results also continue to show an additional 12% of women are reporting "sub-threshold" levels of symptoms at enrollment, meaning they are reporting meaningful but more moderate levels of depression or anxiety and are not yet or currently meeting criteria for clinical diagnosis or intervention. Typically, OBs, midwives, and other health providers recommend these women be monitored closely as they are more likely to benefit from or need intervention and support at some point during pregnancy or the first year following birth. Finally, 70% of women report non-clinical levels of symptoms at enrollment, meaning this level is well under the threshold for either diagnosis/treatment or ongoing monitoring. Our next steps for analyses are to better understand the longitudinal course of self-reported symptoms and stress levels. For example, we want to know if women who report high levels of stress at the beginning of pregnancy are likely to remain stressed throughout pregnancy, or if these levels will decrease. Also, we will examine what characteristics may be associated with a woman reporting prolonged or increasing clinical levels of stress, versus women whose stress levels decrease or remain low, such as levels of social support,

coping skills, personality traits, pregnancy symptoms (nausea, fatigue), and life events.

Additionally, we are seeing some interesting results from our hair cortisol samples suggesting that analyzing data at the level of 1 cm hair segments may yield important information about the variability in stress hormone output at different times during pregnancy. On average human hair grows approximately 1 cm a month, and our daily cortisol output is incorporated into hair strands as they grow. This means that the 1 cm of hair growth closest to the scalp represents a “stress calendar” of cumulative cortisol output over the last month. The use of hair samples to retrospectively create a calendar of cumulative stress hormone output is a relatively novel methodology for the field of developmental psychology. Currently, research shows that the 3 cm of hair growth closest to the scalp reliably reflects cortisol output over the past 3 months; hair growth beyond this 3 cm length is thought to inaccurately represent stress hormone production due to “washout” effects related to habitual hair care. For the WISHES study, we collect three hair samples at 3, 6, and 9 months of pregnancy and put together a retrospective stress calendar stretching across gestation. However, WISHES is one of the first studies to analyze hair cortisol concentrations from 1 cm segments instead of 3 cm segments. Typically this is not done due to cost of analysis per segment. Also, most research studies may not require data within a narrow, one month period. However, since

development occurs at a rapid rate over pregnancy, for the WISHES study we are interested in examining cortisol output at a more precise increment of time. This will also allow us to better explore the possible association between cortisol levels and self-report levels of stress, which are also collected at one month time intervals. So far, our preliminary results show interesting differences in cortisol output when examined at a 1 cm/1 month time period versus averaging those values over 3 cm/3 month time periods, as seen in Figure 10. We hope that this means our study will be able to contribute new data on the typical trajectory of cortisol output during pregnancy, how it may be associated with self-reported stress, mood, or anxiety symptoms, and how it may be a potential way women’s experiences of prenatal stress at different time points during pregnancy may “get under fetal skin”.

We think our study has the potential to make important contributions to how parents, health care providers, and policy makers can help set up lifelong trajectories of health and well-being by supporting women’s mental and physical health during pregnancy. We are so grateful to all the women and families who have participated, as well as all the many research staff on the WISHES and Gunnar Lab team who have contributed to this project! We look forward to sharing more results next year!

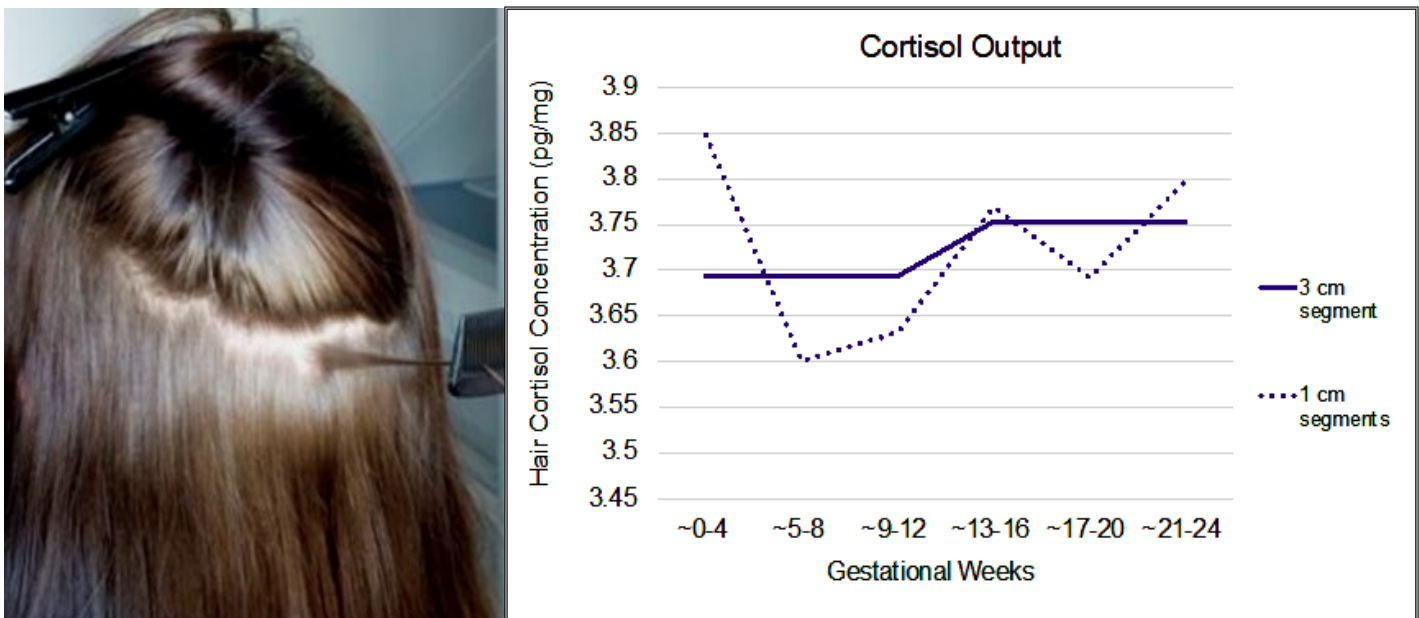


Figure 10. Differences in hair cortisol when sampling 1 cm vs 3 cm during prenatal period.

# MRI Study of Stress and Social Support

*Overcoming obstacles in order to study the brain during a standard social stressor.*

By Bonny Donzella



TSST stressor task for use in an MRI so that we can see the brain at work. There is a math-only version with adults that works for them, but the same task for children and adolescents doesn't increase cortisol at all. We decided to take the whole TSST into the MRI scanner. We are calling this task the Minnesota Imaging Stress Test in Children (MISTiC Study). It's a tricky thing to get pictures of the brain (which requires the person to lie very still) while they are giving a speech/doing math/and being judged (which tends to make people move). Plus, the MRI can itself be stressful, which changes the whole nature of the task.

**T**here is a standard task that is often used to study stress responses in the laboratory. People give a speech and perform mental arithmetic aloud in front of judges while being filmed. The film, they are told, also will be rated. For most people, this is a challenge, and the body responds by producing an increase in cortisol. This hormone is sensitive to stress and prepares the body to use extra energy the challenge requires.

This speech/math task, called the Trier Social Stress Test (it was developed in Trier, Germany) is inherently social—the threat of social evaluation seems key to the cortisol response. What we know from previous work: If you are a school-age child, having a parent present during the task reduces the size of the response. If you are a teen, having a parent present doesn't seem to help as much. If you are a teen, having a friend present may make it worse not better, but this needs more study to understand when & why. When the presence of others helps reduce stress, this is called “social buffering”.

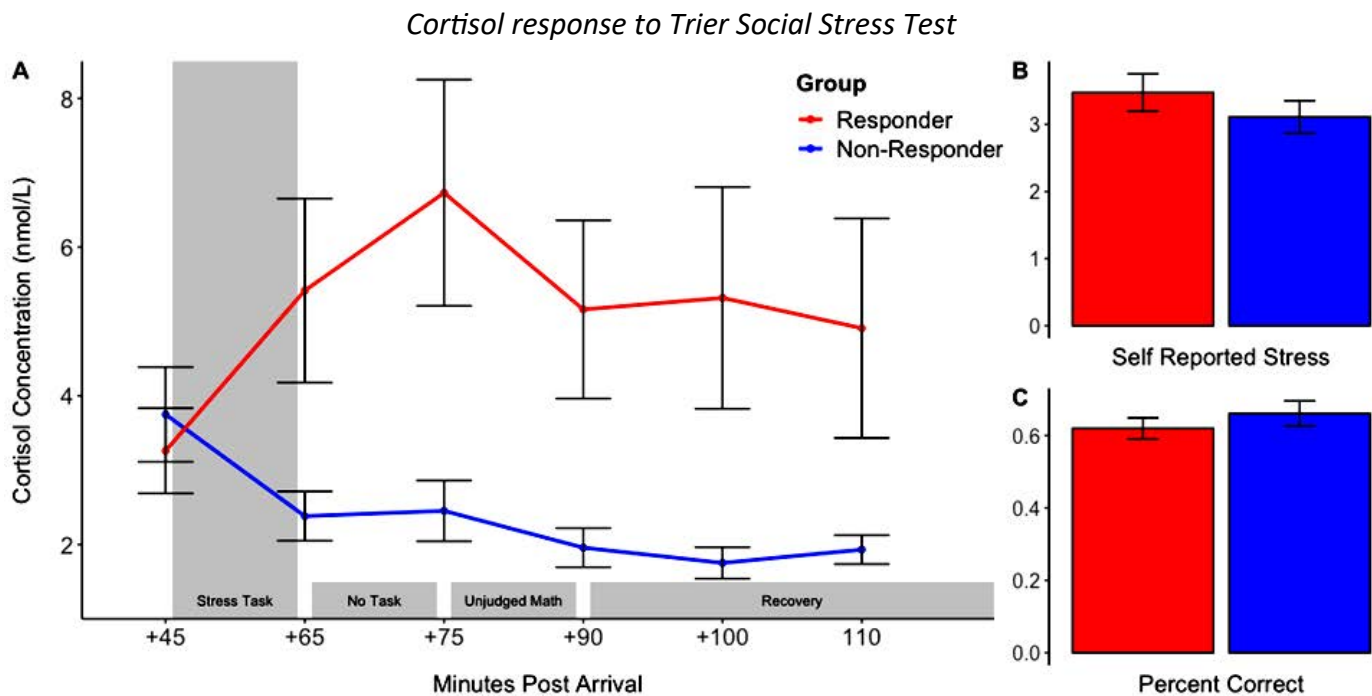
Cool. But, there remains one large gap in our knowledge. What is happening *in the brain* during social buffering? Many labs around the world have tried to adapt the

We've done it! Max Herzberg, Ruskin Hunt, Kathleen Thomas, and Megan Gunnar teamed up to demonstrate the cortisol response to speech and math (and NOT to the scanner) during MRI. Yay! See Figure 11.

Further, we found differences in the brain during the stressor compared to non-stress conditions during the session. Specifically, we found robust task effects in the anterior cingulate and insula. The anterior cingulate is thought to play a role in cognitive functions including error monitoring. The insula is associated with processing social exclusion and evaluation. These both seem quite relevant to the threat of being judged for performance in the task!

But, “what about social buffering”, you say? I'm SO glad you asked! In our latest study, we have begun to explore different social partner conditions as participants perform the speech/math task in the MRI, and we are seeking families to help us learn more!





**Figure 11.** Note that not all people respond to the stressor, and we have separated participants into groups accordingly. (A) Mean cortisol concentrations in cortisol responders and non-responders during completion of the paradigm, beginning with the sample acquired immediately prior to the stress task. Light gray shading indicates the stressful portion of the task. As expected, the peak cortisol response in the responder group occurs approximately 20 minutes after the stressful portions of the task. Error bars indicate  $\pm 1$  SE from the mean. (B) Self-reported stress during the math task; higher values indicate more perceived stress out of a maximum of 5. Group differences were not significant ( $p > 0.05$ ). (C) Accuracy (percent correct) on math problems during the judged math portion of the scanning session. Group differences were not significant ( $p > 0.05$ ).

## PARTICIPATE IN RESEARCH

### MRI Study of Stress and Social Support

We are currently recruiting potential participants who will be invited to the University of MN when restrictions are lifted.

#### Participant eligibility:

- Youth who are between 11-14 years old.
- have never done this speech/math task.
- have no metal in the body that they can't be taken off before going in the MRI scanner.

We invite you to two University visits for surveys, a medical exam, and MRI while giving a speech/performing math. Heart rate and saliva samples will be collected to measure stress hormones. Some participants will be randomly chosen to invite a good friend to come along. Parents

receive a \$10 e-card per visit, and youth receive \$30 & \$40 e-card for visits. **Please email us at [socialbuffering@umn.edu](mailto:socialbuffering@umn.edu) if you would like to participate.** Thank you and we're looking forward to hearing back from you soon!



# Pubertal Recalibration Study Updates

By Megan Gunnar and Mariann Howland

The [Puberty Study](#) continues to provide important insights in the changes with puberty that allow recalibration of stress biology for youth who experienced early adversity due to being reared in institutions (orphanages) prior to adoption. We term them previously institutionalized or PI youth. In our most recent analysis, we examined the production of a hormone called, dehydroepiandrosterone, or DHEA. This is a mild androgen that is produced by the cortex (outer part) of the adrenal gland. This androgen begins to elevate in both boys and girls early in puberty and leads the pubertal sequence. You know it as the hormone that produces pubic hair and changes body odor in both sexes. Not surprisingly, given its function, DHEA increases more and more as puberty progresses. DHEA also responds to stress and is usually correlated with the production of cortisol, a hormone that is often thought of as “the” stress hormone. Cortisol is also produced by the cortex of the adrenal gland.

As we reported last year, in our Pubertal Recalibration Study we found that the cortisol response to delivering a speech in front of judges, while being filmed and then doing math all while being judged, was non-existent at the beginning of puberty for our PI youth. This is consistent with other studies showing that chronic deprivation in infancy blunts the body’s ability to produce cortisol resulting in hypocortisolism. However, we found that as puberty progressed, the PI youth increasingly

showed a normal cortisol stress response.

What about DHEA? Would it act like cortisol? To our surprise, it doesn’t. First, we found no difference between PI and non-adopted (NA) comparison youth for DHEA. It increases with pubertal development irrespective of early life conditions (see Figure 12). Furthermore, with puberty the

association between DHEA and cortisol increases in the PI youth until it is as tightly coupled in PI youth as it is in NA comparison youth (see Figure 13). What we think this is telling us is that recalibration of the cortisol response may be located in the adrenal cortex and not necessarily in the brain that controls the adrenal gland.

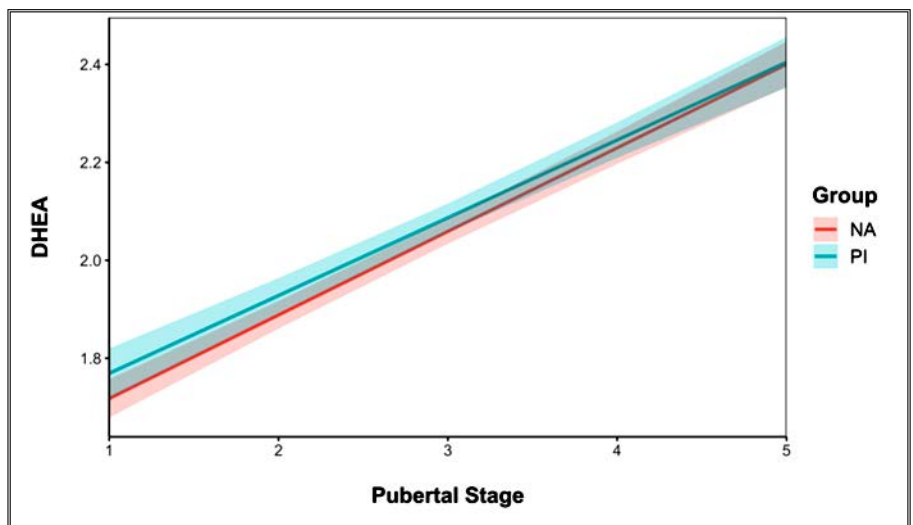


Figure 12. We found no differences in DHEA hormones between PI and NA groups.

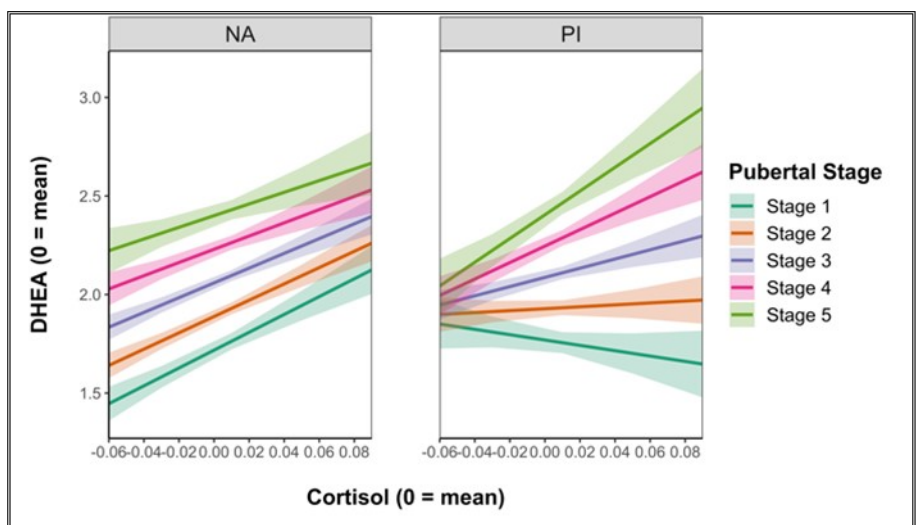


Figure 13. Cortisol and DHEA become more positively associated with advancing puberty in PI youth.

# PARTICIPATE IN RESEARCH

## TODDLER AND PARENT PLAY STUDY

SEEKING PARENTS OF 18-36 MONTH OLDS for an online survey

Emily Reilly, PhD student at the Institute of Child Development, is leading a research study to understand parent's emotional lives and how parents and toddlers play together. This study is looking for parents of 18-36 month old toddlers to complete an online survey. Participants will receive a \$10 gift card upon survey completion.

If interested, you may be invited to come to the University of MN for a 1-hour visit with your toddler. Participants will receive a \$40 debit card and your toddler will receive a small toy for this specific part of the study.

If you are interested in participating or have any questions regarding the study, please contact us by emailing [toddlerandparentplaystudy@gmail.com](mailto:toddlerandparentplaystudy@gmail.com) or text or call us at (612)-351-0768.



## ARE YOU...

- ☒ Asian American?
- ☒ In an interracial relationship?
- ☒ With a White/European American partner?

### Consider Participating in a Research Study about Your Experiences!

Complete a 1-hour survey remotely through a video call. You will be compensated with a \$25 Amazon eGift card.

#### You may be eligible if:

- You are between 18-35 years old
- You were born in the U.S. or immigrated to the U.S. at or before age 10
- Your relationship is between 6 months and 5 years
- You are not currently raising any children

To sign up, go to: [z.umn.edu/airstudy-remote](https://z.umn.edu/airstudy-remote), email [familee@umn.edu](mailto:familee@umn.edu), or scan the QR code



Researchers: Dr. Richard Lee & Christine Wu  
University of Minnesota Psychology Department  
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NHCC IRB Approval: 200228\_Matchinsky

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#### **ONLINE EDITION**

[www.innovation.umn.edu/gunnar-lab/](http://www.innovation.umn.edu/gunnar-lab/)

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