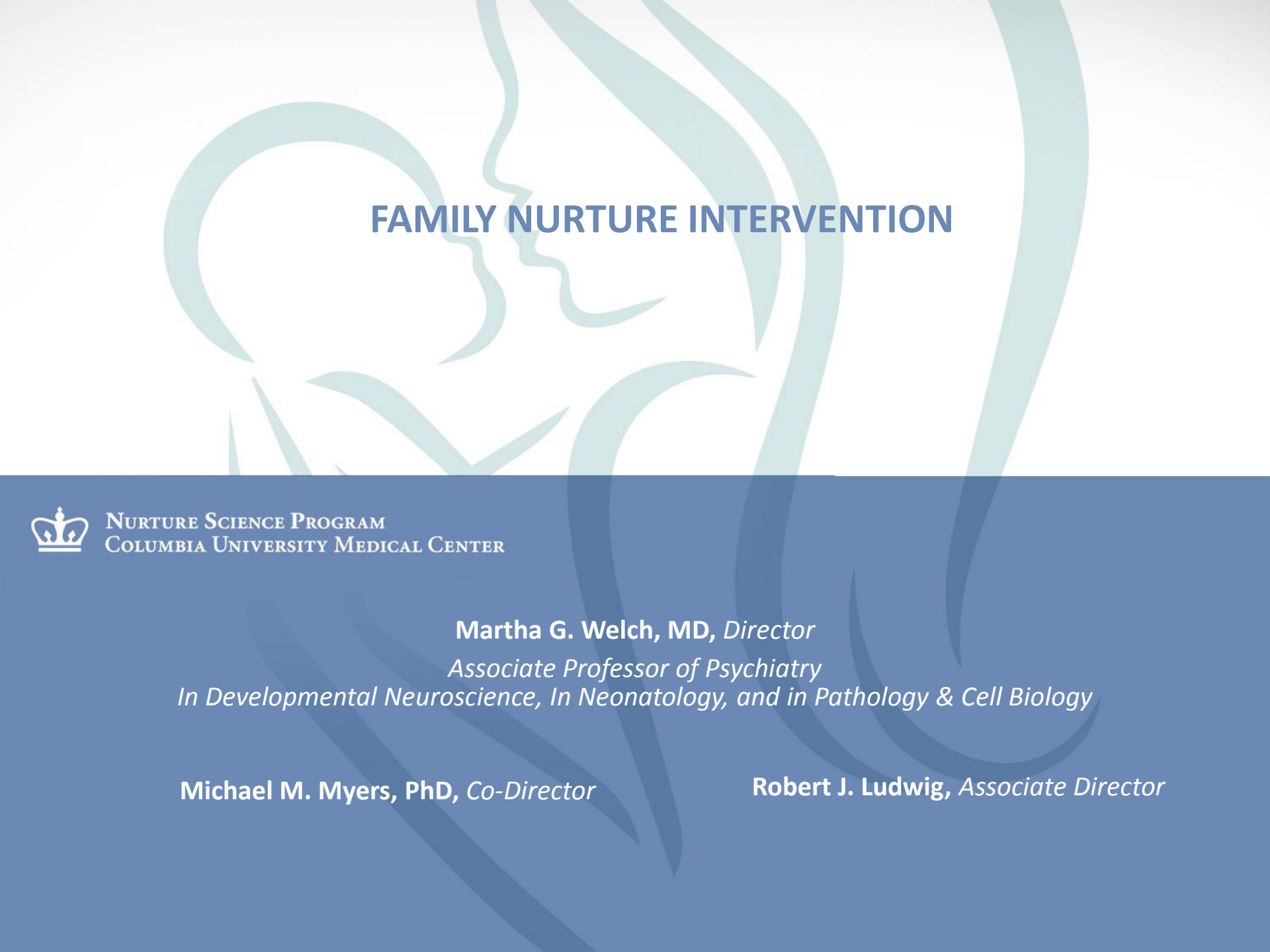




FAMILY NURTURE INTERVENTION



NURTURE SCIENCE PROGRAM
COLUMBIA UNIVERSITY MEDICAL CENTER

Martha G. Welch, MD, *Director*

Associate Professor of Psychiatry

In Developmental Neuroscience, In Neonatology, and in Pathology & Cell Biology

Michael M. Myers, PhD, *Co-Director*

Robert J. Ludwig, *Associate Director*

Nurture Science Program Mission



Investigate the underlying biological mechanisms of nurture

Develop evidence-based interventions as a means to prevent
and overcome emotional, behavioral and developmental
disorders

Create a very brief scale for pediatricians and other
professionals

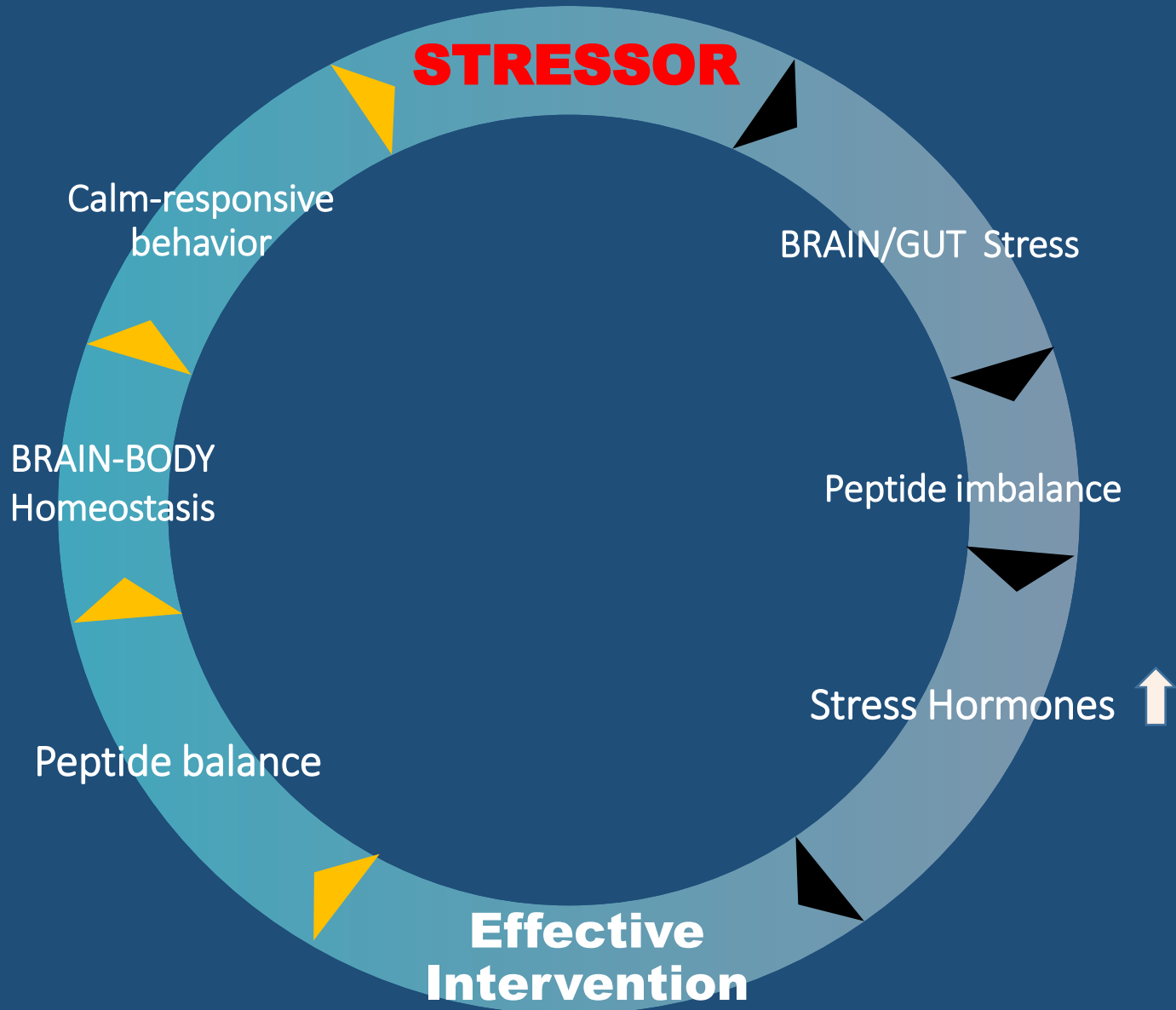


Background

- 1974 Ethology → FNI
- Goodall's chimps
 - High nurture → Optimal development
- Niko Tinbergen
 - Nobel 1973 Medicine or Physiology
 - Approach/Avoidance Conflict
- Idea!!!!
 - Apply high nurture → approach behaviors
 - => Stop avoidance
- 1977 to 2003 The Mothering Center



Hypothesized Hormone Conditioning

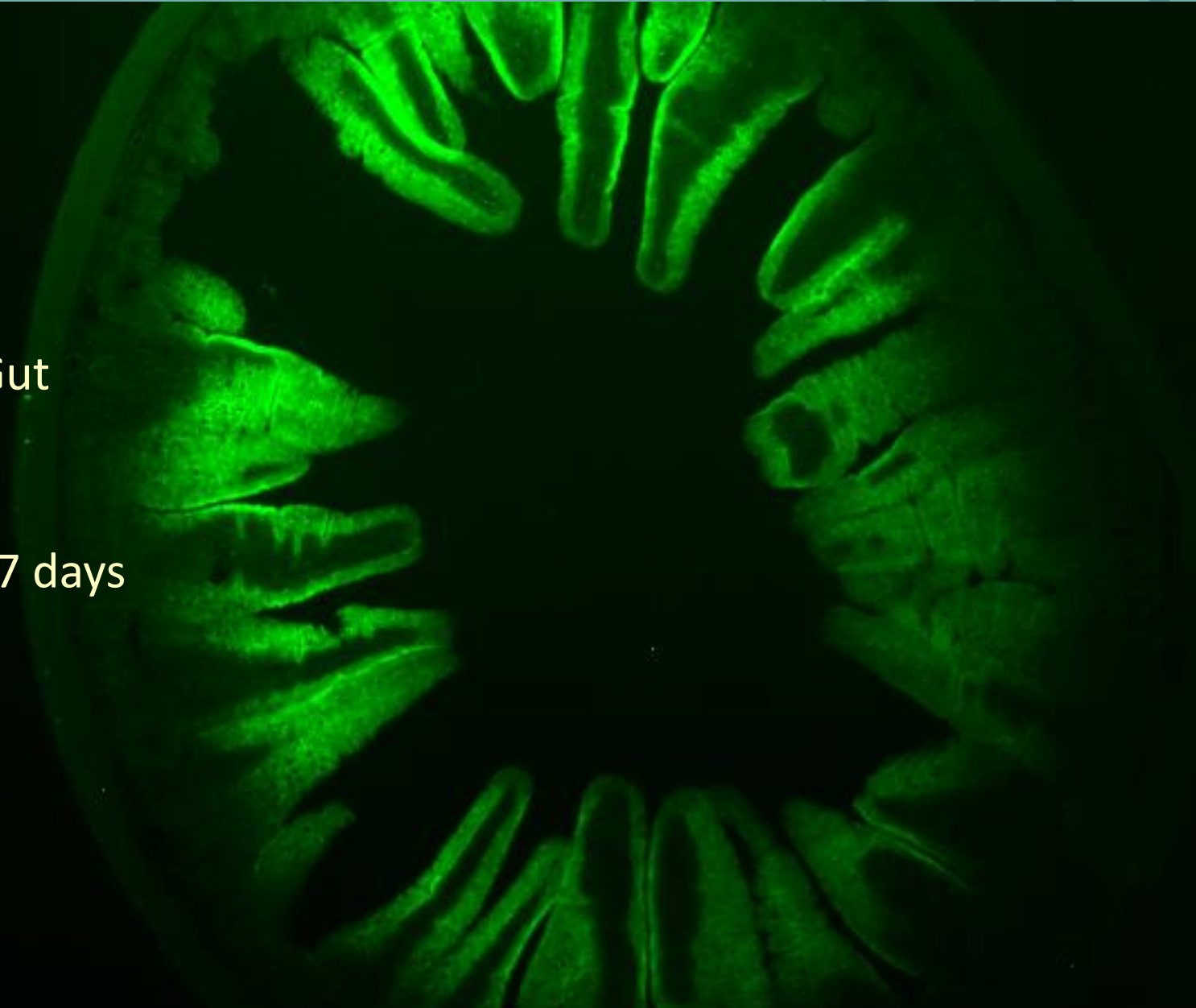


Oxytocin receptor expression during feeding

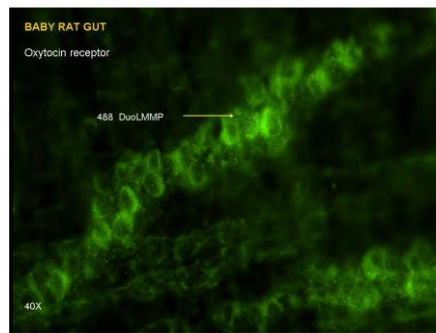
Baby Rat Gut

Mucosa

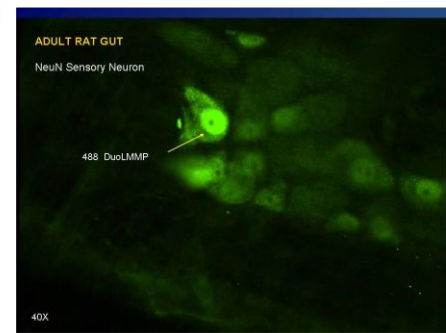
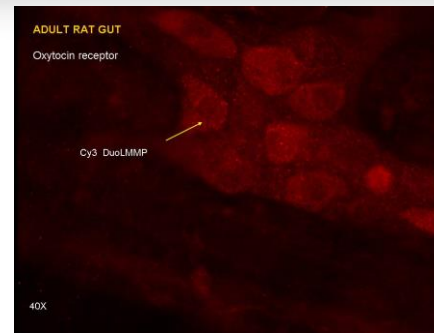
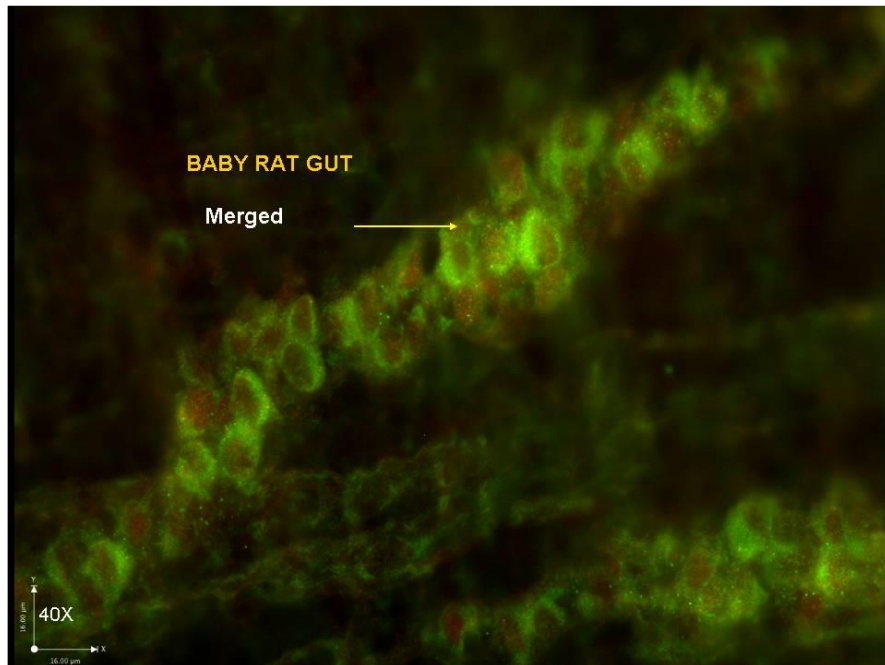
Post natal 7 days



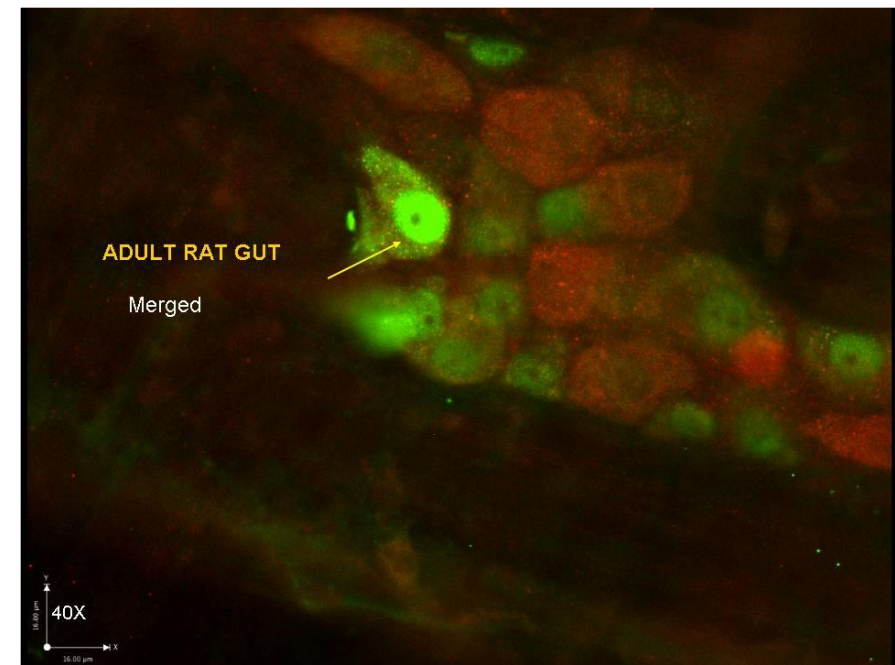
Oxytocin receptor in enteric neurons



Baby Rat



Adult Rat





RCT of Family Nurture Intervention in the NICU

- 2008-2012 at Columbia University Medical Center
- 150 infants randomized to FNI or standard care
- 26-34 week gestational age
- *Less than one hour FNI per day for 7 weeks*
- Cohort follow-up in progress to age five



FNI Calming Sessions



- Create Emotional Connection & Co-Regulation
- Nurture Specialist administered
- Engage mother and infant in repeated calming sessions
- Experiential, *not didactic*
- Mother calms baby ⇔ Baby calms mother
- Condition ANS of each other
- Counter-condition adverse experience



Family Nurture Intervention

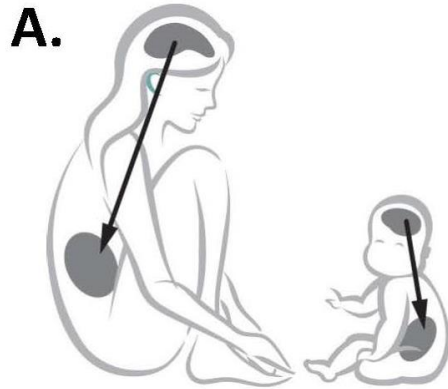


*Emotional
Communication
between mother
and infant*

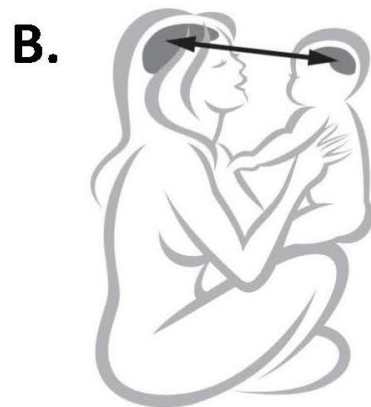
During ...



Types of regulation



Self-regulation



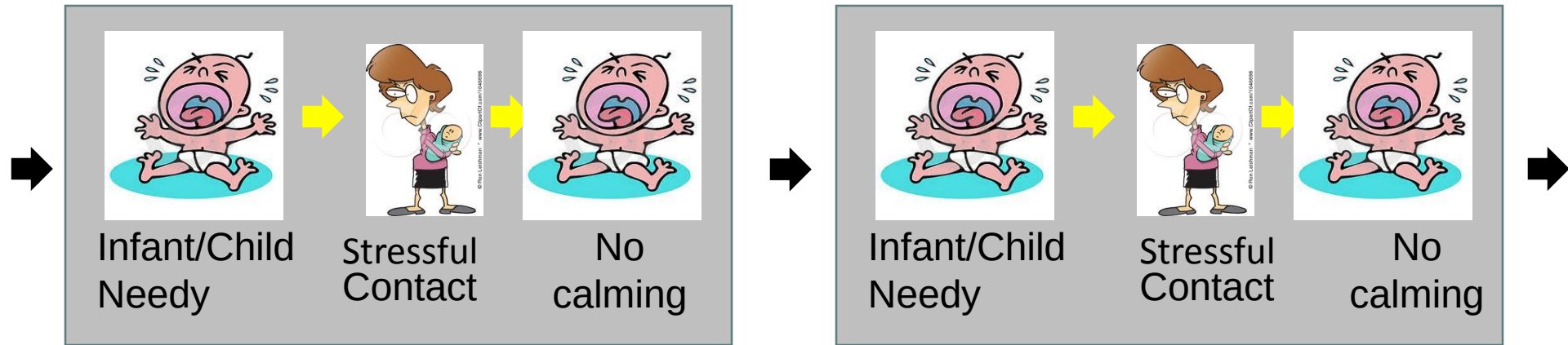
Psychological Co-regulation



Visceral/autonomic
Co-regulation



Negative conditioning



Negative
Contact



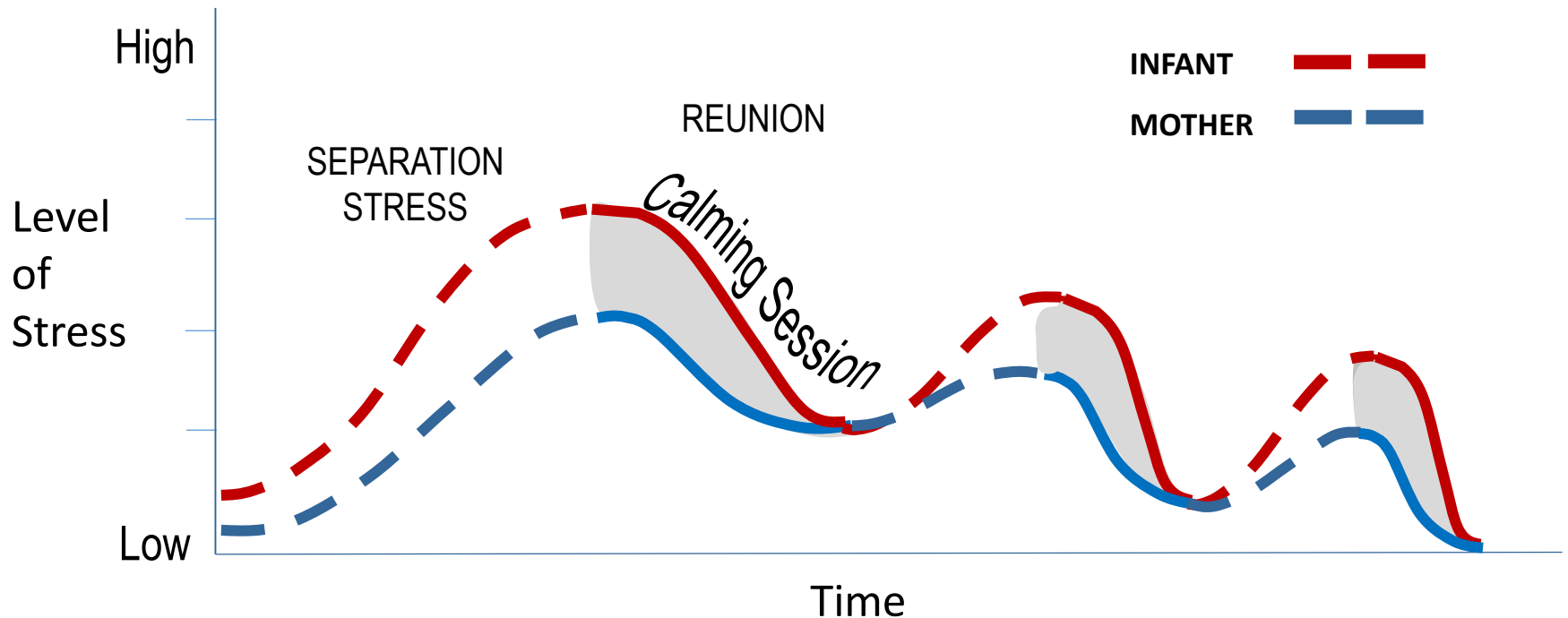
Dysregulation
and
Avoidance



Facilitating emotional connection

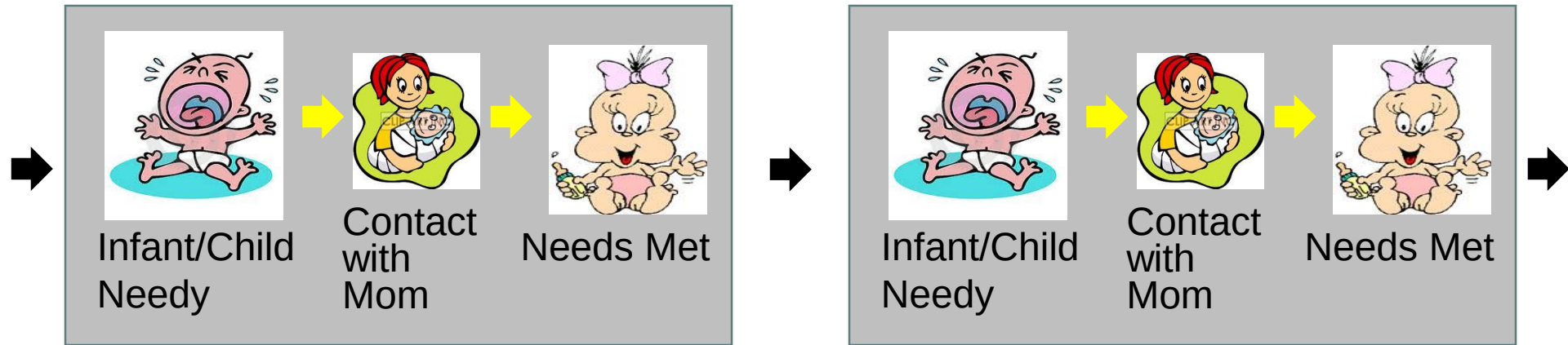


The Calming Cycle



Over time Calming Cycle interactions lower levels of stress in both the mother and the infant, and do so in less and less time

Positive conditioning



Positive
Contact



Attraction



FNI RCT published results



36 Wks -	Mom	Caregiving behavior	↑	p<0.01
40 Wks -	Infant	EEG Power	↑	p<0.001
40 Wks -	Infant	EEG Coherence	↓	p<0.001
4 Mos -	Mom	Depressive symptoms	↓	p<0.04
4 Mos -	Mom	Anxiety	↓	p<0.01
4 Mos -	Infant	Lower heart rate during stress (in prep)	↓	p<0.02
18 Mos -	Infant	Language, Cognition (Bayley)	↑	p<0.01,<0.04
18 Mos -	Infant	Attention Problems (CBCL)	↓	p<0.02
18 Mos -	Infant	Risk for Autism (MCHAT)	↓	p<0.01



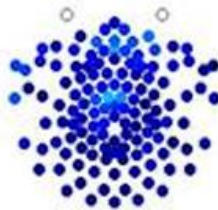
FNI EEG outcomes - Term Age



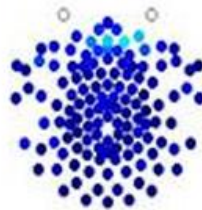
1-3 Hz



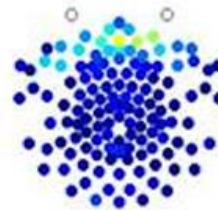
4-6 Hz



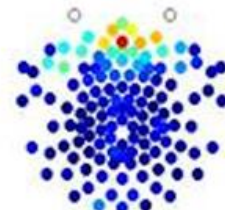
7-9 Hz



10-12 Hz



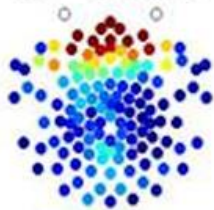
13-15 Hz



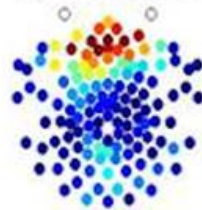
16-18 Hz



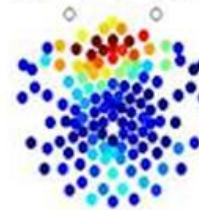
19-21 Hz



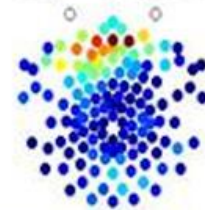
22-24 Hz



25-36 Hz



37-48 Hz



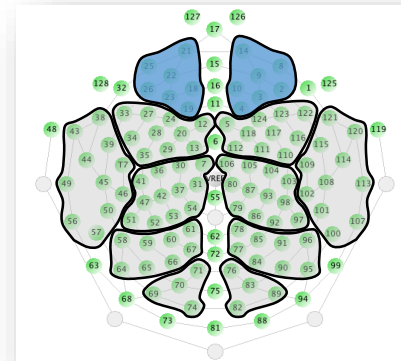
Welch et al, Clinical Neurophysiology (2014)



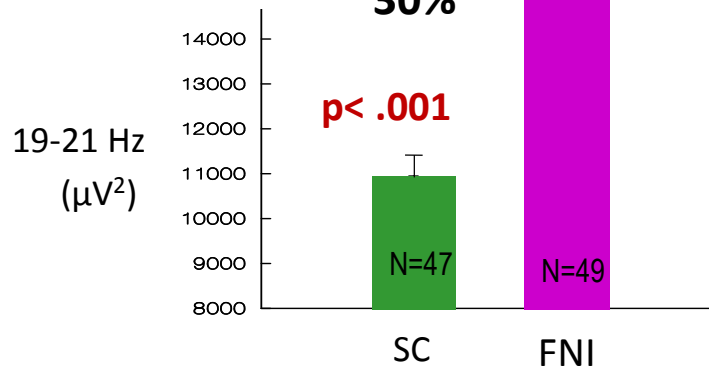
EEG Power during sleep



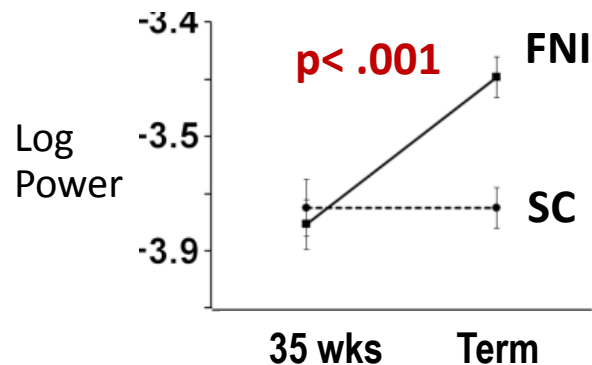
Frontal Cortex



FNI EEG POWER
Average increase
~30%

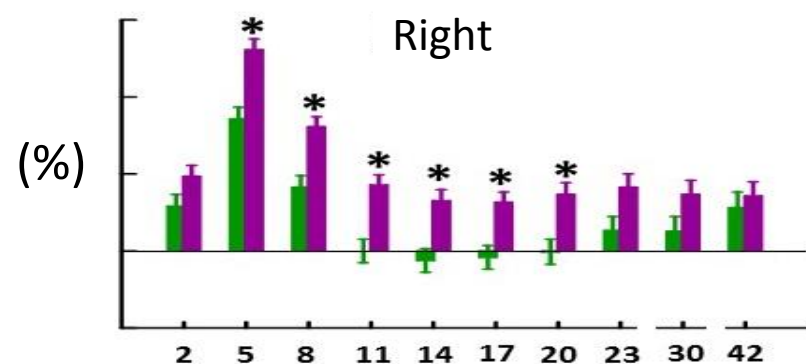
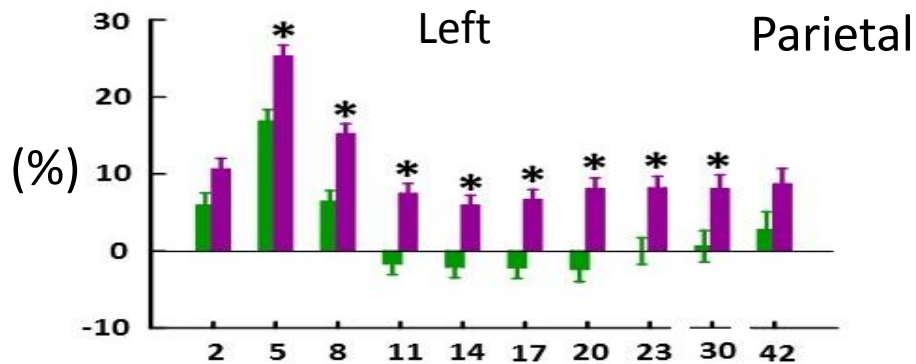
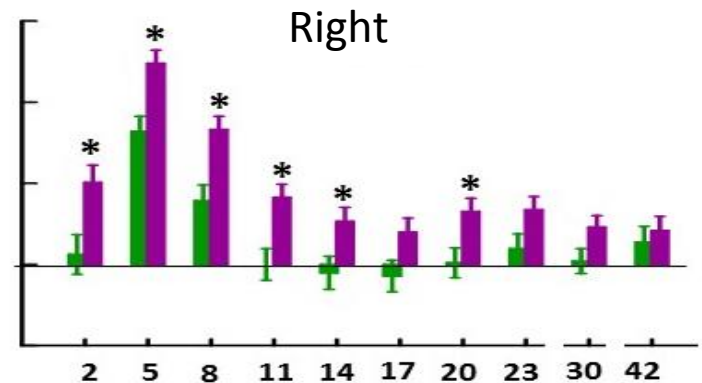
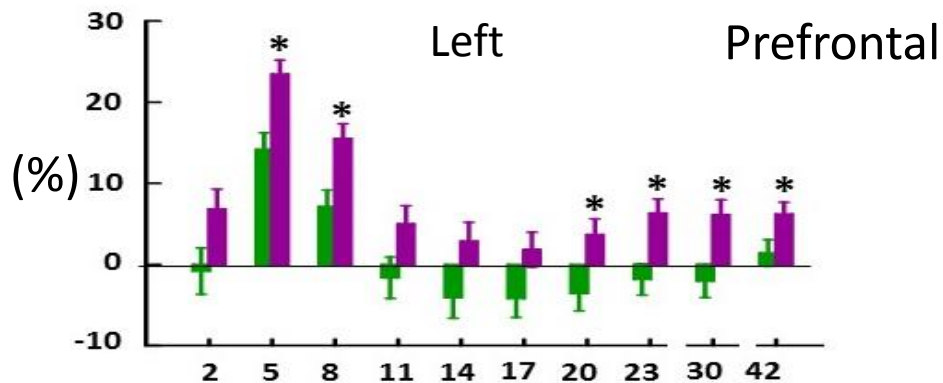


FNI EEG POWER
Increased with Age



Brain-wide developmental changes

Change in EEG Power per week

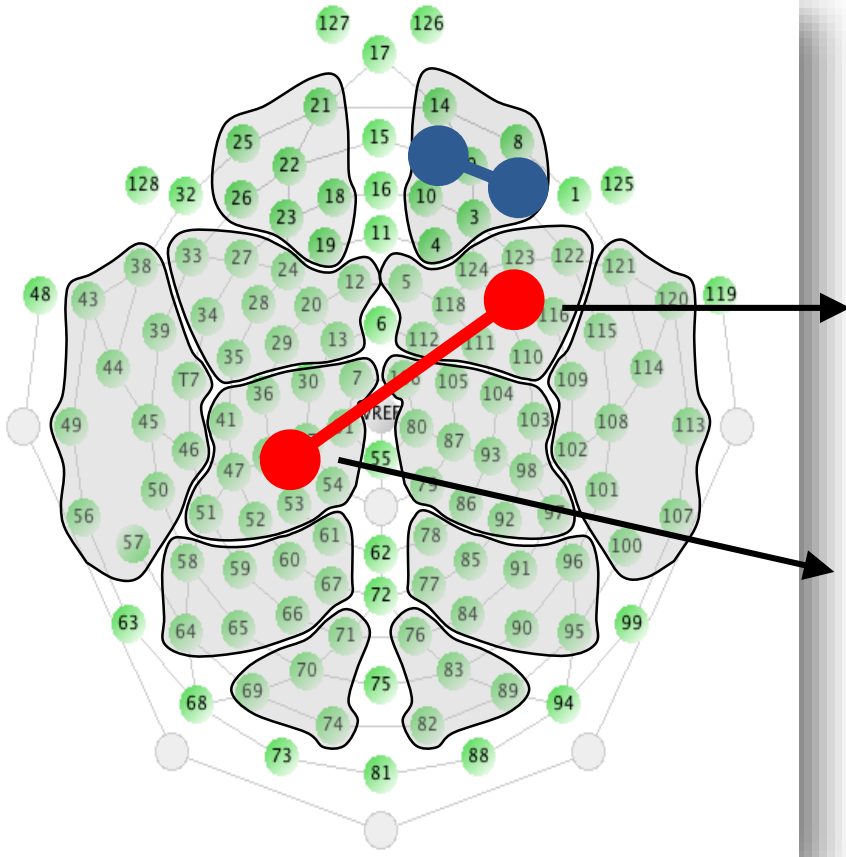


Frequency (Hz)

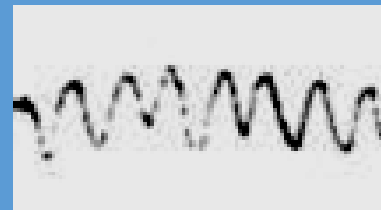
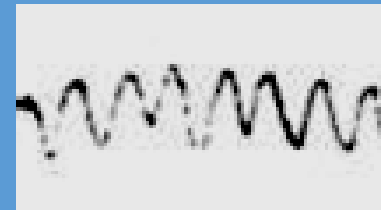


EEG Coherence

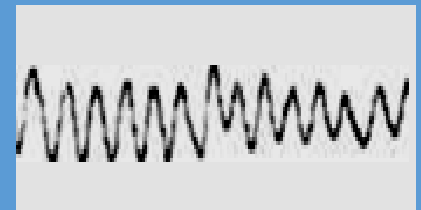
Between regions and Within regions



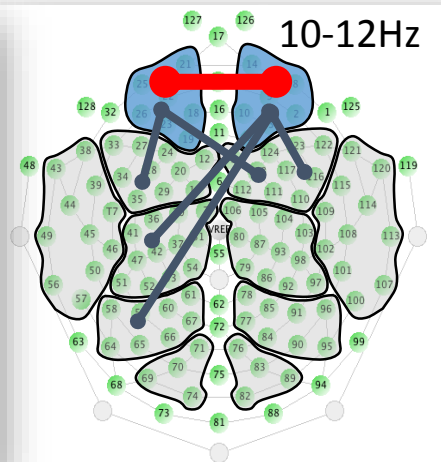
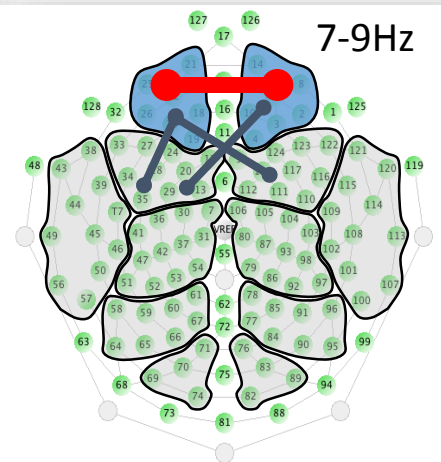
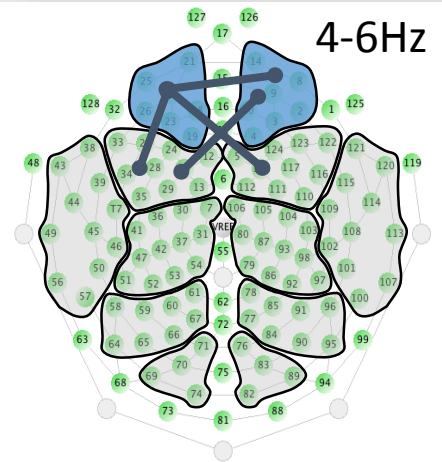
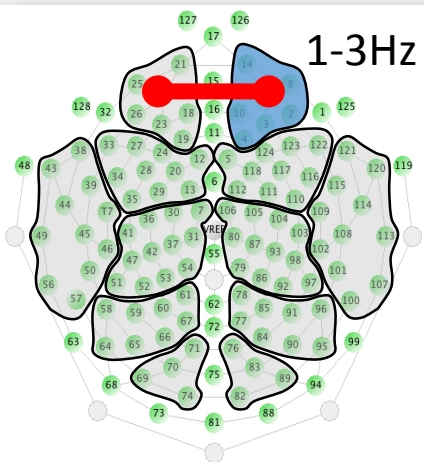
High
Coherence



Low
Coherence



FNI vs SC Coherence



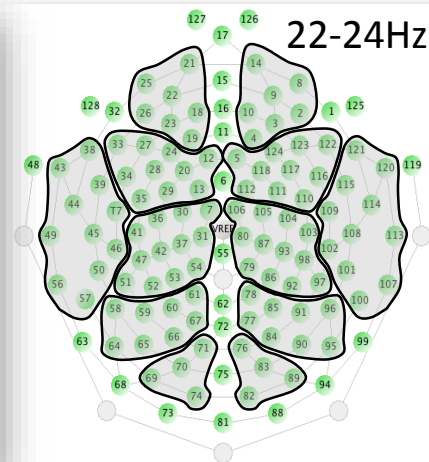
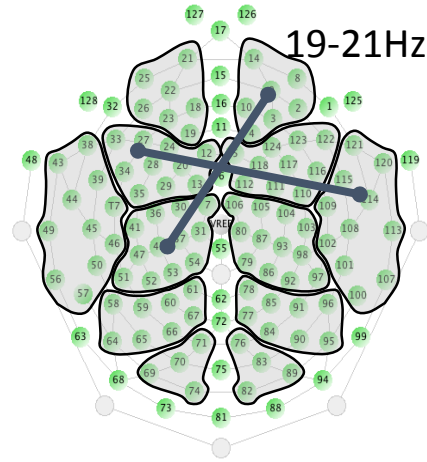
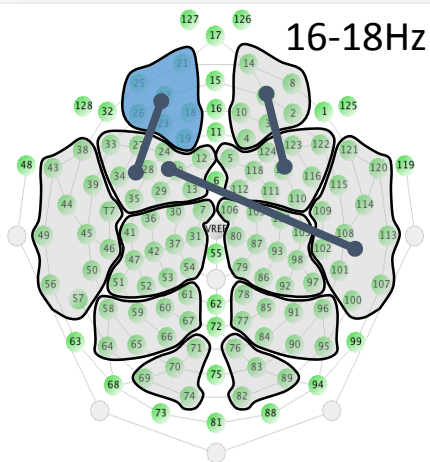
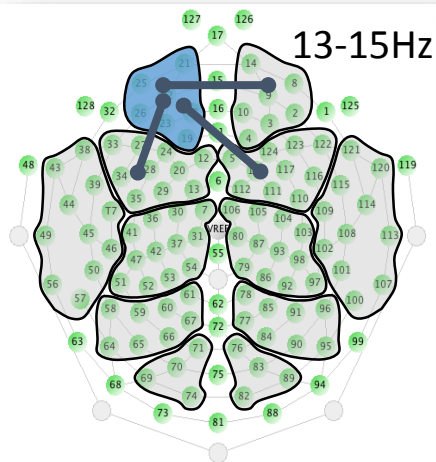
WITHIN
FNI LOWER
 $p < 0.01$



BETWEEN
FNI LOWER
 $p < 0.01$



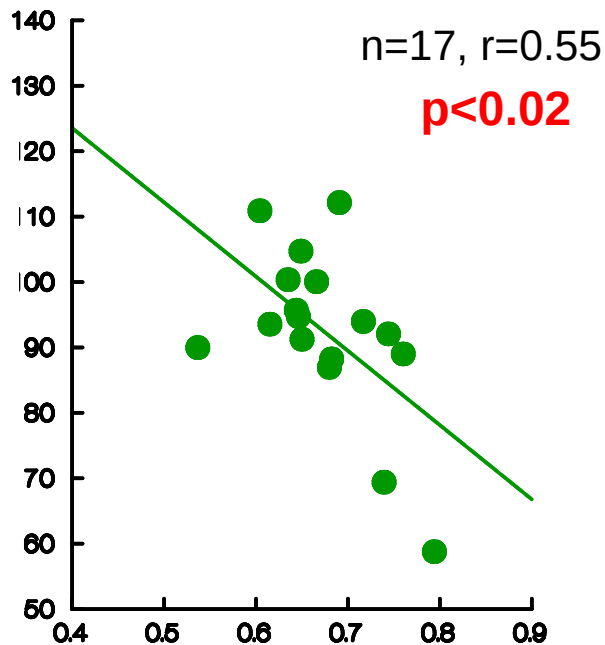
BETWEEN
FNI LOWER
 $p < 0.001$



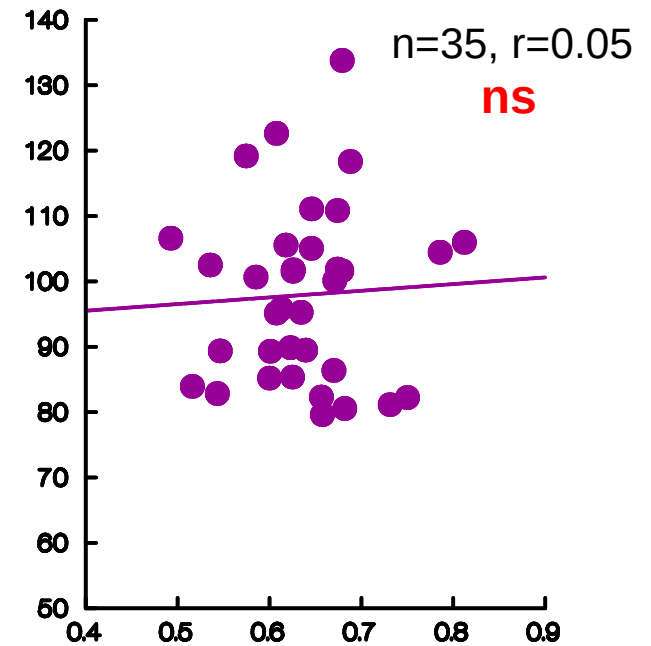
Coherence and Bayley III at 18 mos.

SC

Bayley III
Cognitive
Score
at
18 mos.



FNI

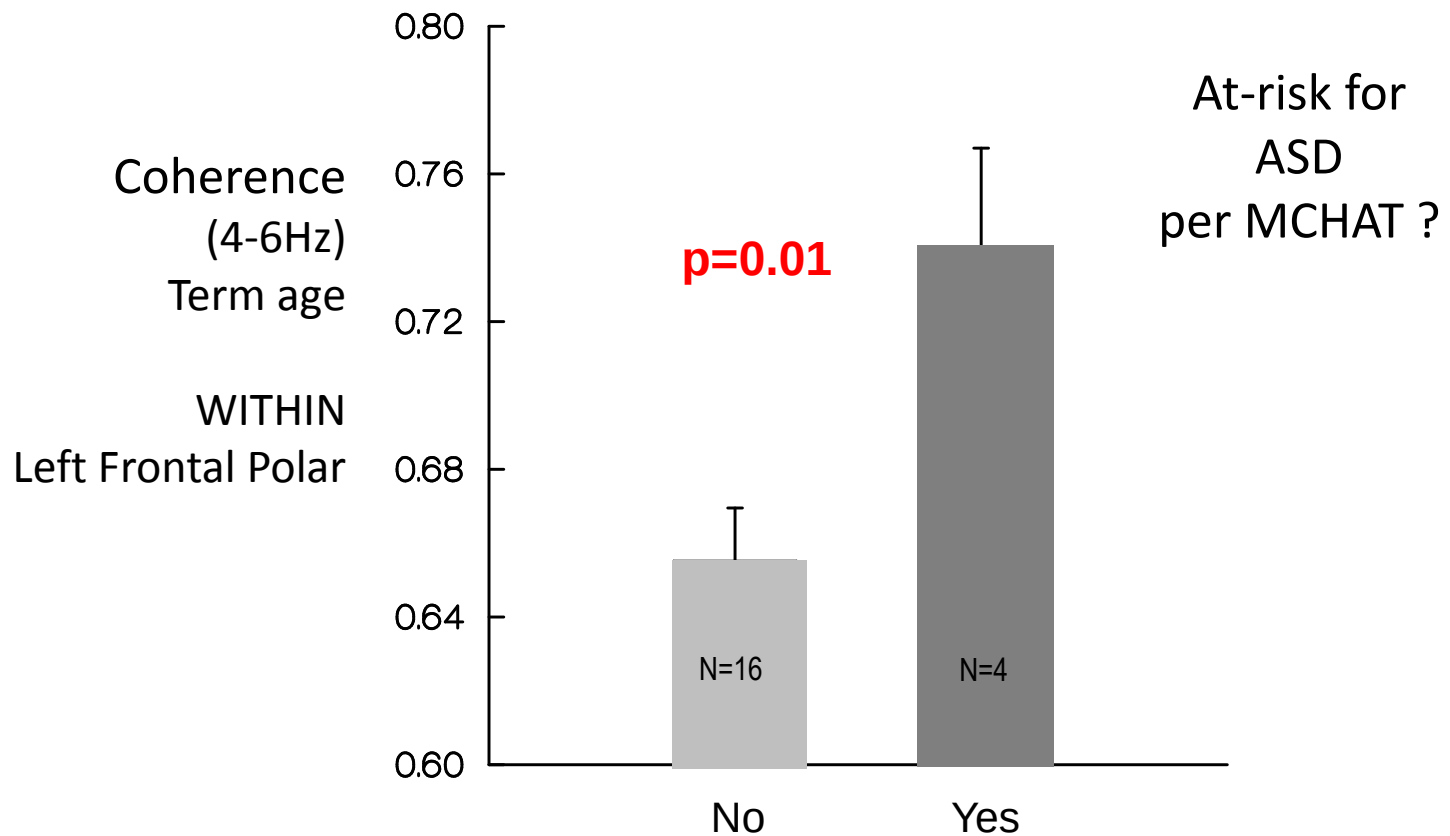


Coherence Within Left Frontal Polar – 4-6Hz

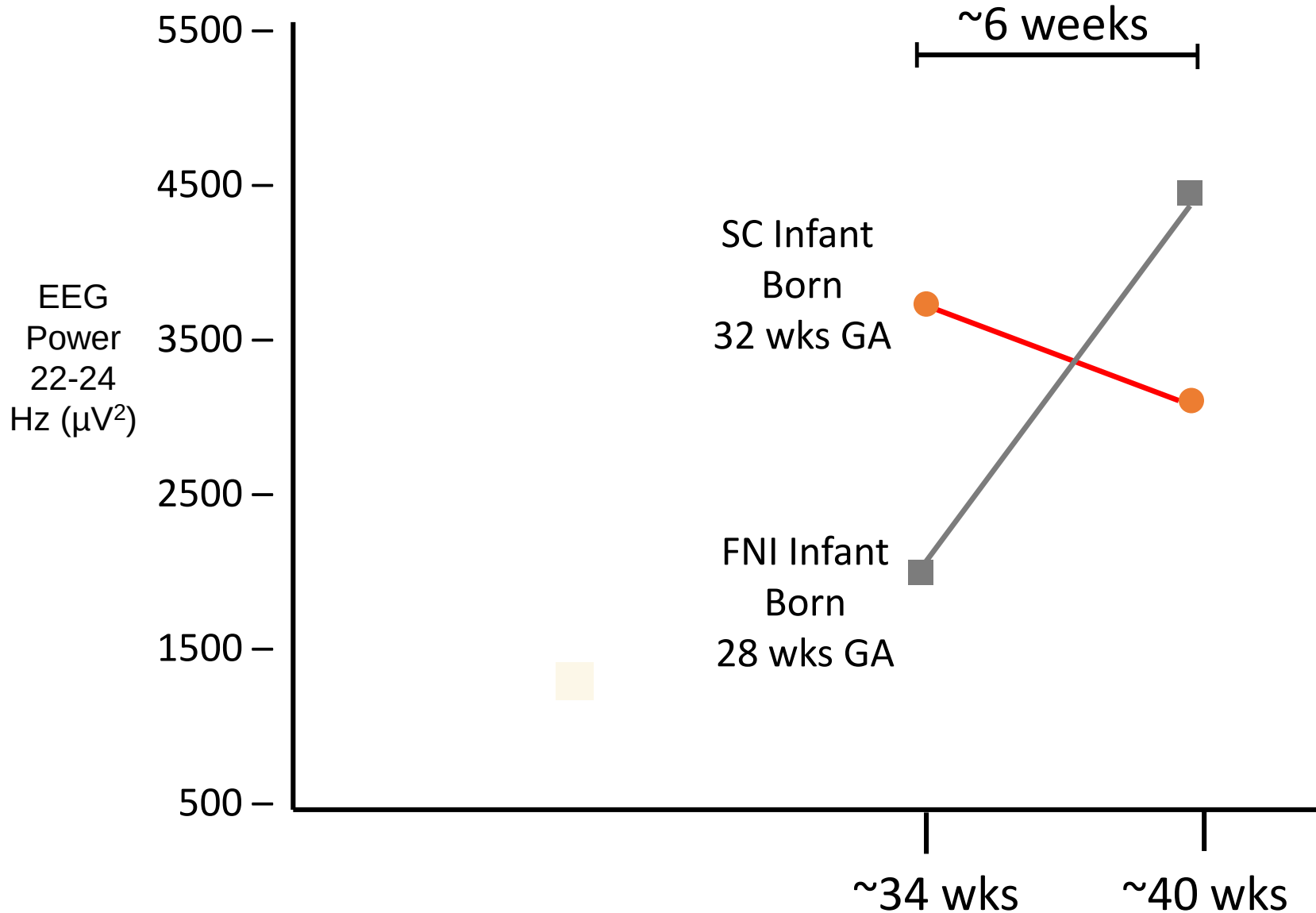


Coherence and Risk for ASD

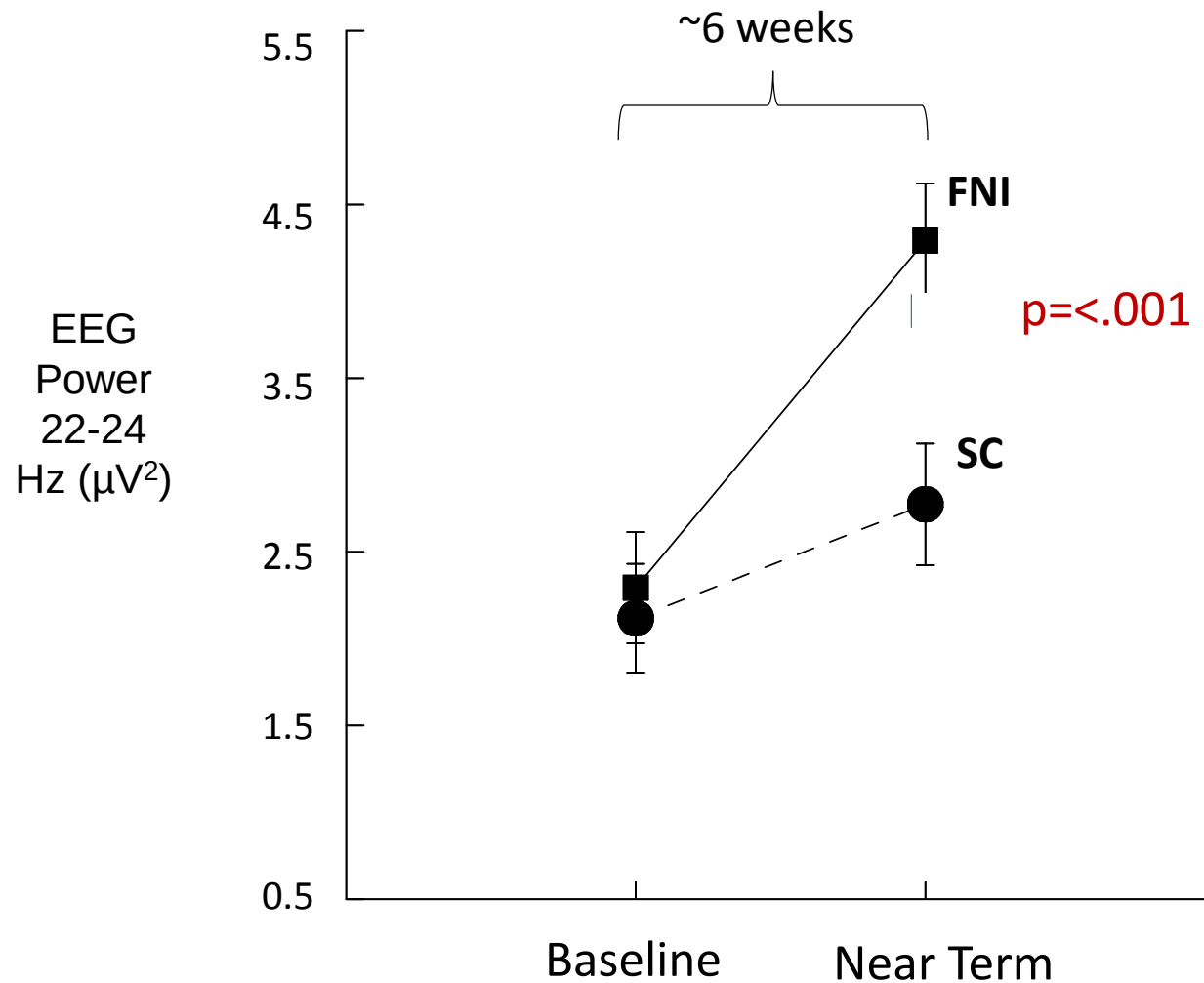
Standard Care (SC) Infants at age 18 months



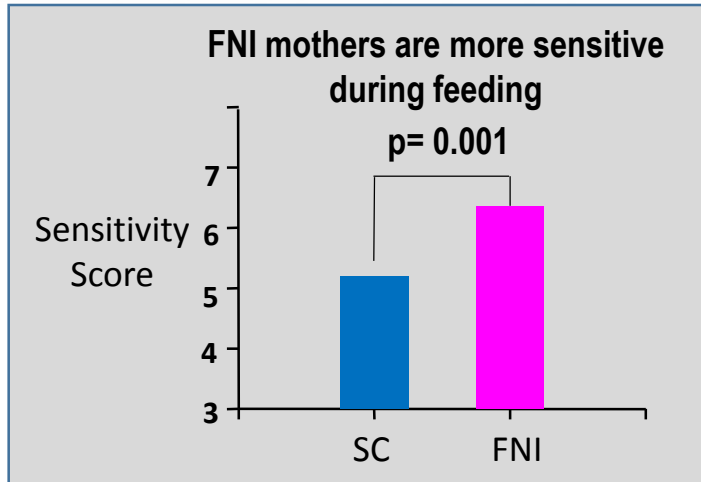
Change in EEG power



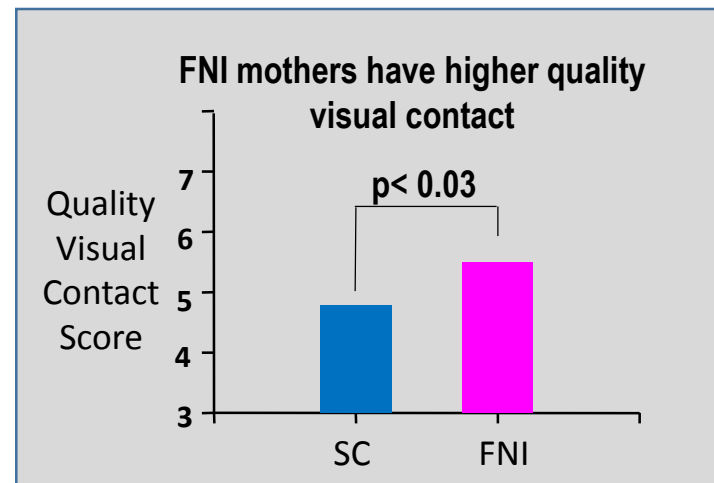
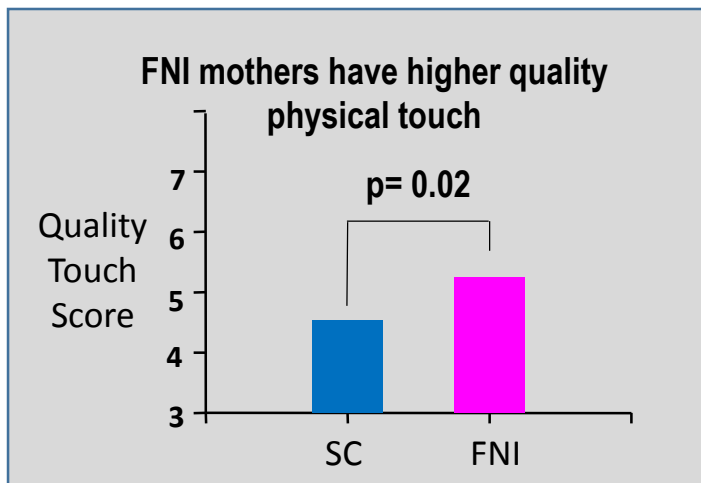
Group change in EEG power



Maternal Behavior in NICU



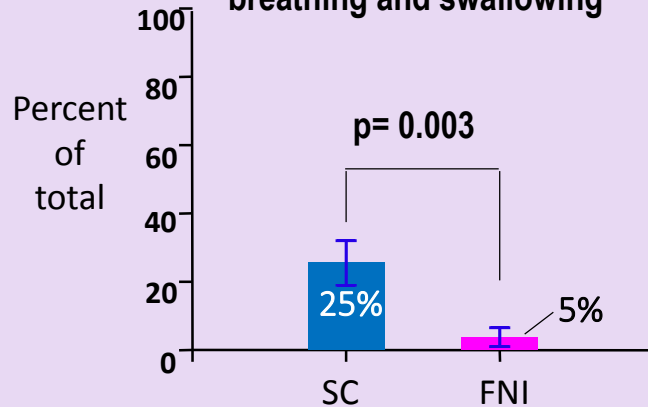
- Maternal Caregiving Behavior
 - Blinded Assessment * Hane Lab
 - $n = 51$ (FNI-23 , SC-28)



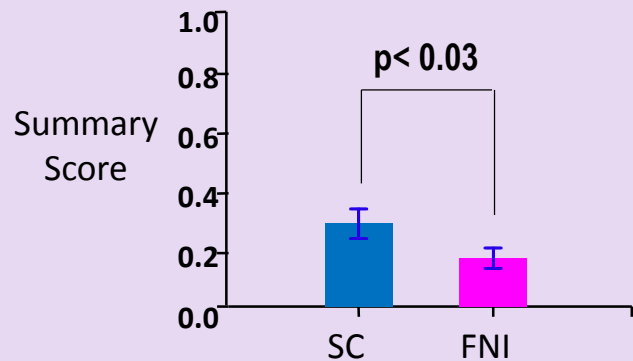
Neurobehavioral function near to term



Less difficulty coordinating breathing and swallowing



Fewer calming maneuvers needed during orienting interactions

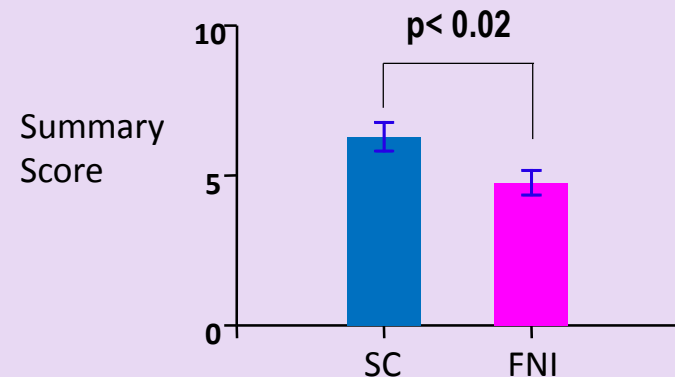


- NICU Network Neurobehavioral Scale (NNNS) Assessment

- Blinded assessment

- $n = 108$ (FNI- 60, SC-48)

Fewer non-optimal reflexes

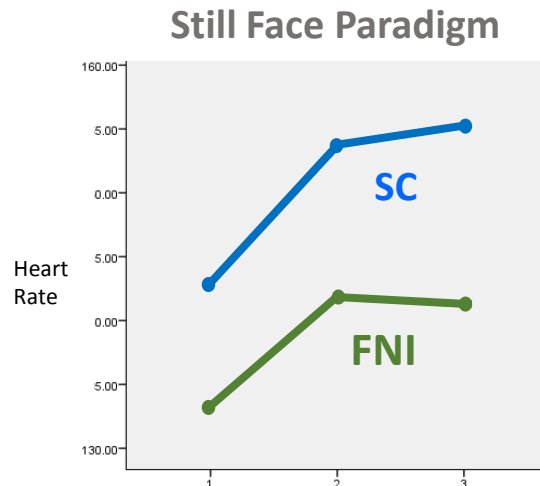


Stress paradigm at 4 months



FNI babies are calmer

- More regulated pattern of HR and vagal tone



FNI mom's greater approach after stress

- Positive affect
- Touch

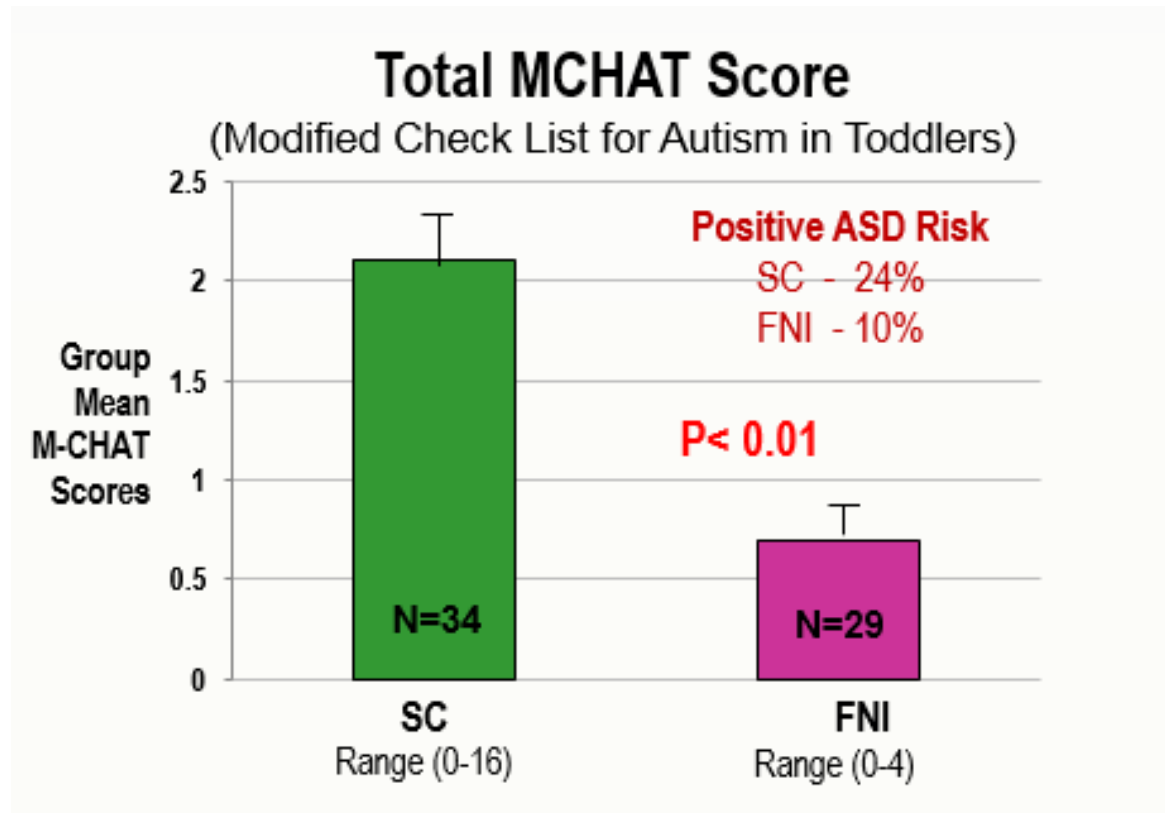
FNI babies greater approach during play

- Smile
- Gaze

FNI moms' positive affect associated with:

- Less HR increase at reunion







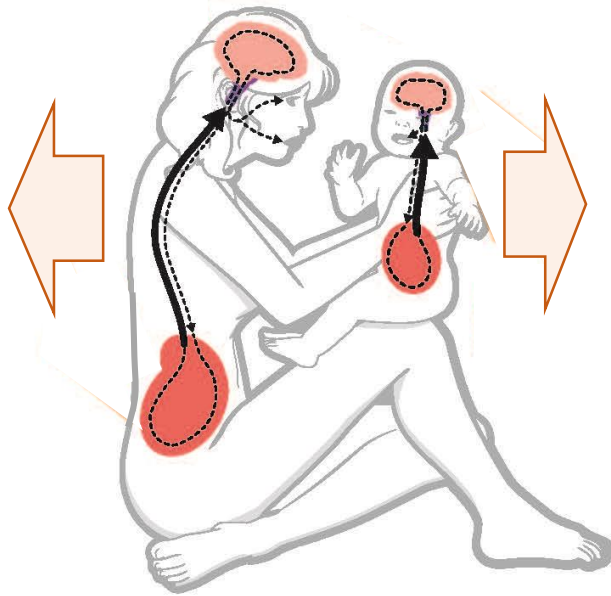
FNI shows 3-fold reduction in % of infants failing any item

	SC	FNI	χ^2	p
Failed any item	75.8% (25 of 33)	26.9% (7 of 26)	13.97	<0.001
Failed any critical item	21.2% (7 of 33)	0% (0 of 26)	6.26	<0.02
Failed two or more critical items	18.2% (6 of 33)	0% (0 of 26)	5.26	<0.03
Failed any 3 or more items	21.2% (7 of 33)	7.7% (2 of 26)	2.06	<0.20



Determining Emotional Connection

Disconnected



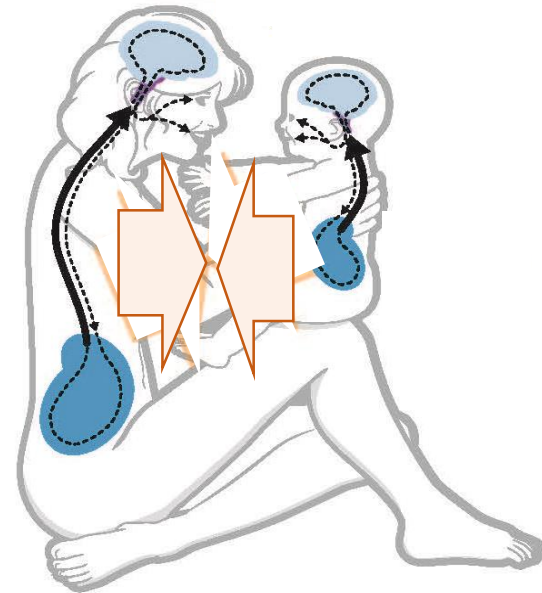
Not attracted

Negative vocal communication

Negative Facial Expression

Not responsive

Connected



Attracted

Positive vocal communication

Positive Facial Expression

Responsive



Welch Emotional Connection Scale (WECS)



ATTRACTION TO EACH OTHER

Mom often touches & gazes at child	3	Mom	Child	3	Child often reaches for & gazes at mom
Variable	2			2	Variable
Mom rarely touches or gazes at child	1			1	Child rarely reaches for or gazes at mom

AFFECTIVE VOCAL COMMUNICATION

Positive	3	Mom	Child	3	Positive
Variable	2			2	Variable
Negative or none	1			1	Negative

AFFECTIVE FACIAL EXPRESSIVENESS

Positive and responsive	3	Mom	Child	3	Positive and responsive
Variable or mixed	2			2	Variable or mixed
Negative or unresponsive	1			1	Negative or unresponsive

SENSITIVITY / RESPONSIVITY TO EACH OTHER

Often follows child & responds to child's affective state correctly	3	Mom	Child	3	Often follows mom & positively responds to her affect attentively
Variable	2			2	Variable
Rarely interprets or responds to child's affective state correctly	1			1	Rarely attentive to mom or responsive to her affect

ARE THE TWO EMOTIONALLY CONNECTED?

YES ☐

☐ NO



WECS – Domain 1

ATTRACTION TO EACH OTHER

Mom often touches & gazes at child (3) Mom
Variable (2)
Mom rarely touches or gazes at child (1)

Child (3) Child often reaches for & gazes at mom
 (2) Variable
(1) Child rarely reaches for or gazes at mom



Domain 1 - Attraction to each other



Domain 2 – Vocal Communication

AFFECTIVE VOCAL COMMUNICATION

Positive	3	Mom	Child	3	Positive
Variable	2			2	Variable
Negative or none	1			1	Negative



Domain 2 - Affective facial communication



Domain 3 –Facial expressiveness

AFFECTIVE FACIAL EXPRESSIVENESS

Positive and responsive (3) Mom
Variable or mixed (2)
Negative or unresponsive (1)

Child (3) Positive and responsive
 (2) Variable or mixed
 (1) Negative or unresponsive



Domain 3 - Affective facial expressiveness



Domain 4 – Sensitivity / Responsivity



SENSITIVITY / RESPONSIVITY TO EACH OTHER					
Often follows child & responds to child's affective state correctly	☐ 3	Mom	Child	☐ 3	Often follows mom & positively responds to her affect attentively
Variable	☐ 2			☐ 2	Variable
Rarely interprets or responds to child's affective state correctly	☐ 1			☐ 1	Rarely attentive to mom or responsive to her affect



Domain 4 – Sensitivity / Responsivity



Global Domain – Yes / No

ARE THE TWO EMOTIONALLY CONNECTED?

YES

☐

NO



Noldus Observational Software

205 4 Month.mov



Playback Control

46.41 1 x

Time	Behavior	Modifier	Comment
45.48	Smile		
53.52	Gaze off infant		
53.62	Positive affect		
53.95	Gaze off infant		
58.46	Positive affect		
66.87	Positive affect		
66.87	Gaze off infant		

Codes

Subjects Behaviors Modifiers

Status

Mom

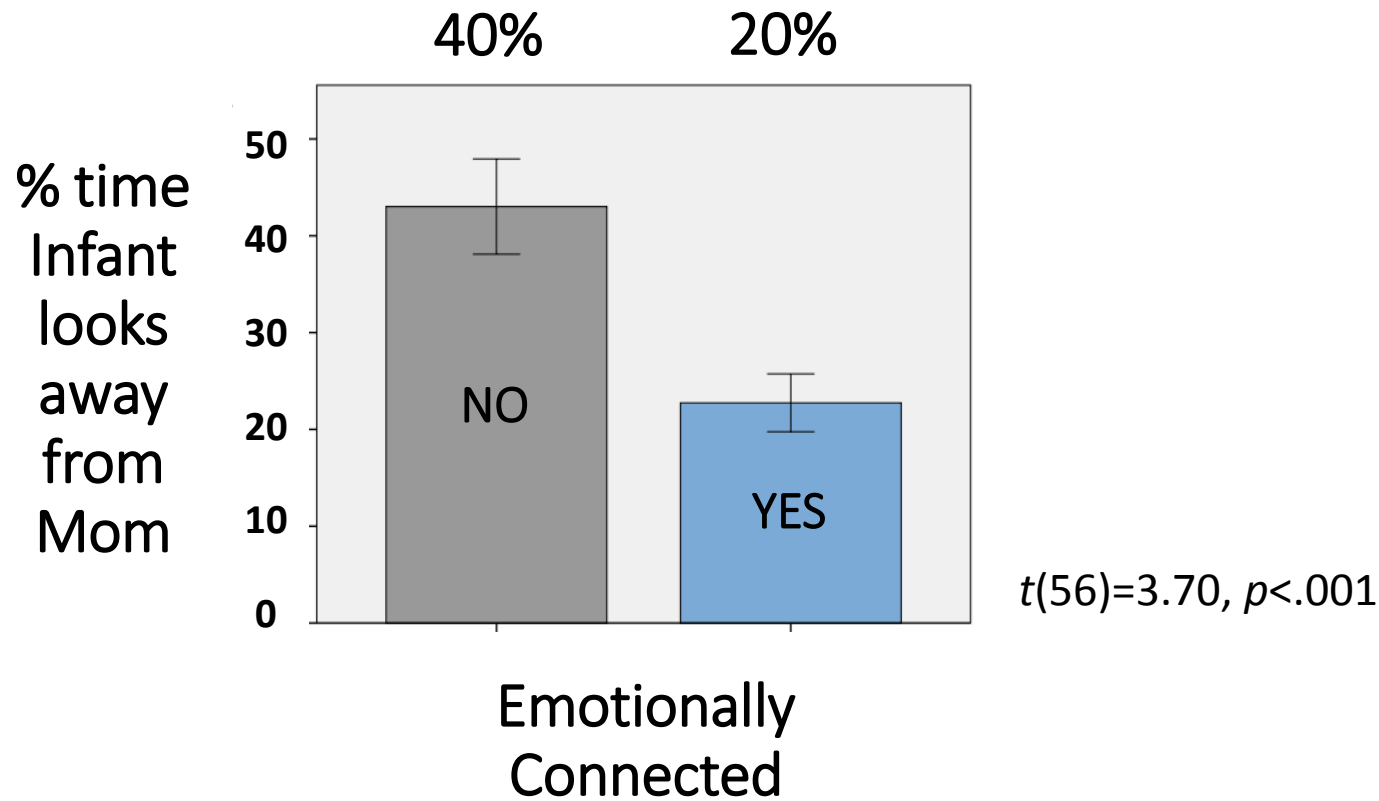
Beep		B	
Mom initial		M	
Gaze off infant		1	2
Vocalizations	* Subjec...	e	r
Touch infant	* Subjec...	u	i
Positive affect	* Subjec...	4	5

WECS compared with Noldus coding

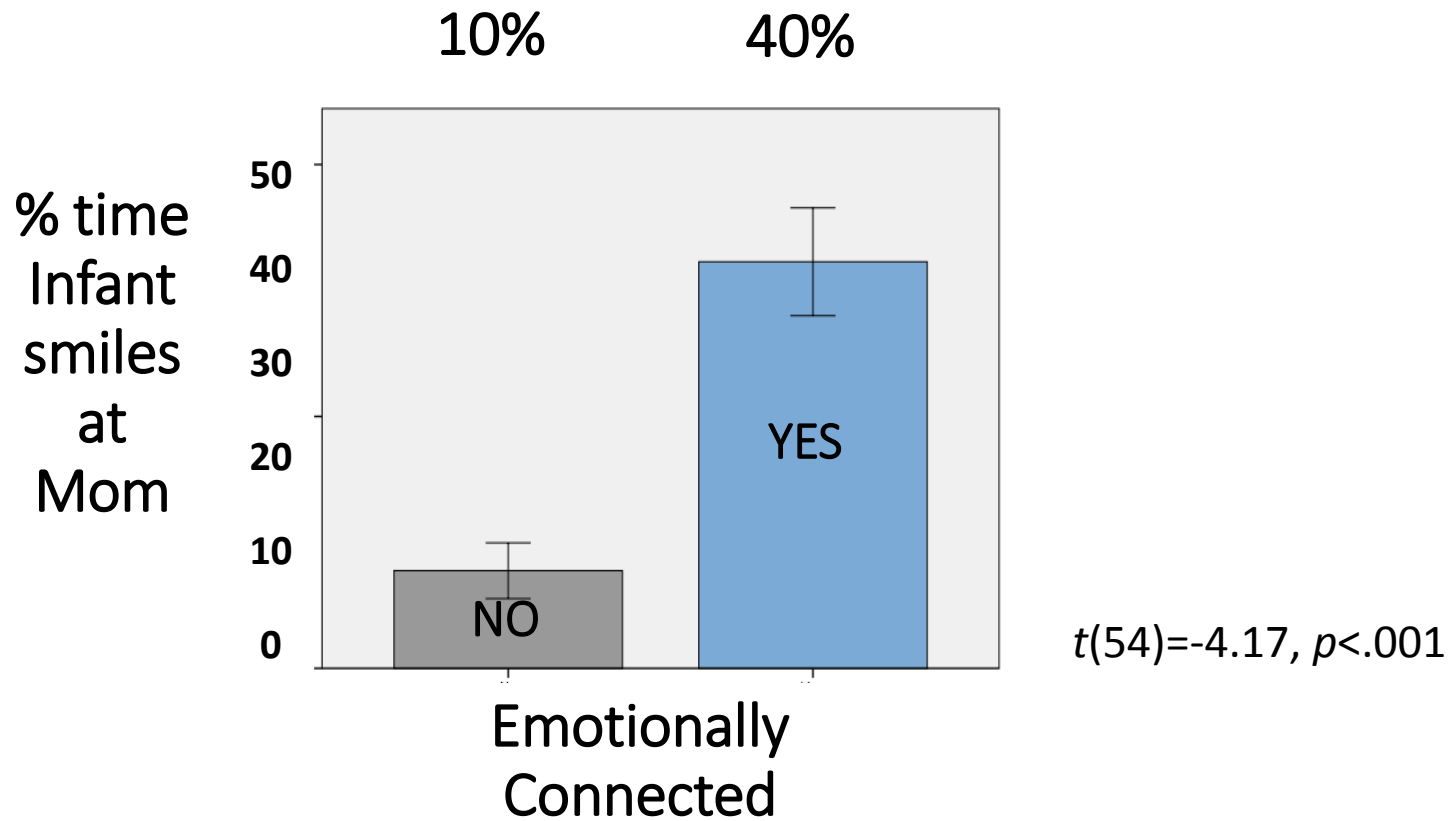
	Mom		Infant				
WECS Item	% Negative affect	% Positive affect	% Smile	% Looks away from mom	% Looks toward mom	% Vocal distress	% Turns head away from mom
Mother Attraction	-.16	.20	.22	-.04	-.09	.08	-.41 **
Infant Attraction	.21	-.21	.47 **	-.58 **	.40 **	-.26 *	-.14
Mother Affective Vocal	-.28 *	.16	.16	-.13	-.003	-.14	.13
Infant Affective Vocal	-.06	.29 *	.43 **	-.25	.32 *	-.23	-.21
Mother Facial Expression	-.16	.34 **	.36 **	-.08	-.04	.32 *	-.14
Infant Facial Expression	-.17	.36 **	.57 **	-.37 **	.17	-.60 **	-.15
Mother Sensitivity	-.20	.23	.45 **	-.37 **	.17	-.34 **	-.15
Infant Sensitivity	-.19	.20	.48 **	-.50 **	.29 *	-.19	-.11



Eye Contact



Smiling



WECS Prediction to 18-Month Outcome



4-Mos WECS Predicts 18 Mos Referral



	With Risk	Without Risk
Clinical Referral Measure	WECS Sensitivity	WECS Specificity
MCHAT =>3 Total Item Failed, =>2Critical Item Failed	75%	76%
CBCL T>50 Total Problems	88%	94%
Bayley Cognitive DQ<85	78%	76%
Met any of the above referral criteria	65%	78%

All X^2 $p<.005$

Goals of the WECS



- Measure new construct – *Emotional Connection*
- Apply to entire population of parents and children 0-5
- Measure of mother/infant relational health and social behavior (especially one that predicts ASD risk)
- Replace labor intensive coding in large-scale longitudinal studies





- **Assess risk or progress**
 - Variety of settings – hospital, clinic, home, daycare, school
 - Variety of situations – holding, toy play, basic care tasks
 - Brief observations - 10 minutes or less
- **Screen and Refer**
- **Monitor Progress** - Continued observations
 - Assess emotional connection in any intervention
- **Training Practitioners**
 - Train clinician to see relational health of the dyad
 - Identify points for intervention



Dissemination Strategy



FNI-NICU model

Preterm Proof of concept NICU RCT

CHONY

Preterm Replication NICU RCTs

CHONY

UT Health Science Center at San Antonio

South Miami Hospital

UT Health Science Center at Houston

Parkland Memorial Hospital – UTSW

Children’s Medical Center Dallas - UTSW

Preterm Effectiveness trials

Above 6 NICUs

Valley Hospital – Ridgewood, NJ

Preschool model

2 - 4 yr olds Proof of concept RCT
Group FNI RCT

NSP Clinic, NYC

Norwalk, CT Housing Authority

Welch Emotional Connection Scale (WECS)

Predictive and Construct validity

NICU

Pediatric Practice

6 months Free Play Paradigm UNT



Child has always been this avoidant of his mother



First Breakthrough on Sixth Visit – Complete Emotional Connection





Nurture Science Program



Michael M Myers
Co-Director

Martha G Welch
Director

Robert J Ludwig
Managing Director

Neonatology

Richard A Polin, Chief
Raymond I Stark
Philip Grieve
Joseph Isler

Behavioral Coding

Amie Hane, Director
Joy V Browne

IHN Masters Candidates

Amanda Surman
Marianne Reeves

Post Bacc Students/Interns

Chris Musial
Katie Kwon

NUSURA

Jim Chesnutt

Welch Lab

Muhammad Anwar
Benjamin Y. Klein
Mary McKiernan
Molly Roberts
Suzanne Bryjak
Aaron Kaplan
Joseph Barone
Morgan Firestein
Ewelina Fiedor
Katie Feder
Jasmine LaCoursiere
Mai Mitsuyama
Ali Schulz
Christian Treat
Maryann Austin
Beatriz Preter
Katherine Velez
Manon Ranger
Jasmine Kaidbey

Developmental Neuroscience

Myron A. Hofer
Harry Shair

Pathology & Cell Biology

Michael D. Gershon
Hadassah Tamir
Kara Gross Margolis
Sam Li
Wanda Sedlik

Data Coordinating Center

Howard Andrews
Judy Austin
David Merl

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