



NEWS FROM  
The Research Study Team

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## Seven Years of Fruitful Collaboration in Support of Young Children

For the past 7 years, Children's MN has collaborated with researchers at the University of Minnesota's Institute of Child Development to explore the extent to which well-child checkups can be used to identify children at risk due to excessive stress activation (i.e., toxic stress). In a series of studies (described in this newsletter) we have focused on measures of the development of the prefrontal cortex, a brain region highly sensitive to toxic stress, and on the role of protective attachment relationships in buffering young children growing up in stressful contexts.

The context of our work together is as a part of the national JPB Network on Toxic

Stress and Pediatric Innovation Cluster, led by Harvard University's Center on the Developing Child, of which both Mike Troy at Children's Minnesota and Megan Gunnar at the University of Minnesota are members. The goal of this network is to develop a validated battery of biological and behavioral measures that can be employed in pediatric practice to identify children suffering the effects of toxic stress, long before they reach kindergarten. Currently, cheek swabs for DNA methylation assay, saliva for measuring inflammatory cytokines, and urine samples for assessing isoprostanes (a measure of cell endangerment response) are being collected on 6000 children in clinics around the US as part of the battery validation work. [Note that Children's MN will also be part of that work.]



THANK YOU.

## Thank you to the staff at Children's St. Paul and West St. Paul

Our work has been conducted at Children's St. Paul and West St. Paul primary care clinics. Our team truly cannot thank the staffs of these clinics enough for their support and the time they graciously gave to this research. Without you, we could not have accomplished what we have! You have welcomed us into your lobbies, employee spaces, and treatment rooms, helped us with scheduling families, and supported our needs for space. Importantly, you made us feel welcomed.

Our best wishes,  
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## What We Have Learned So Far From Our Joint Efforts

### Secure Attachments are Powerful Stress Buffers

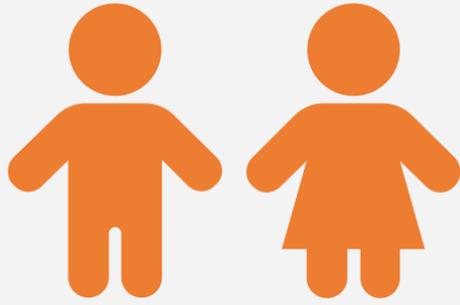
**Secure attachment relationships** are a baby's first and most important line of defense against the adversities they and their family experience. Our first study in 2017 (Toddlers and Parents Study) was designed to determine whether attachment security worked to reduce stress hormone production in toddlers growing up in families reporting high levels of stress and/or living close to or below the federal poverty level (i.e. the poor and near poor). We designed our study around the fact that toddler well-child visits often involve inoculations, which Dr. Gunnar had previously shown elevates the stress hormone, cortisol. We took multiple saliva samples over the well-child visit to assay cortisol. To measure

attachment security, a researcher accompanied the family throughout the visit and watched how the child used the parent as a source of security. The researcher then completed the Attachment Q-sort to quantify attachment security. To measure the stresses in the family's life, we asked the parents to complete a set of questionnaires. 190 English- or Spanish-speaking families participated at either a 12-month, 15-month, or 18-month well-child appointment.

Family income was correlated both with how many stressors the family experienced and with the security of the child's attachment relationship. This was an expected finding based on many other studies in the literature. Among the families with lower incomes (about 1/2 of the families), attachment

Family income was correlated both with how many stressors the family experienced and with the security of the child's attachment relationship.

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## Toddler & Parent Study Overview

190 assessments  
24 Spanish-speaking families  
167 English-speaking families  
94 girls & 94 boys  
Ages: 12-, 15-, and 18-months

watch a computer screen is being used to understand the development of attention in many research laboratories.

Part of our second study (Toddler Attention Study) was a feasibility study to see if we could

security mattered a lot. In these families, insecurely attached toddlers came into the clinic with higher cortisol levels to begin with and these levels rose over the visit. In families with lower incomes, securely attached toddlers came in with lower cortisol levels that actually were lower than those of the children from families with higher incomes and fewer stresses. Secure attachment emerges from a history of predictably sensitive, responsive care, a pattern of care that is hard for parents to sustain when life is itself difficult and unpredictable.

One take on these findings is that parents who manage to create secure relationships with their babies under trying circumstances are pretty amazing parents who may be even better stress buffers than those parenting under less harsh circumstances. The other takeaway is the importance of identifying early those families where the children are not able to use the parent as a source of stress-buffering security. More on this later.

## Measuring Development of the Prefrontal Attention System

**How babies deploy their attention** tells a lot about the development of their brains. How do you know where the baby is deploying her attention? You track her eyes. Eye-tracking while babies

mount an eye-tracker on an iPad and incorporate this type of assessment within a well-child appointment. Then could we assess the baby's attention development during down times in the pediatric visit. We figured out how to mount the eye-tracking equipment on an iPad so that we could capture the infants' eyes. Additionally, we figured out how NOT to capture the parent's eyes, because no matter if we told parents not to look at the screen, it was hard for them not to. We learned that giving the parent a word search task that we hung on the wall at a 90-degree angle from the iPad worked well.

What the baby saw on the screen were lights that blinked on in a set pattern. After watching a while, the baby's eyes were supposed to anticipate the next light to come on. After they learned the pattern, it changed and we measured how long it took the baby to shift from the old to the new pattern.

One hundred and seventy three English-speaking families at Children's St. Paul clinic participated at either a 9-month, 12-month, or 15-month well-child appointment. We found that on the iPad it was hard to actually determine where the eyes were moving. However, we were able to get many of the babies to attend to the task, and with a larger iPad and a somewhat modified task, eye-tracking assessments of attention during



## Toddler Attention Study Overview

173 assessments  
all English-speaking families  
92 girls & 81 boys  
Ages: 9-, 12-, and 15-months

the “down time” in a pediatric clinic should be feasible.

### Assessing the Development of Social Brain

Because the eye-tracking part of the Toddler Attention Study was a feasibility study, we wanted to add a task that we knew would give us solid data. At 9-months of age and through most of the 2<sup>nd</sup> year of life the *social brain* develops rapidly. It is during this time that children begin looking when other people point and later follow where others are looking without the need for a point. This is also when they begin to show adults objects, and assume both parties are contemplating the same object. This is called *joint attention* and it is essential for the development of language (e.g., the baby has to understand that the ball is what the mom is pointing to connect mom saying ball with the right object). It is also

- Joint attention task where researcher points to a toy and the child looks to where she is pointing.

essential to learning that other people have thoughts and feelings that may not be the same thing that the child is thinking or feeling (*theory of mind*). It is important to note that children who develop on the autism spectrum do not follow the typical milestones in the development of the social brain.

The Dimensional Joint Attention Assessment (DJAA) measures the development of joint attention. It is a floor task where the toddler and the administrator simply play with toys as the administrator looks to (lowest level), points to (higher level), and points and labels (highest level) different toys and things in the room.

There has been a strong argument among theorists that joint attention development is NOT affected by the child’s experiences. However, in the 173 infants aged 8-18 months that we tested, we once again found that growing up in poverty mattered. Poverty appeared to slow the development of the social brain.

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Less sophisticated joint attention skills raise questions about whether the child is on the autism spectrum. However, if children whose families have low incomes develop these skills more slowly, we may need to take income into account when we are seeing a child we think might be on the spectrum.

## Assessing Executive Function in 5 Minutes During a Clinic Visit

**Good executive functions (EF)** are necessary for doing well in school, doing math (not just arithmetic) and managing to have a well-ordered life. Executive functions depend on circuitry in the prefrontal cortex and encompass skills like working memory (how much you can keep in mind at one time), inhibitory control (can you play red light green light or Simon Says well?), and set shifting (once you learn to solve a problem one way, if the problem changes, do you keep perseverating or can you shift to a new solution?).

Executive Function skills start developing in late infancy and develop rapidly during the preschool years, but are not fully developed until young adulthood. EF is improved when young children live in predictable environments with developmentally appropriate rules and expectations. EF improves with parenting that supports the child's autonomy to make choices between acceptable alternatives and when adults provide structure but do not solve problems for the child that the child is capable of solving themselves. Children who are delayed in EF are at risk for poor developmental outcomes;

catching these delays early can help support EF development so that children are successful.

Old EF tests used to take up to 30 minutes or more to administer. Obviously, this is not feasible during a well-child visit. The Minnesota Executive Function Scale (MEFS) is a task that takes less than 5 minutes. It was developed by Phil Zelazo and Stephanie Carlson, Megan Gunnar's colleagues at the Institute of Child Development. It is programmed on a tablet and the scoring is done over the internet. Percentiles are calculated based on age and sex against a large number of individuals aged 2 years to adult.

▼ Researcher administers the MEFS task on a tablet.



In 2018, we began the “Preschool Attention Study.” We followed children to measure their EF starting when they were at their 2- or 3- year well-child visit and then again at the next two annual well-child visits. We planned to assess about 150 children longitudinally (we enrolled 157) and to recruit another group only at age 4-5 to see if annual assessment and talking with the parents about EF might affect the growth of EF. We were about 1.5 years into the project when the pandemic struck and we suspended testing.

We were able to return to the clinics a few months ago. With your help, we still completed a total of 305 assessment visits. We have completed the analysis of our first year of data collection and are now looking at EF “growth curves” based on the longitudinal data we were able to collect.

We learned that it is feasible to assess EF during the “down time” in a clinic visit. As a result, in the large validation study that is beginning now across the country, EF will be assessed using the MEFS on all of the children who are 2.5 years and older (about 3000). The MEFS really does only take 5 minutes, and often less. A good number of the 2 to 2.5 year olds struggled to understand what they were to do, but by 2.5 years and above it was fairly easy.

Our results were, on average, about 10 percentile points below the reference sample, but that is because these two clinics, St. Paul and West St. Paul, have more diverse families with lower

incomes than the reference sample. When we only looked at the children whose families were at or above 150% of the federal poverty limit, the results from the clinics were spot on in comparison with the reference sample norms. Thus, you can get an accurate measure of EF in a short time during a well-child visit. Furthermore, at every income level, we did see some children who were below the 20<sup>th</sup> percentile for EF development. However, there were more of these children in families with lower incomes. Once again, income was our strongest negative predictor of children’s neurocognitive development. It was stronger than parent education and family life stress.

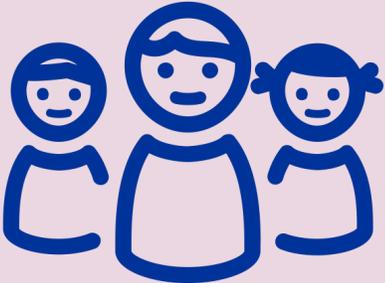
## Screening for Problematic Attachment Relationships

**Our last project is ongoing** but now on hold because the pandemic has reduced everyone’s bandwidth for new endeavors. Given the importance of attachment relationships for buffering children from toxic stress, identifying relationships that are failing to provide young children with the support they need early and getting those families help would be a boon for the child’s development. As individuals who work with families every day, you have a good feel for those relationships that are probably in trouble, but do not have an objective metric to use to identify parent-child relationships that might

benefit from additional support services.

In the last year, we have been working on an 8-item screener that pediatric personnel (everyone who sees the

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### Preschool Attention Study Overview

- 305 assessments
- 30 Spanish-speaking families
- 184 English-speaking families
- 107 girls & 107 boys
- Ages: 2—6 years old

family during a visit) could provide input on. The 8 items are simple descriptions of behaviors, some that signal a working attachment relationship that is supporting the child (e.g., *When something happened during the appointment that distressed the toddler, s/he reached for or looked to the parent/guardian*), and some (if enough items were checked) should signal relationships where support may be needed (e.g., *The toddler consistently pushed, moved away, or otherwise rejected the parent/guardian's attempts to calm them when distressed*).

We developed these eight items from a longer list after focus groups with pediatricians, pediatric nurses and other clinic personnel at Children's MN and across the United States. The items were then reviewed by attachment experts and amended based on their feedback. The last phase of the development of this screening tool is to train pediatric clinic staff to use the screener and to validate it against the Attachment Q-sort (a more extensive measure of attachment). However, in light of the many demands and challenges pediatric clinics are currently facing, we have concluded that this is not the time for that validation study. We are going to wait a year—hopefully we won't need to wait more—until we all have more bandwidth, and then we will work with providers within Children's MN who are interested in helping with this validation.

## **We Never Planned For Our Works to Be All About Poverty**

**Although we expected low family income** to contribute to toxic stress, we expected that other factors in addition would matter, like maternal depression and anxiety, family life stresses, low parent education and minority racial/ethnic status. Poverty is correlated with all these things,

but again and again, once family income was in our analyses, it swamped everything else. This is not always the case in studies of children's development. We think it was salient in our work because Children's has such a large range of family income from quite impoverished to rather wealthy. This means that our findings probably gave a better picture of the power of income to drive children's development than research where the income of the sample was more restricted.

In recent years, the importance of poverty for children's development is being increasingly discussed. Researchers who used to shy away from such a messy variable are now naming it for what it is. Poverty is a terrible threat to children's brain development and health. The Twin Cities is one of the sites of the Baby's First Year Study, a remarkable study of income supplementation (just give families more money) in low income families to see if it impacts infant cognitive and emotional development (see <https://www.babysfirstyears.com/>). Of course, concerns with the destructive power of poverty is also behind the Child Tax Credit and other government programs that hope to lift families out of poverty and support healthier development. The work we have done together contributes to the public conversation about the toxic role of poverty in children's lives. Thank you for making this important contribution possible.

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