

A stylized icon on the left side of the slide. It features a large blue silhouette of a person's head and shoulders, with a smaller orange silhouette of a child's head and shoulders positioned in front of it, appearing to be held or supported. The overall shape is rounded and organic.

TTAC

NYC Early Childhood
Mental Health

Training and Technical Assistance Center

Reimagining the Transition to Parenthood for 2-Gen Impact

Presented by Catherine Monk, Ph.D.

Diana Vagelos Professor of Women's Mental Health
Columbia University Vagelos College of Physicians and
Surgeons
New York, USA

Who We Are

The New York City Early Childhood Mental Health Training and Technical Assistance Center (TTAC), is funded by the NYC Department of Health and Mental Hygiene (DOHMH)

TTAC is a partnership between the New York Center for Child Development (NYCCD) and the McSilver Institute on Poverty Policy and Research

- **New York Center for Child Development** has been a major provider of early childhood mental health services in New York with expertise in informing policy and supporting the field of Early Childhood Mental Health through training and direct practice
- **NYU McSilver Institute for Poverty Policy and Research** houses the Community and the Managed Care Technical Assistance Centers (CTAC/MCTAC), which offer clinic, business, and system transformation supports statewide to all behavioral healthcare providers

TTAC is tasked with building the capacity and competencies of mental health and early childhood professionals through ongoing training and technical assistance

<http://www.TTACny.org>



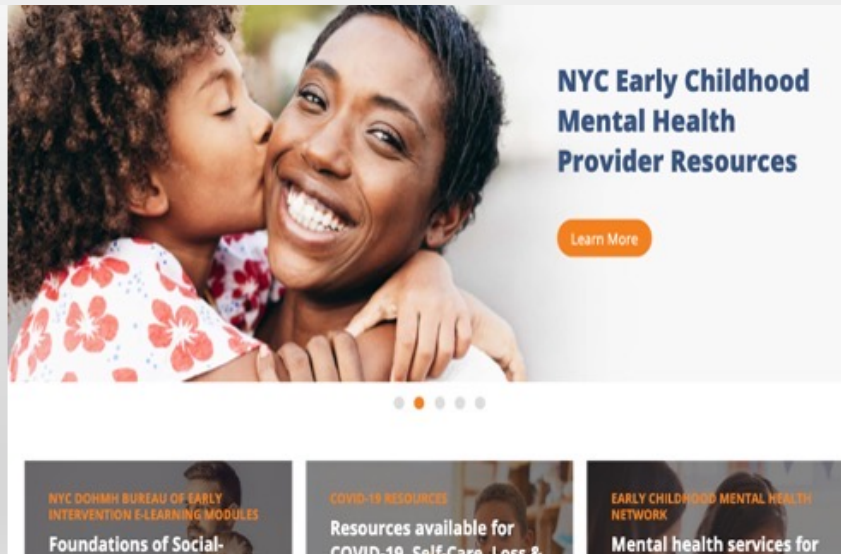
Updated TTAC Website

A Selection of Features:

- Seamlessly filter, toggle and search through upcoming and archived content, trainings and resources
- View videos, slides, and presenter information on the same training page
- Contact the TTAC team by clicking on Ask TTAC and filling out our Contact Us form
- And more!

Have questions or need assistance? Please contact us at ttac.info@nyu.edu and we'll be happy to assist you

Explore all
the provider
resources at
ttacny.org



TTAC Infant and Early Childhood Mental Health (IECMH) Learning Modules are now live!

Two Learning Modules:

- The first module in the series is **the Impact of Early Childhood Adversity (An Overview of the Topic)**
- The second module in the series is **Nurturing Resilience: Supporting Infant and Early Childhood Mental Health**
- CEUs Available upon completion!

MODULE I

Infant & Early Childhood Mental Health and the Impact of Adversity

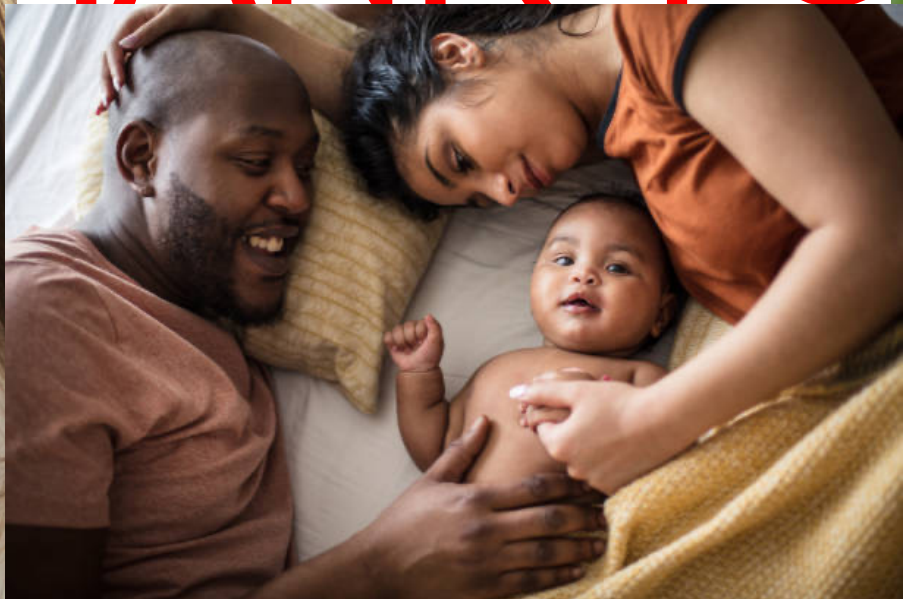




Reimagining the Transition to Parenthood for 2-Gen Impact

Catherine Monk, Ph.D.

Diana Vagelos Professor of Women's Mental Health
Columbia University Vagelos College of Physicians and Surgeons
New York, USA



THANK YOU!!!



Topics

- **PART 1**

- Prenatal Programming

- Past
- Present
- Future
- Caveats

- **PART 2**

- Parental Psychological and Biological Plasticity
- Active Consideration: Enhancing the Perinatal Ecosystem for 2-Gen Impact



Prenatal Programming



*“The womb is an influential
first home.”*

– David James Purslove Barker,
physician and epidemiologist, born 29 June 1938; died 27 August 2013

- * Experiences and context of pregnant person's life affect the developing child
- * The *ex-utero* environment affects the developing child
- * A range of exposures considered: diet, emotions (mood), substance use, (pollution, toxicants)

OCTOBER 4, 2010

Environment Special:
The oceans—why 70%
of our planet is in danger

The Facebook Movie:
The secret history of
social networking

TIME

How the first nine months shape the rest of your life

The new science
of fetal origins

BY ANNIE MURPHY PAUL



WWW.TIME.COM

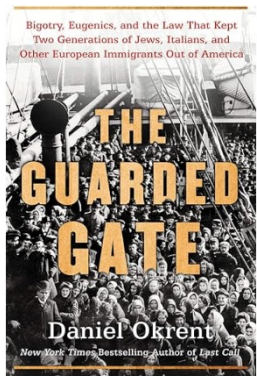
Developmental
Origins of Health
and Disease
(DOHaD)

Prenatal Programming: Past



Throughout History...

- *The daughter of Virata . . . {was} exceedingly afflicted by grief on account of the death of her husband . . . They all feared that the embryo in her womb might be destroyed.* The Mahabharata, Book 14, Section LXII (500 BC; cited in Dipietro, JA 1996)
- *For behold, when the sound of your greeting came to my ears, the baby in my womb leaped for joy.* Luke 1: 44-45
- *The criminal and vicious classes were made so by their mothers during gestation.* Victoria Woodhull, American suffragist, 1875



(and the reality of now...)

- *The criminal and vicious classes were made so by their mothers during gestation.*
Victoria Woodhull, American suffragist, 1875



Original Investigation | Obstetrics and Gynecology

Association of Preterm Births Among US Latina Women With the 2016 Presidential Election

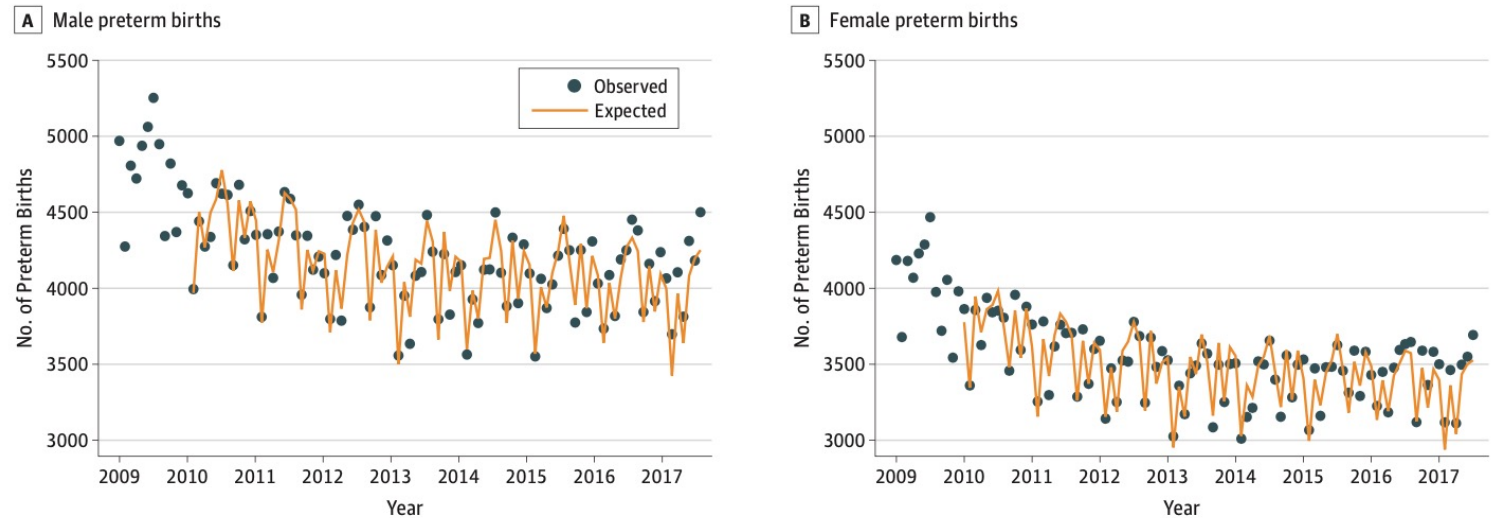
Alison Gemmill, PhD; Ralph Catalano, PhD; Joan A. Casey, PhD; Deborah Karasek, PhD; Héctor E. Alcalá, PhD; Holly Elser, PhD; Jacqueline M. Torres, PhD

(and the reality of now...)

Association of Preterm Births Among US Latina Women With the 2016 Presidential Election

Alison Gemmill, PhD; Ralph Catalano, PhD; Joan A. Casey, PhD; Deborah Karasek, PhD; Héctor E. Alcalá, PhD; Holly Elser, PhD; Jacqueline M. Torres, PhD

Figure 1. Observed and Expected Monthly Trend of Male and Female Preterm Births to Latina Women



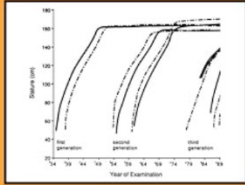
In the 9-month period beginning with November 2016, an additional 1342 male (95% CI, 795-1889) and 995 female (95% CI, 554-1436) preterm births to Latina women were found above the expected number of preterm births had the election not occurred.

Back to History...

GROWTH,
MATURATION
AND BODY
COMPOSITION

The Fels Longitudinal
Study 1929–1991

ALEX F. ROCHE



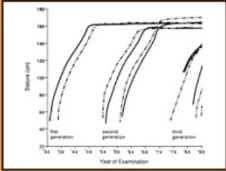
The Fels Longitudinal Study

- Founded in Yellow Springs, Ohio, in 1929 as part of the Fels Research Institute; one of five similar studies that began in the United States between 1927 and 1932
- Arthur Morgan, then president of Antioch College in Yellow Springs, posed the question, "*What makes people different?*"

GROWTH,
MATURATION
AND BODY
COMPOSITION

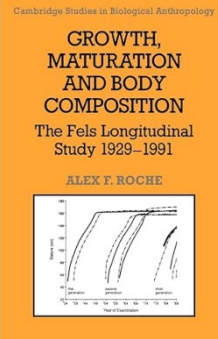
The Fels Longitudinal
Study 1929–1991

ALEX F. ROCHE



The Fels Longitudinal Study

- *“Most of the vast amount of study on the physical and mental development of children has begun with birth, more or less completely neglecting the possible influence of environment during the period of intra-uterine development”.*
(Sontag & Wallace, 1934)
- Understood development starts *in utero* though realized studies were limited because *“our organism is not seen, nor scarcely felt nor heard”*



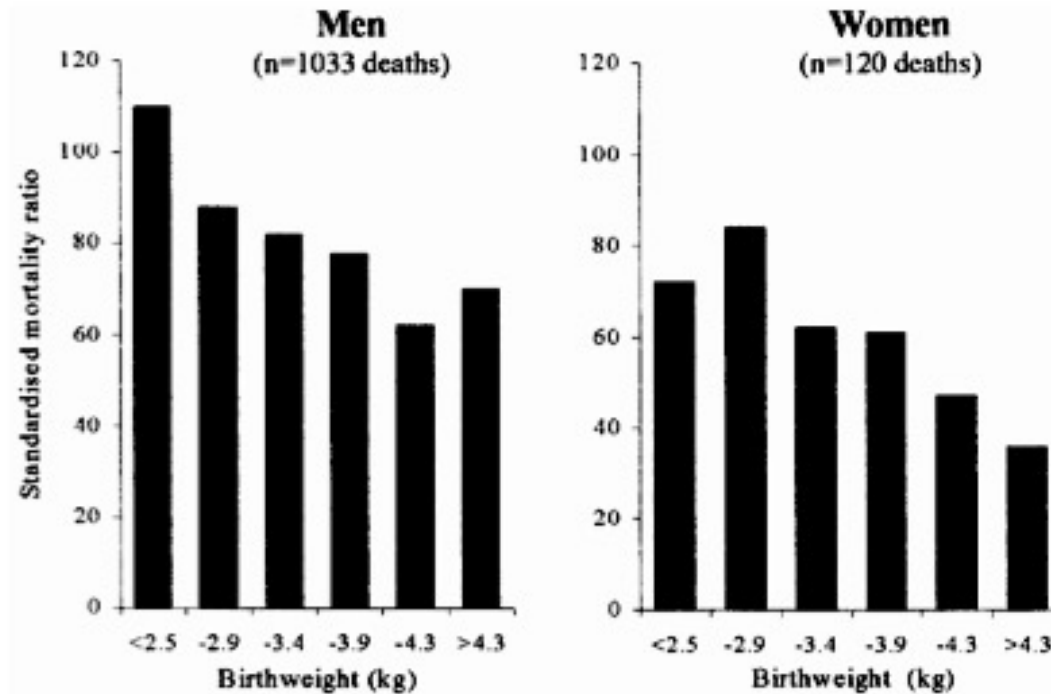
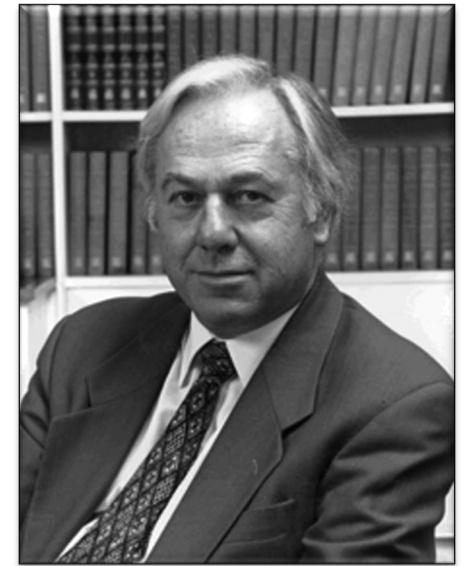
The Fels Longitudinal Study

- Maternal diet related to infant birthweight
- Fetal movement frequency accounted for 30-70% of the variance in infant performance on Gesell scale at 6 months (Richards & Newbery, 1938)
 - Mothers who are better observers, higher IQ OR increased use of nervous system during period of myelinization, improved function (Sontag, 1941)
- Maternal smoking associated with increased baseline fetal heart rate “*due to passage of toxins into the fetal circulation*” (Sontag & Wallace, 1935)

Fetal programming and adult health

Keith M Godfrey* and David JP Barker

MRC Environmental Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton, SO16 6YD, UK



Birthweight considered, in part, a consequence of fetal exposure to inadequate maternal nutrition

Fig. 1 Coronary heart disease death rates, expressed as standardized mortality ratios, in 10141 men and 5585 women born in Hertfordshire, UK according to birthweight⁸

The Wellcome Foundation Lecture, 1994.

The fetal origins of adult disease

D. J. P. BARKER

MRC Environmental Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton, SO16 6YD, U.K.

SUMMARY

Recent findings suggest that many human fetuses have to adapt to a limited supply of nutrients and in doing so they permanently change their physiology and metabolism. These 'programmed' changes may be the origins of a number of diseases in later life, including coronary heart disease and the related disorders: stroke, diabetes and hypertension.

Proceedings of the Bio Sci (1995)

Early Leaders in Prenatal Programming

Of Human Bonding: Newborns Prefer Their Mothers' Voices

Abstract. By sucking on a nonnutritive nipple in different ways, a newborn human could produce either its mother's voice or the voice of another female. Infants learned how to produce the mother's voice and produced it more often than the other voice. The neonate's preference for the maternal voice suggests that the period shortly after birth may be important for initiating infant bonding to the mother.

Human responsiveness to sound begins in the third trimester of life and by birth reaches sophisticated levels (1), especially with respect to speech (2). Early auditory competency probably subserves a variety of developmental functions such as language acquisition (1, 3) and mother-infant bonding (4, 5). Mother-infant bonding would best be served by (and may even require) the

ability of a newborn to discriminate its mother's voice from that of other females. However, evidence for differential sensitivity to or discrimination of the maternal voice is available only for older infants for whom the bonding process is well advanced (6). Therefore, the role of maternal voice discrimination in formation of the mother-infant bond is unclear. If the newborn's sensitivities to

speech subserves bonding, discrimination of and preference for the maternal voice should be evident near birth. We now report that a newborn infant younger than 3 days of age can not only discriminate its mother's voice but also will work to produce her voice in preference to the voice of another female.

06-1174\$00.50/0 Copyright © 1980 AAAS

SCIENCE, VOL. 208, 6 JUNE 1980

ANTHONY J. DECASPER

WILLIAM P. FIFER

*Department of Psychology,
University of North Carolina at
Greensboro, Greensboro 27412*

Early Leaders in Prenatal Programming

Fetal Neurobehavioral Development

**Janet A. DiPietro, Denice M. Hodgson,
Kathleen A. Costigan, and Sterling C. Hilton**

Johns Hopkins University

Timothy R. B. Johnson

University of Michigan

Child Development, 1996

The hypotheses to be tested center on the nature of the maturational function within and across each neurobehavioral domain with advancing gestation. We expect that increased parasympathetic control will be manifest by increased fetal heart rate variability and responsivity to external stimuli; cardiac and movement patterns will become integrated into specific fetal states; and ontogenic parallels and discontinuities will exist across domains. Finally, we propose that maternal stress will significantly affect fetal functioning in a manner consistent with sympathetic activation and/or reduced parasympathetic control.

points. Short-term FHR variability was negatively affected by reports of maternal stress, partially confirming our hypothesis. The potential role of maternal age in this finding is unclear, as older women reported more stress. Variations in neuroendocrine levels

Heart Rate
Variability:

The heart is
happiest
when it
dances

Early Leaders in Prenatal Programming

Developmental Psychology
2004, Vol. 40, No. 3, 445–456

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0012-1649/04/\$12.00 DOI: 10.1037/0012-1649.40.3.445

Fetal Neurobehavioral Development: A Tale of Two Cities

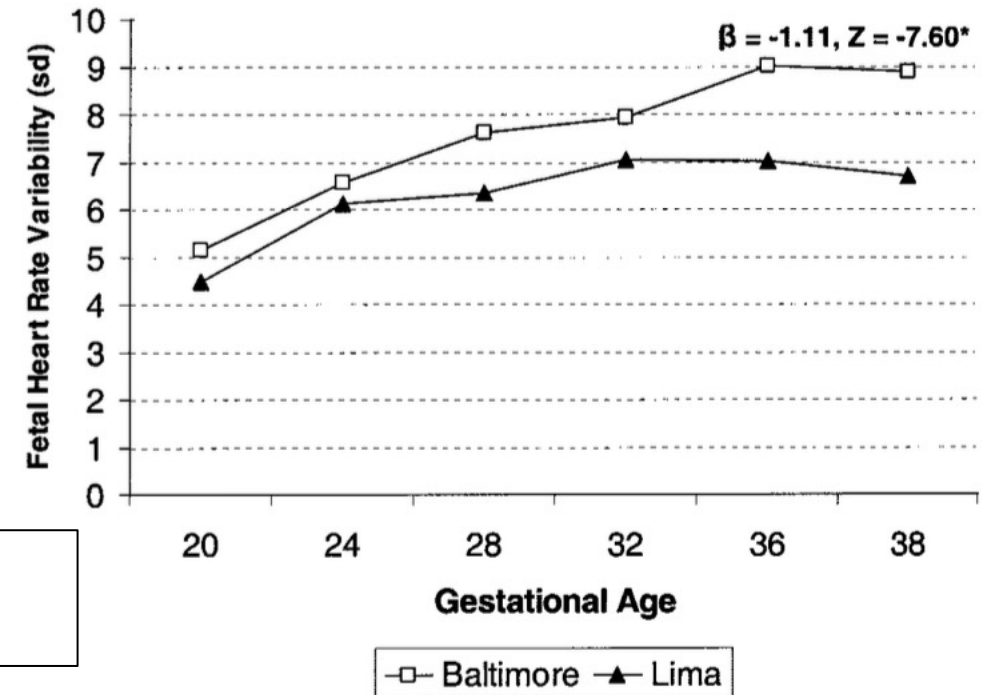
Janet A. DiPietro and Laura E. Caulfield
Johns Hopkins University

Kathleen A. Costigan
Johns Hopkins Medical Institutions

Mario Merialdi and Ruby H. N. Nguyen
Johns Hopkins University

Nelly Zavaleta
Instituto de Investigacion Nutricional

Edith D. Gurewitsch
Johns Hopkins Medical Institutions



Population level
environmental factors

Early Leaders in Prenatal Programming

Published in final edited form as:

Neurotoxicol Teratol. 2011 ; 33(2): 240–243. doi:10.1016/j.ntt.2010.09.003.

Fetal Neurobehavioral Effects of Exposure to Methadone or Buprenorphine

Lauren M. Jansson, MD¹, Janet A. DiPietro, PhD², Martha Velez, MD¹, Andrea Elko, PA-C³, Erica Williams¹, Lorraine Milio, MD³, Kevin O'Grady, PhD⁴, and Handrée E. Jones, PhD⁵

- buprenorphine-exposed vs. methadone-exposed fetuses had
 - higher levels of fetal heart rate variability, more accelerations in fetal heart rate and greater coupling between fetal heart rate and fetal movement (24, 28 gestational weeks)
 - less suppression of motor activity and longer duration of movements (32, 26 gestational weeks)
 - These results may have implications for the optimal treatment of the opioid-dependent pregnant woman

Early Leaders in Prenatal Programming

BRITISH JOURNAL OF PSYCHIATRY (2002), 180, 502-508

Maternal antenatal anxiety and children's behavioural/emotional problems at 4 years[†]

Report from the Avon Longitudinal Study of Parents
and Children

THOMAS G. O'CONNOR, JONATHON HERON, JE/
MICHAEL BEVERIDGE and VIVETTE GLOVER

Antenatal Anxiety Predicts Child Behavioral/Emotional Problems Independently of Postnatal Depression

THOMAS G. O'CONNOR, PH.D., JONATHAN HERON, PH.D., VIVETTE GLOVER, PH.D.,
AND THE ALSPAC STUDY TEAM

J. AM. ACAD. CHILD ADOLESC. PSYCHIATRY, 41:12, DECEMBER 2002

The persisting effect of maternal mood in pregnancy on childhood psychopathology

KIERAN J. O'DONNELL,^a VIVETTE GLOVER,^b EDWARD D. BARKER,^c AND THOMAS G. O'CONNOR^d

^aMcGill University; ^bImperial College London; ^cBirkbeck University; and ^dUniversity of Rochester Medical Center

Abstract

Developmental or fetal programming has emerged as a major model for understanding the early and persisting effects of prenatal exposures on the health and development of the child and adult. We leverage the power of a 14-year prospective study to examine the persisting effects of prenatal anxiety, a key candidate in the developmental programming model, on symptoms of behavioral and emotional problems across five occasions of measurement from age 4 to 13 years. The study is based on the Avon Longitudinal Study of Parents and Children cohort, a prospective, longitudinal study of a large community sample in the west of England ($n = 7,944$). Potential confounders included psychosocial and obstetric risk, postnatal maternal mood, paternal pre- and postnatal mood, and parenting. Results indicated that maternal prenatal anxiety predicted persistently higher behavioral and emotional symptoms across childhood with no diminishment of effect into adolescence. **Elevated prenatal anxiety (top 15%) was associated with a twofold increase in risk of a probable child mental disorder, 12.31% compared with 6.83%, after allowing for confounders.** Results were similar with prenatal depression. These analyses provide some of the strongest evidence to date that prenatal maternal mood has a direct and persisting effect on her child's psychiatric symptoms and support an in utero programming hypothesis.

Developmental or adaptive programming, including in the fetal period, has emerged as a major model for understanding the developmental origins of health outcomes. The model proposes that in utero exposures instigate an adaptive response in the organism that is carried forward in development with persisting effects on behavior and biology. Much of this work focuses on poor nutrition or an index of poor growth (e.g., low birth weight) as the causal factor, although other and additional sources of stress with causal effects may be operating (Barker, 1999; Gluckman & Hanson, 2004; Painter, Roseboom, & Bleker, 2005; Wadhwa, Buss, Entringer, & Swanson, 2009). Evidence for the model as applied to cardiovascular and metabolic outcomes is substantial, derives from numerous large-scale investigations in diverse settings, and has spawned an influential line of study because of its potential to influence health and development of populations in developed and developing countries (Gillman et al., 2007).

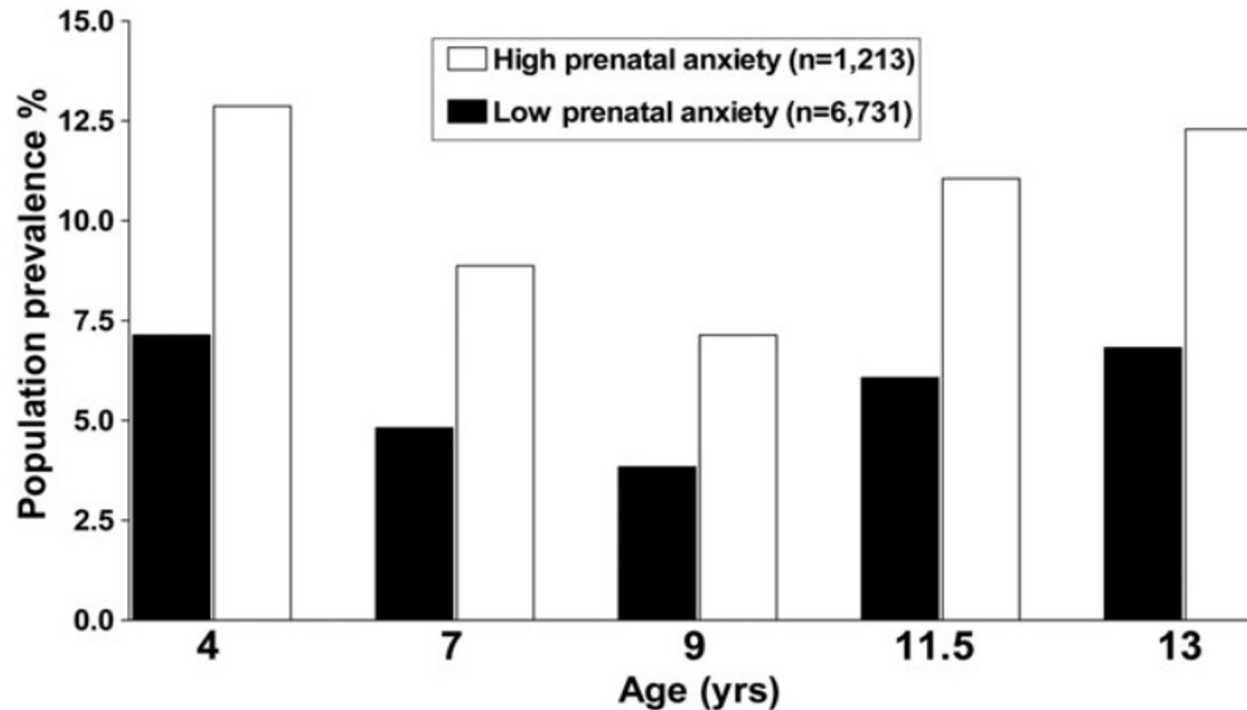
Building on the fetal programming model for somatic health, several research groups are seeking to translate the model for psychological and neuroscience outcomes. These studies focus on maternal prenatal anxiety or stress as a putative causal agent initiating a developmental programming response. The focus on prenatal anxiety or stress follows from decades of experimental animal studies linking prenatal stress to sizable and lasting effects on offspring fear, neurogenesis, immunity, and stress physiology, among other outcomes (Coe et al., 2003; Maccari et al., 2003). A number of observational studies in humans show that prenatal anxiety or stress in the mother is associated with behavioral outcomes in children (Bergman, Sarkar, O'Connor, Modi, & Glover, 2007; Buitelaar, Huizink, Mulder, de Medina, & Visser, 2003; Davis, Glynn, Waffarn, & Sandman, 2011; O'Connor, Heron, Golding, & Glover, 2003; Robinson et al., 2011; van den Bergh et al., 2006). These results raise important conceptual challenges for studies of developmental models of psychopathology that, with a few exceptions (Fisher et al., 2011; Liu, Portnoy, & Raine, 2012), tend to consider neither prenatal exposures nor programming effects. Furthermore, the hypothesis that there are prenatal programming effects for psychopathology has sizable implications for intervention, and particularly the timing of early interventions. Interventions starting in early infancy to promote the mother–infant relationship and the quality of parenting (Allen, 2011; Melhuish, Belsky, Leyland, & Barnes, 2008) are grounded in research linking the quality of the early postnatal rearing environment and the behavioral, emotional, and cognitive development of the child (Murray et al., 2011; Nelson et al., 2007; Ramchandani

We are extremely grateful to all of the families who took part in this study; the midwives for their help in recruiting them; and the whole Avon Longitudinal Study of Parents and Children team, which includes interviewers, computer and laboratory technicians, clerical workers, research scientists, volunteers, managers, receptionists, and nurses. The UK Medical Research Council, the Wellcome Trust, and the University of Bristol currently provide core support for the Avon Longitudinal Study of Parents and Children. This particular project was funded in part by NIH Grant R01 MH073842.

Address correspondence and reprint requests to: Thomas G. O'Connor, Department of Psychiatry, Wynne Center for Family Research, University of Rochester Medical Center, 300 Crittenden Boulevard, Rochester, NY 14642; E-mail: Tom_OConnor@URMC.Rochester.edu.

Maternal Anxiety & a 2-Fold Increase in Child Mental Health Disorder

Rates of
ADHD,
Anxiety
N=7,944

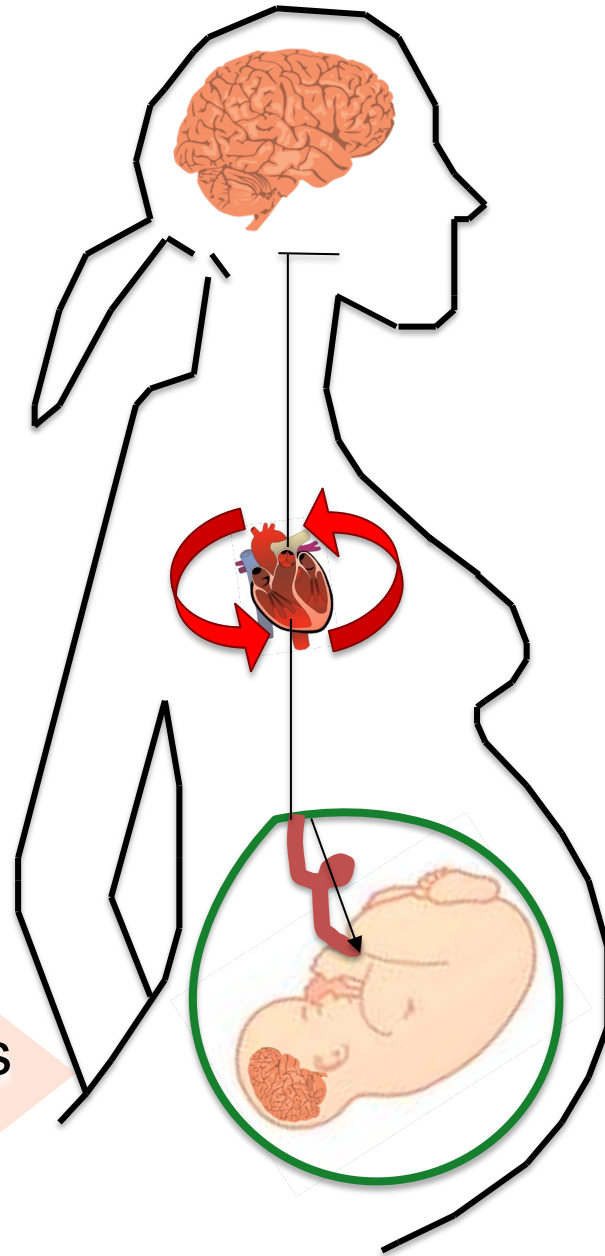


*comparable
results with
depression

Figure 3. The predicted population prevalence of a probable mental health disorder in children born to high (open bars represent the top 15%) and low (filled bars) anxiety mothers. Estimates are based on total Strengths and Difficulties Questionnaire scores generated using growth curve analysis controlling for birth weight, gestational age, substance use in pregnancy, maternal age, education, crowding as index of socioeconomic status, parenting style (see Methods), maternal depression at 8 weeks postnatal, maternal postnatal anxiety at 33 months, paternal prenatal anxiety, paternal postnatal depression at 8 weeks, and paternal postnatal anxiety at 33 months.

Maternal Prenatal Distress

Prenatal distress predicts Postnatal environment



Child Risk for Psychopathology

Asking the fetus questions...



In one study from 1967...

“the patient was told that she was breathing a gas which contained only half the amount of oxygen necessary to support fetal life, but that her normal body mechanisms would probably compensate for this altered environmental condition” (Copher & Huber, 1967)



Maternal heart rate



Fetal heart rate

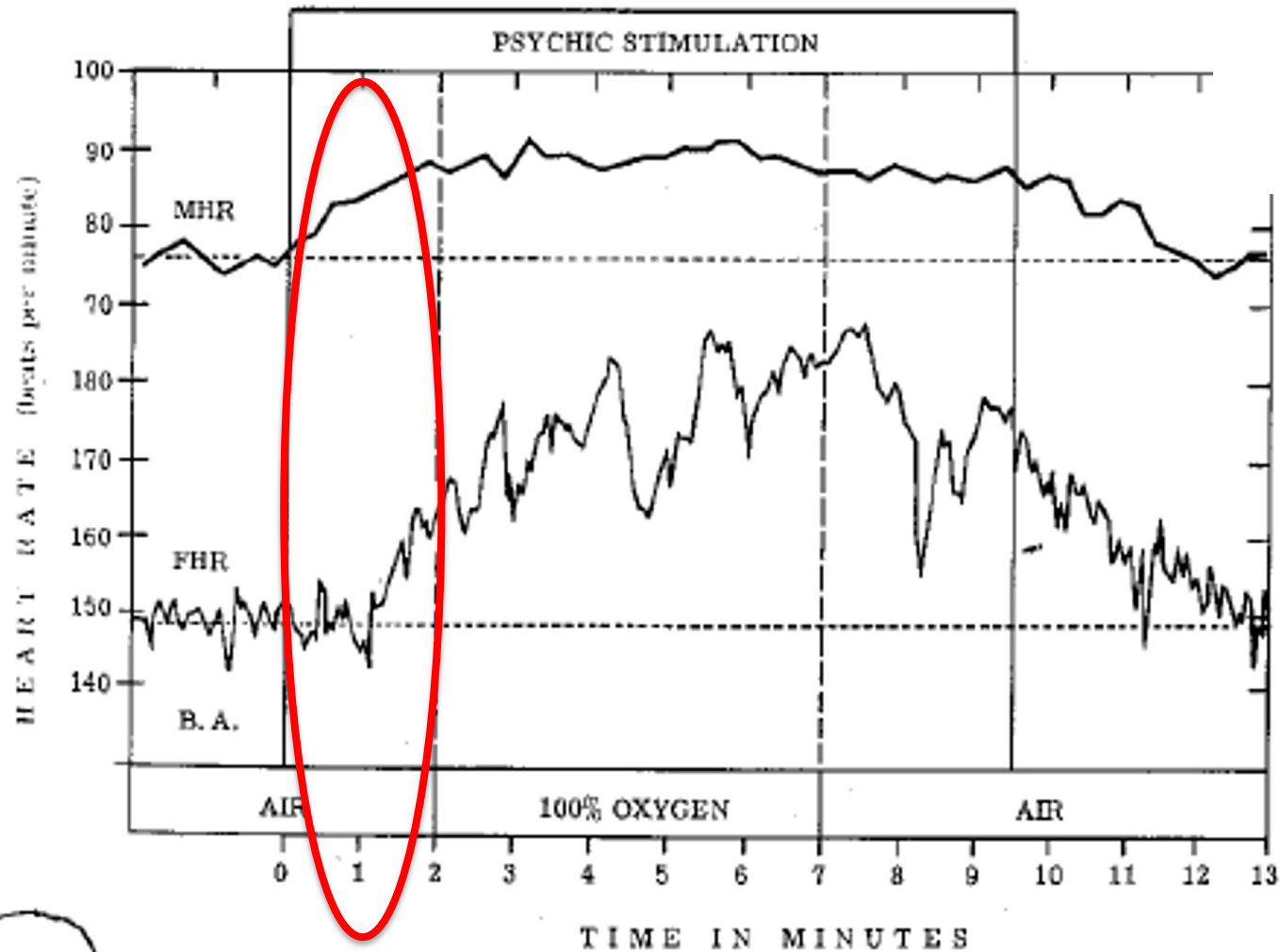
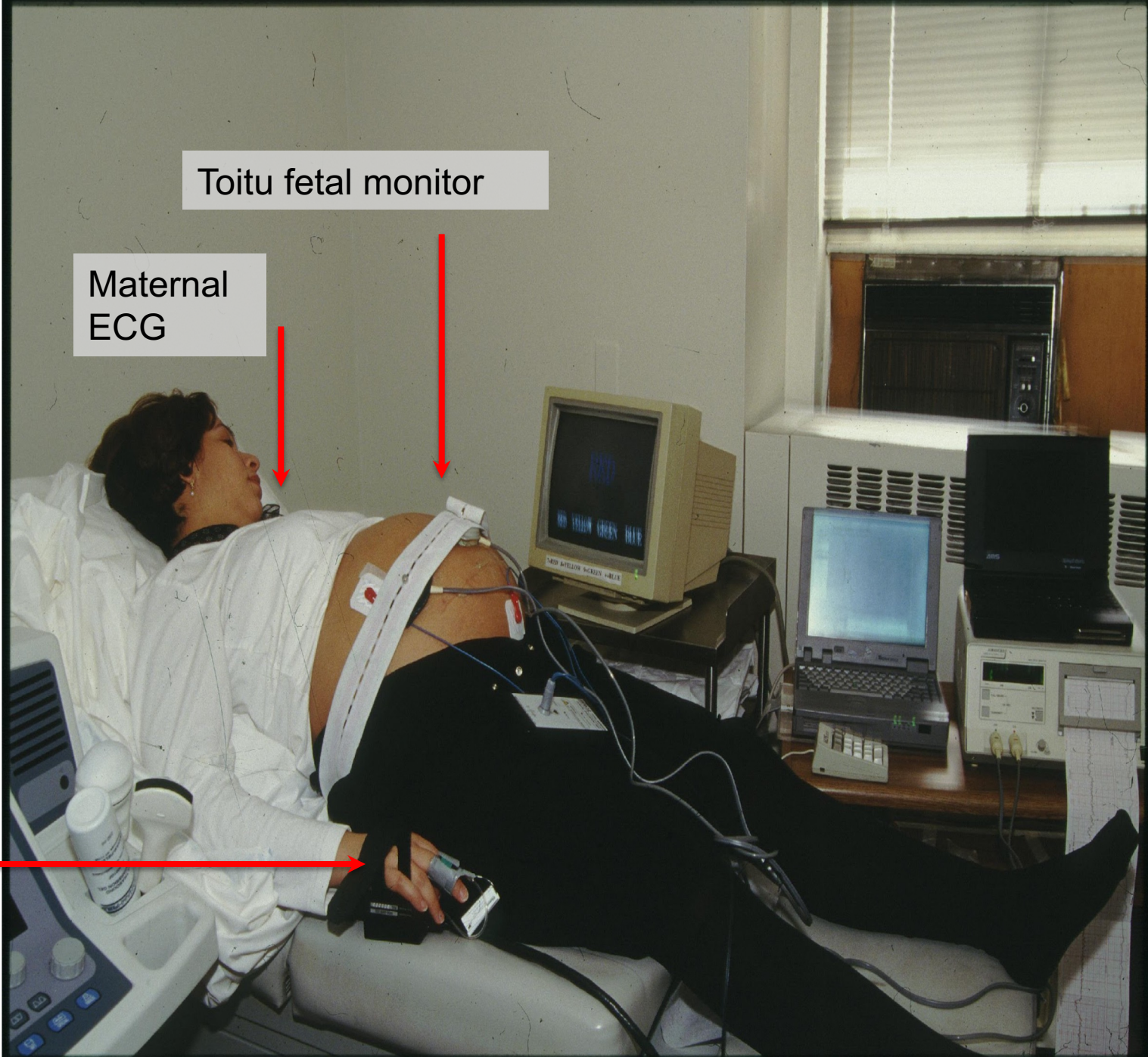


Fig. 3. The effect of induced maternal anxiety with concomitant gaseous stimulation of the maternal and fetal heart rates.

Fetus registers mother's acute emotional experience

Implication: fetus may be shaped over gestation based on exposure to chronic maternal affect experiences



Toitu fetal monitor

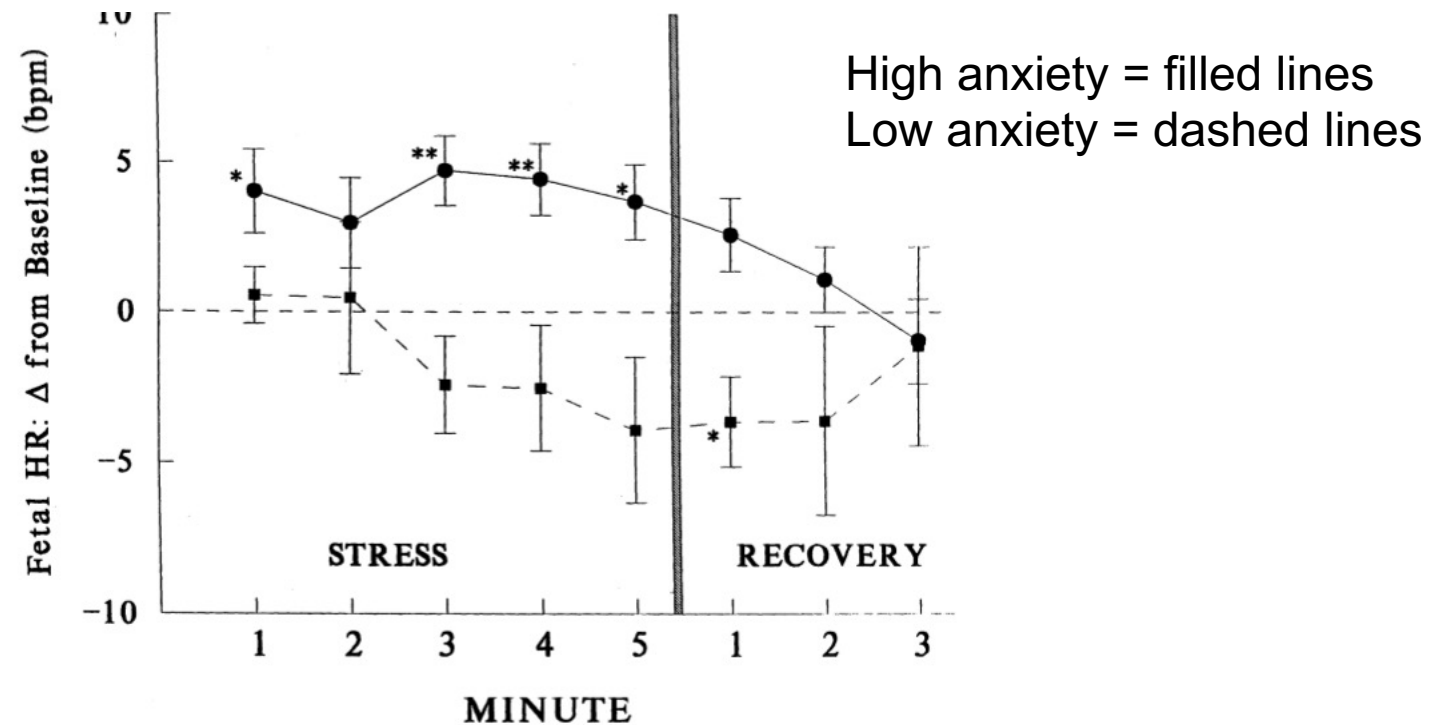
Maternal ECG

Blood pressure

Eliciting Stress in the Lab

- Elicit maternal stress in the laboratory
- Observe transmission to the fetus via fetus registering experience and showing a change in fetal heart rate
- Stressor
- Stroop color word matching task
- NADA

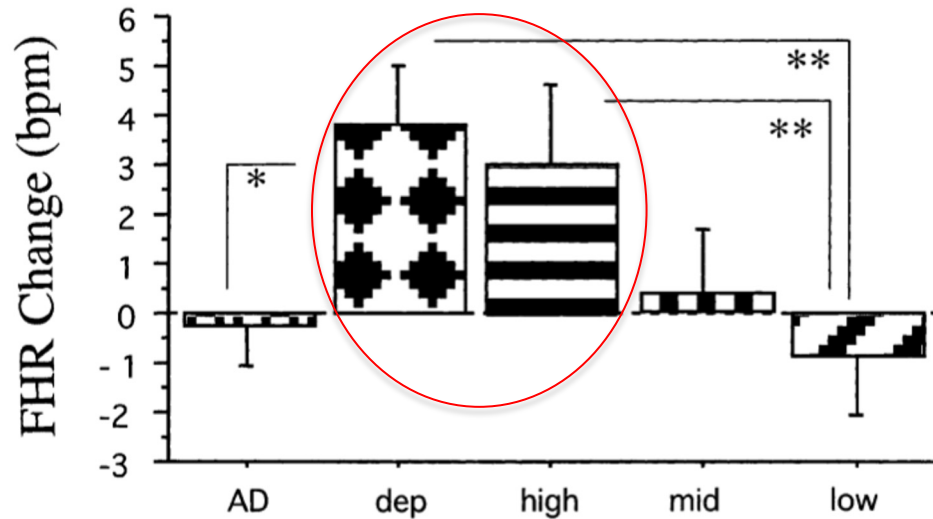
Maternal Stress Responses and Anxiety during Pregnancy: Effects on Fetal Heart Rate



Fetal Heart Rate Reactivity Differs by Women's Psychiatric Status: An Early Marker for Developmental Risk?

CATHERINE MONK, PH.D., RICHARD P. SLOAN, PH.D., MICHAEL M. MYERS, PH.D., LAUREN ELLMAN, B.A., ELIZABETH WERNER, B.A., JIYEON JEON, B.A., FELICE TAGER, PH.D., AND WILLIAM P. FIFER, PH.D.

J. AM. ACAD. CHILD ADOLESC. PSYCHIATRY, 43:3, MARCH 2004



No baseline differences fetal heart rate

No differences in maternal responses to lab stressor

As if a door suddenly opens...

ORIGINAL ARTICLE

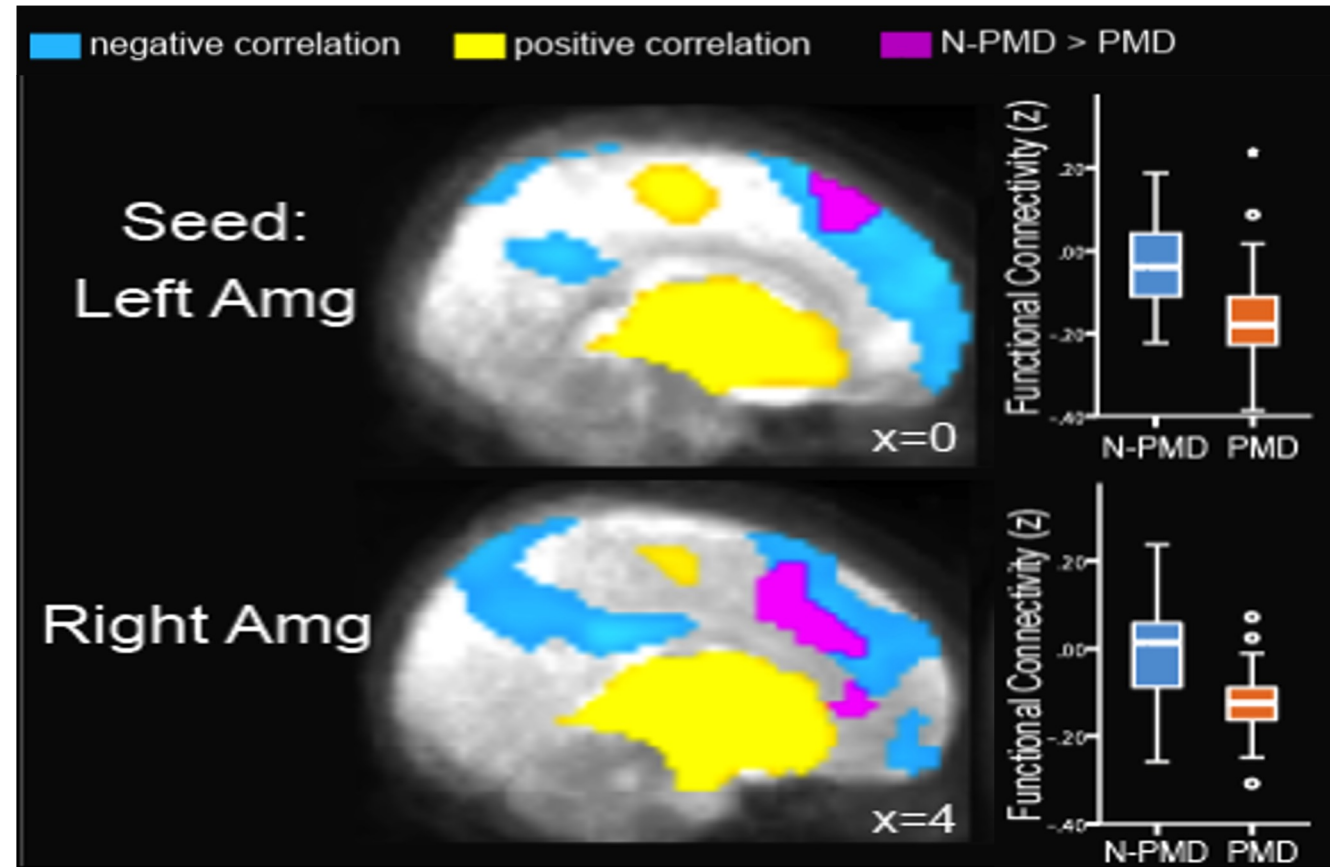
Alterations in amygdala–prefrontal circuits in infants exposed to prenatal maternal depression

J Posner^{1,2,5}, J Cha^{1,2,5}, AK Roy³, BS Peterson⁴, R Bansal⁴, HC Gustafsson¹, E Raffanello², J Gingrich^{1,2} and C Monk^{1,2}

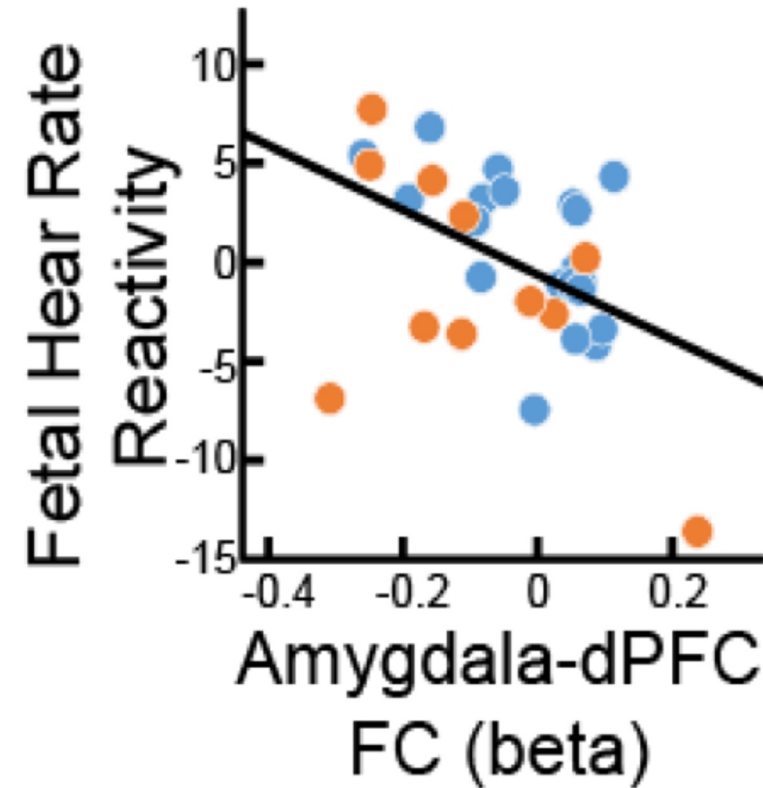
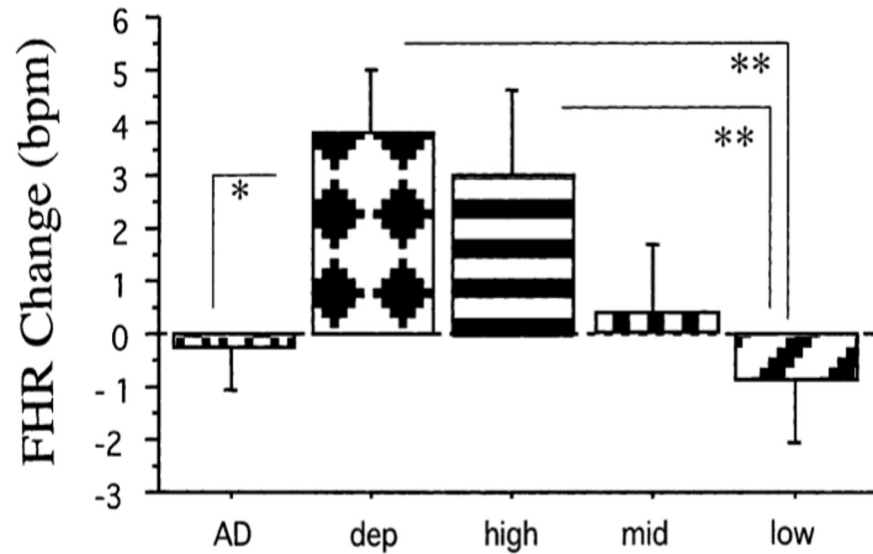


Jiook Cha, Jonathan Posner, Jay Gingrich

fMRI Results: Newborns Exposed to Untreated Maternal Depression versus No Depression Have Less Connectivity between the Prefrontal Cortex and the Amygdala

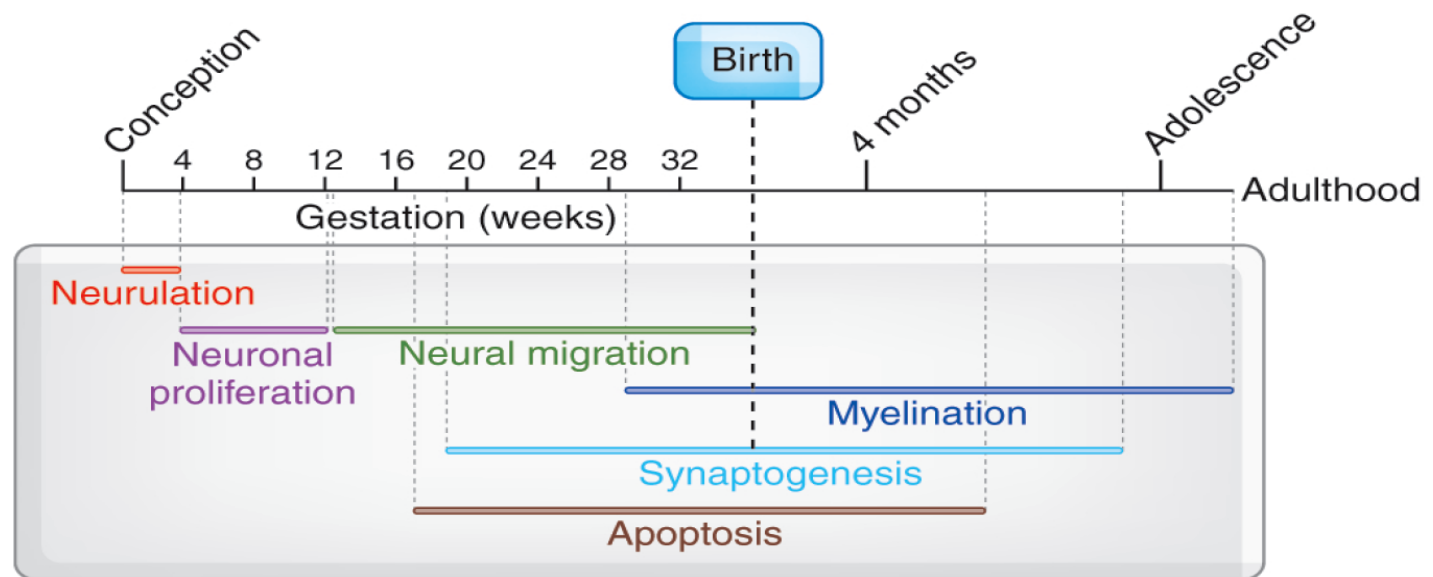


Fetal Heart Rate Reactivity is Associated with Infants' Brain Connectivity



Prenatal Brain Development

- 80–90 billion neurons most produced by mid pregnancy
- Neuronal migration peaks mid pregnancy
- 40,000 new synapses formed every second in late 3rd trimester, a peak period
- Prenatal period is time of rapid development of the fetal brain that outpaces any other stage of the lifespan; during the first year, the brain continues to develop at an amazing rate (Gilmore, J.H., Knickmayer, R. C., & Gao, W. (2018) *Nature Reviews Neuroscience*)



Fetal Heart Rate Reactivity is Associated with Infant Behavior



Elizabeth A. Werner

Michael M. Myers

William P. Fifer

Bin Cheng

Yixin Fang

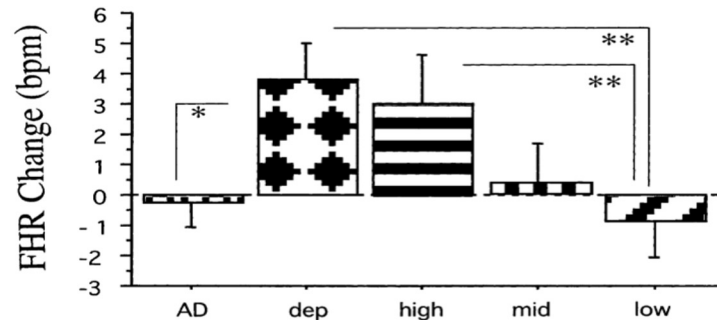
Rhiannon Allen

Catherine Monk

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Prenatal Predictors of Infant Temperament

ABSTRACT: Emerging data suggest that prenatal factors influence children's temperament. In 50 dyads, we examined fetal heart rate (FHR) activity and women's antenatal psychiatric illness as predictors of infant temperament at 4 months (response to novelty and the Infant Behavior Checklist). **FHR change during maternal challenge was positively associated with observed infant motor reactivity to novelty ($p = .02$). The odds of being classified as high versus low motor among fetuses who had an increase in FHR during maternal stress was 11 times those who had a decrease in FHR ($p = .0006$).** Antenatal psychiatric diagnosis was



Elizabeth Werner

Early Childhood Predictors of Adult Anxiety Disorders

Jerome Kagan and Nancy Snidman

From Harvard University, Cambridge, Massachusetts.
Address reprint requests to: Jerome Kagan, Department of Psychology, Harvard
University, 33 Kirkland Street, Cambridge, MA 02138.
Received February 5, 1999; revised May 3, 1999; accepted May 4, 1999.

© 1999 Society of Biological Psychiatry

REPORTS

Inhibited and Uninhibited Infants “Grown Up”: Adult Amygdalar Response to Novelty

Carl E. Schwartz,^{1,2,3*} Christopher I. Wright,^{2,3,4} Lisa M. Shin,^{2,5}
Jerome Kagan,⁶ Scott L. Rauch^{2,3}

20 JUNE 2003 VOL 300 SCIENCE www.sciencemag.org

Prenatal Programming: Present



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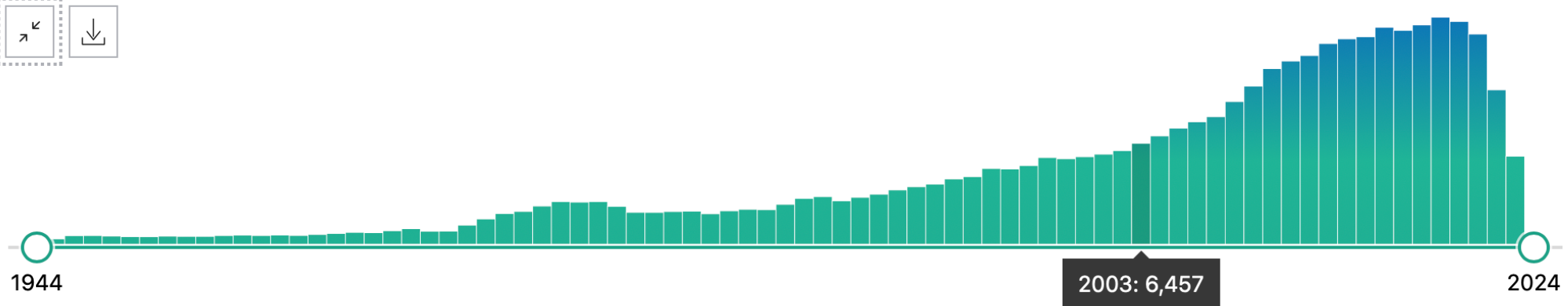
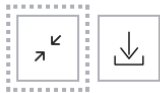


Display options

RESULTS BY YEAR

321,265 results

Page 1 of 32,127



Observational Outcomes

NEW RESEARCH

Check for updates

Associations of Maternal Prenatal Stress and Depressive Symptoms With Childhood Neurobehavioral Outcomes in the ECHO Cohort of the NICHD Fetal Growth Studies: Fetal Growth Velocity as a Potential Mediator

Vanessa Babineau, PhD , Yaneve N. Fonge, MD , Emily S. Miller, MD, MPH, William A. Grobman, MD, MBA, Pamela L. Ferguson, PhD , Kelly J. Hunt, PhD , John E. Vena, PhD, Roger B. Newman, MD, Constance Guille, MD, MSCR, Alan T.N. Tita, MD, PhD, Paula C. Chandler-Laney, PhD , Seonjoo Lee, PhD , Tianshu Feng, MS, Pamela Scorza, ScD, MPH , Lea Takács, PhD , Ronald J. Wapner, MD, Kristy T. Palomares, MD, PhD, Daniel W. Skupski, MD, Michael P. Nageotte, MD, Anthony C. Sciscione, DO, Stephen Gilman, ScD , Catherine Monk, PhD 

J Am Acad Child Adolesc Psychiatry 2022;61(9):1155-1167.



NIH Toolbox: lower levels of inhibitory control, sustained attention in males

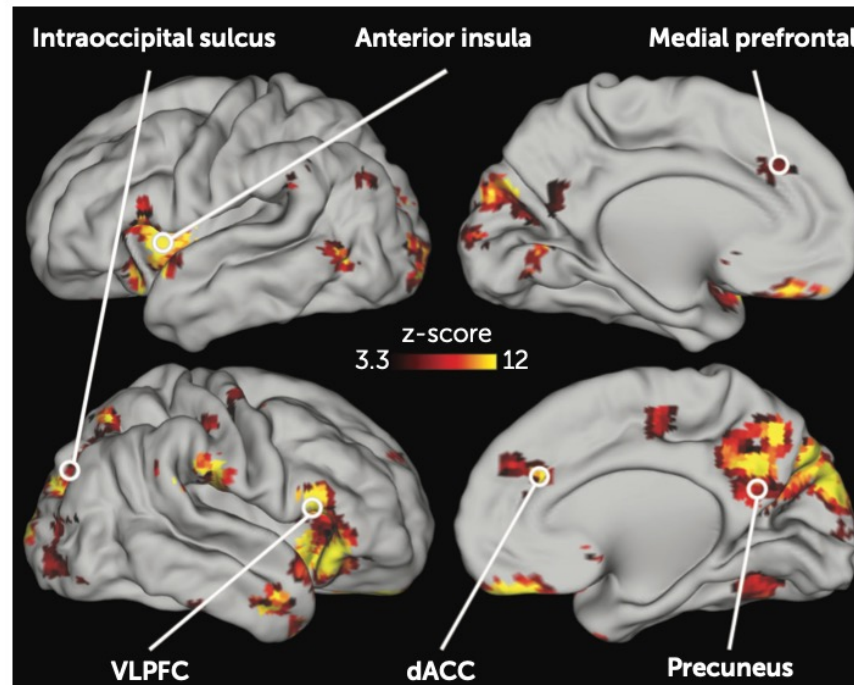
Sophisticated Methodologies: Access to the Brain

Neonatal Brain Response to Deviant Auditory Stimuli and Relation to Maternal Trait Anxiety

Chad M. Sylvester, M.D., Ph.D., Michael J. Myers, B.A., Michael T. Perino, Ph.D., Sydney Kaplan, B.S., Jeanette K. Kenley, B.S., Tara A. Smyser, M.S., Barbara B. Warner, M.D., Deanna M. Barch, Ph.D., Daniel S. Pine, M.D., Joan L. Luby, M.D., Cynthia E. Rogers, M.D., Christopher D. Smyser, M.D.

Am. Journal Psychiatry, 2021

FIGURE 3. Brain areas in which neonatal neural activity following onset of deviant sounds varied depending on maternal trait anxiety^a



- Variation in stimulus response (increased reactivity)
- Increased neural activity related to anxiety disorders in adults: VLPFC, anterior insula, dorsal ACC, and subgenual anterior cingulate

Sex as a Biological Variable

Check for updates

Maternal prenatal stress phenotypes associate with fetal neurodevelopment and birth outcomes

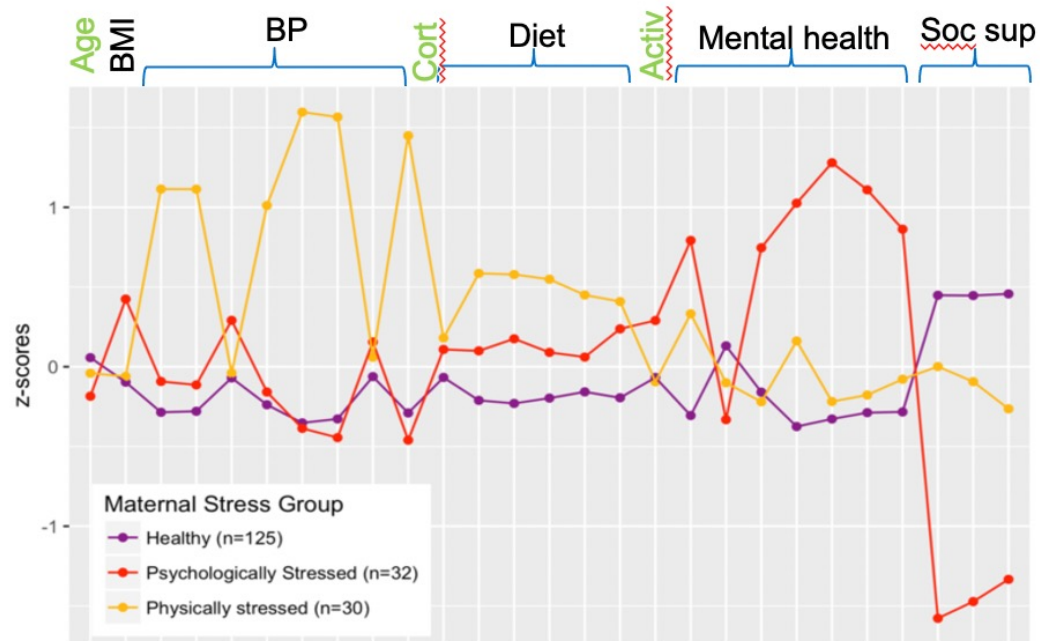
Kate Walsh^{a,b}, Clare A. McCormack^c, Rachel Webster^d, Anita Pinto^e, Seonjoo Lee^{f,g}, Tianshu Feng^g, H. Sloan Krakovsky^d, Sinclair M. O'Grady^d, Benjamin Tycko^h, Frances A. Champagne^{i,j}, Elizabeth A. Werner^{d,i}, Grace Liuⁱ, and Catherine Monk^{d,f,i,1}

^aFerkauf Graduate School of Psychology, Yeshiva University, The Bronx, NY 10461; ^bDepartment of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY 10032; ^cCenter for Science and Society, Columbia University, New York, NY 10027; ^dDepartment of Obstetrics and Gynecology, Columbia University Medical Center, New York, NY 10032; ^eData Science, Columbia University, New York, NY 10027; ^fDivision of Behavioral Medicine, New York State Psychiatric Institute, New York, NY 10032; ^gDepartment of Biostatistics (in Psychiatry), Mailman School of Public Health, Columbia University, New York, NY 10032; ^hHackensack-Meridian Health Center for Discovery and Innovation, Nutley, NJ 07110; ⁱDepartment of Psychiatry, Columbia University, New York, NY 10032; and ¹Department of Psychology, University of Texas at Austin, Austin, TX 78712

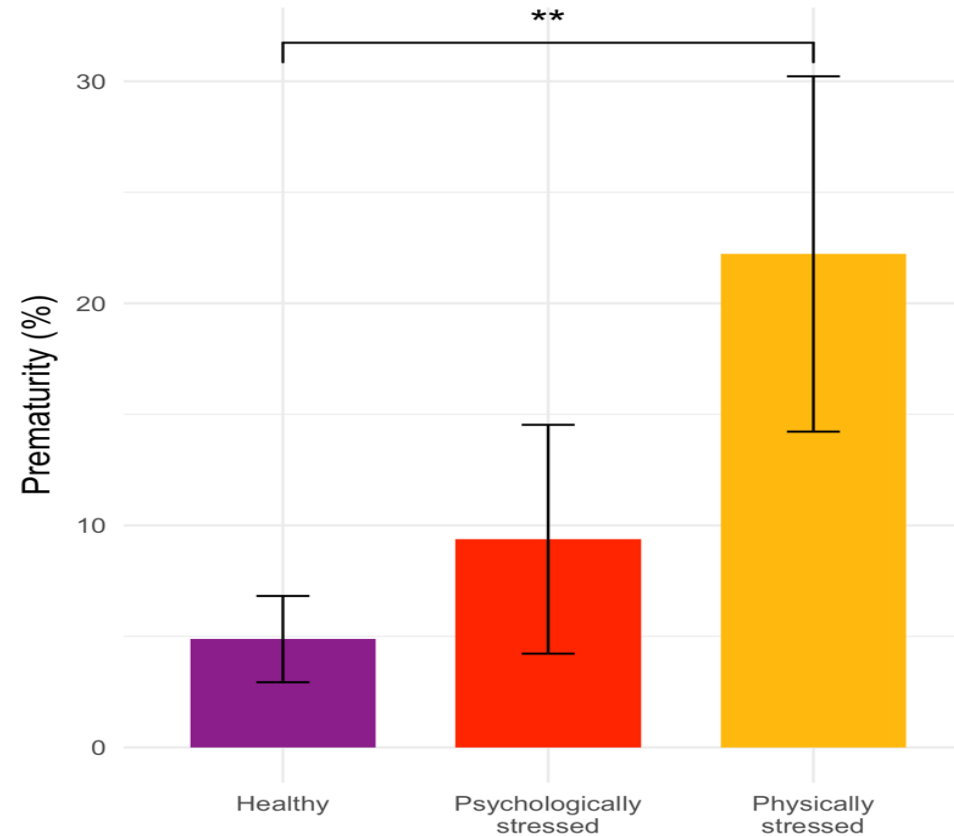
Edited by Bruce S. McEwen, Rockefeller University, New York, NY, and approved September 18, 2019 (received for review April 16, 2019)



AS PNAS



Baby Outcomes Prematurity (\leq to 37 weeks) by Stress Groups



- 67% healthy
- 17% psychologically stressed
- 16% physically stressed

Sex as a Biological Variable

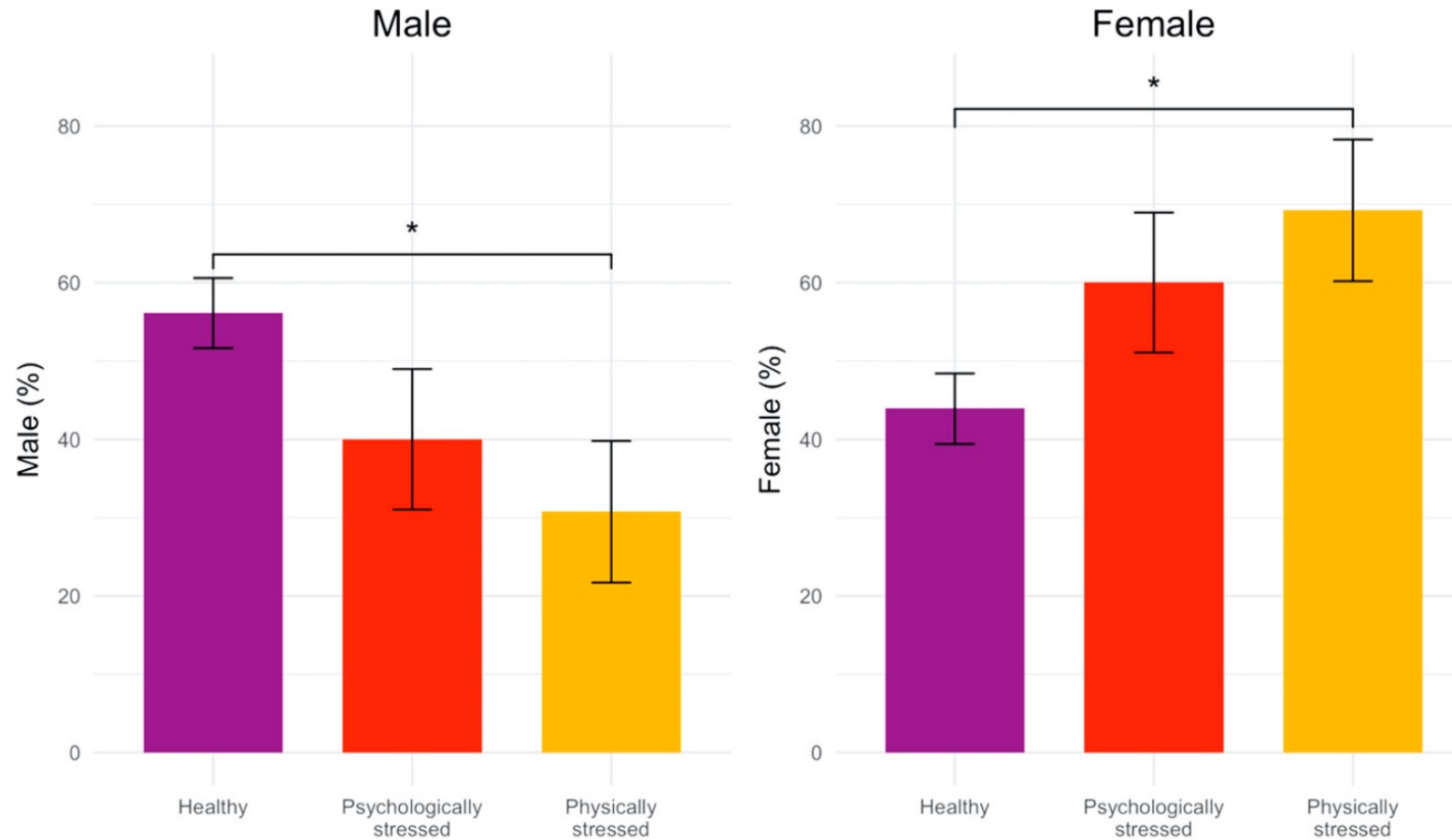


Fig. 2. χ^2 differences in fetal sex (percent) by maternal stress group ($*P < 0.05$) with SE bars; 8 of 187 participants were missing fetal sex. For both sexes, significant differences were only observed between the healthy and physically stressed groups.

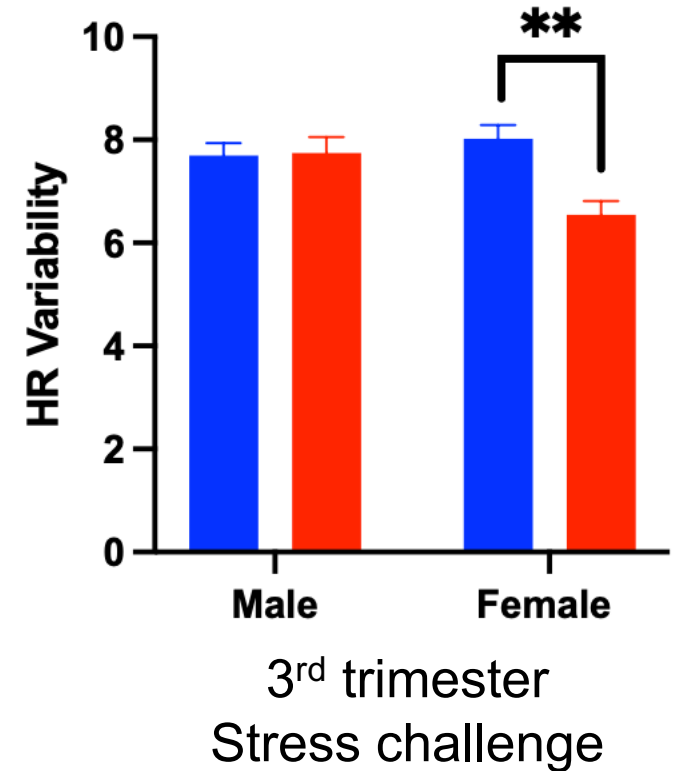
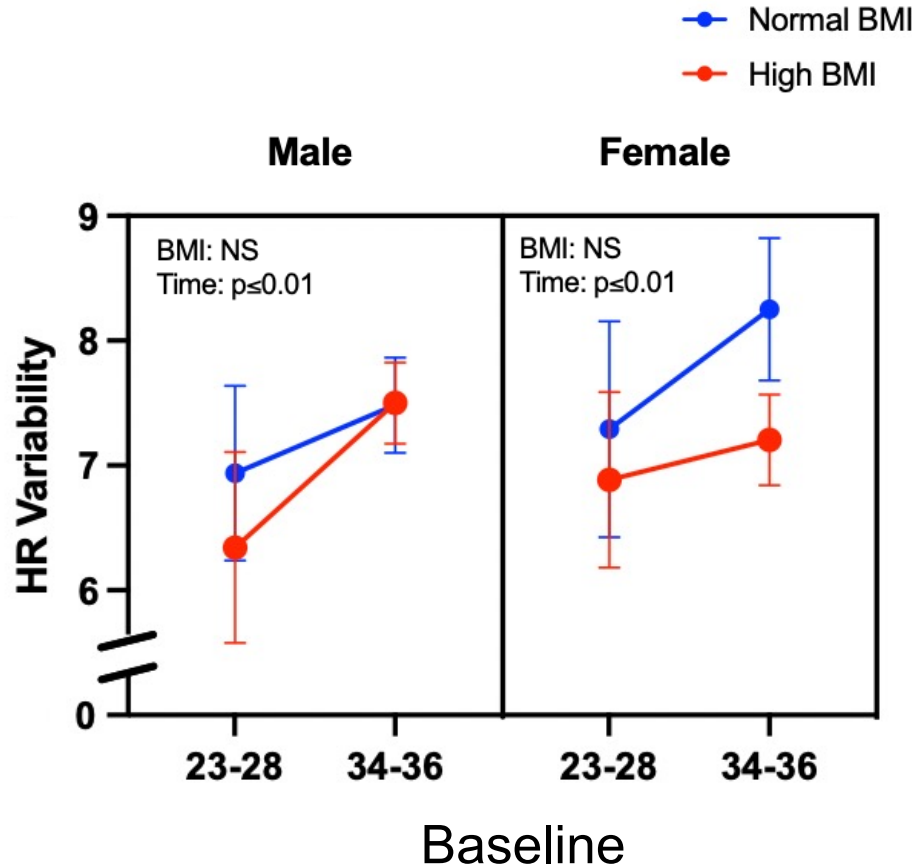


FETAL AUTONOMIC NERVOUS SYSTEM



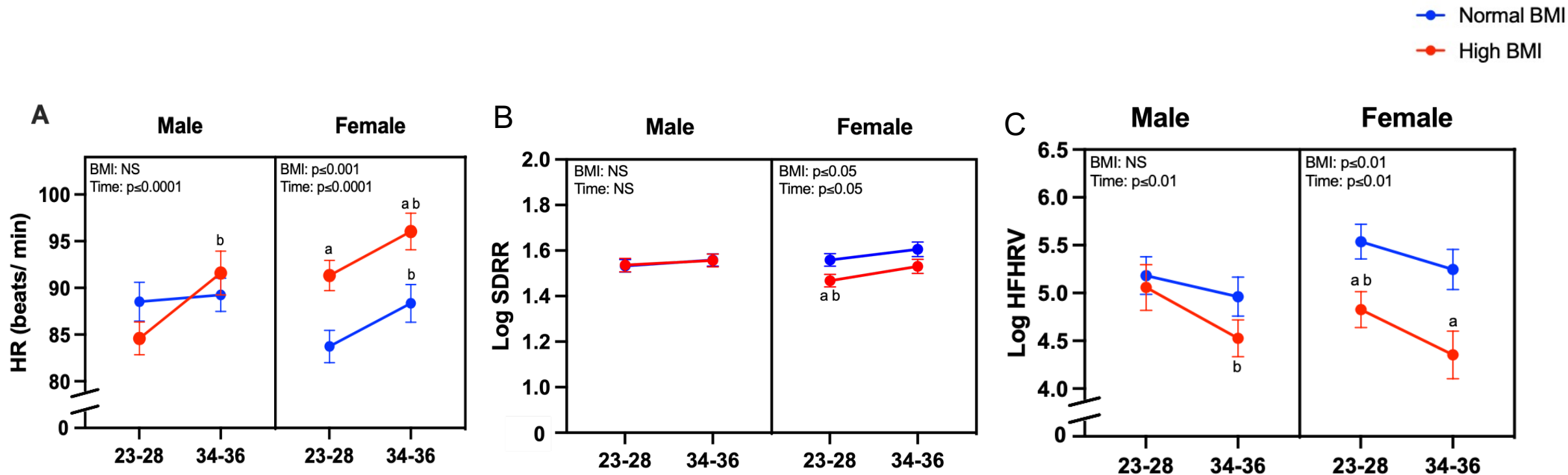
Sameera Abuaisih

Female fetuses of high BMI women had significantly lower HRV





MATERNAL AUTONOMIC NERVOUS SYSTEM



Only high BMI women carrying females had significantly higher HR & lower HRV

Mechanisms of Transmission

AR ANNUAL
REVIEWS

Annual Review of Clinical Psychology

Prenatal Developmental Origins of Future Psychopathology: Mechanisms and Pathways

Catherine Monk,^{1,2,3} Claudia Lugo-Candelas,^{1,3}
and Caroline Trimpff^{1,3}

¹Department of Psychiatry, Columbia University, New York, NY 10032, USA;
email: cem31@cumc.columbia.edu

²Department of Obstetrics and Gynecology, Columbia University, New York, NY 10032,
USA

³New York State Psychiatric Institute, New York, NY 10032, USA;
email: Claudia.Lugo@nyspi.columbia.edu, Caroline.Trimpff@nyspi.columbia.edu

Annu. Rev. Clin. Psychol. 2019. 15:16.1–16.28

The *Annual Review of Clinical Psychology* is online at
clinpsy.annualreviews.org

<https://doi.org/10.1146/annurev-clinpsy-050718-095539>

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Keywords

prenatal stress, DOHaD, brain development, depression, placenta

Abstract

The developmental origins of health and disease hypothesis applied to neurodevelopmental outcomes asserts that the fetal origins of future development are relevant to mental health. There is a third pathway for the familial inheritance of risk for psychiatric illness beyond shared genes and the quality of parental care: the impact of pregnant women's distress—defined broadly to include perceived stress, life events, depression, and anxiety—on fetal and infant brain–behavior development. We discuss epidemiological and observational clinical data demonstrating that maternal distress is associated with children's increased risk for psychopathology: For example, high maternal anxiety is associated with a twofold increase in the risk of probable mental disorder in children. We review several biological systems hypothesized to be mechanisms by which maternal distress affects fetal and child brain and behavior development, as well as the clinical implications of studies of the developmental origins of health and disease that focus on maternal distress. Development and parenting begin before birth.

Cortisol/HPA Axis

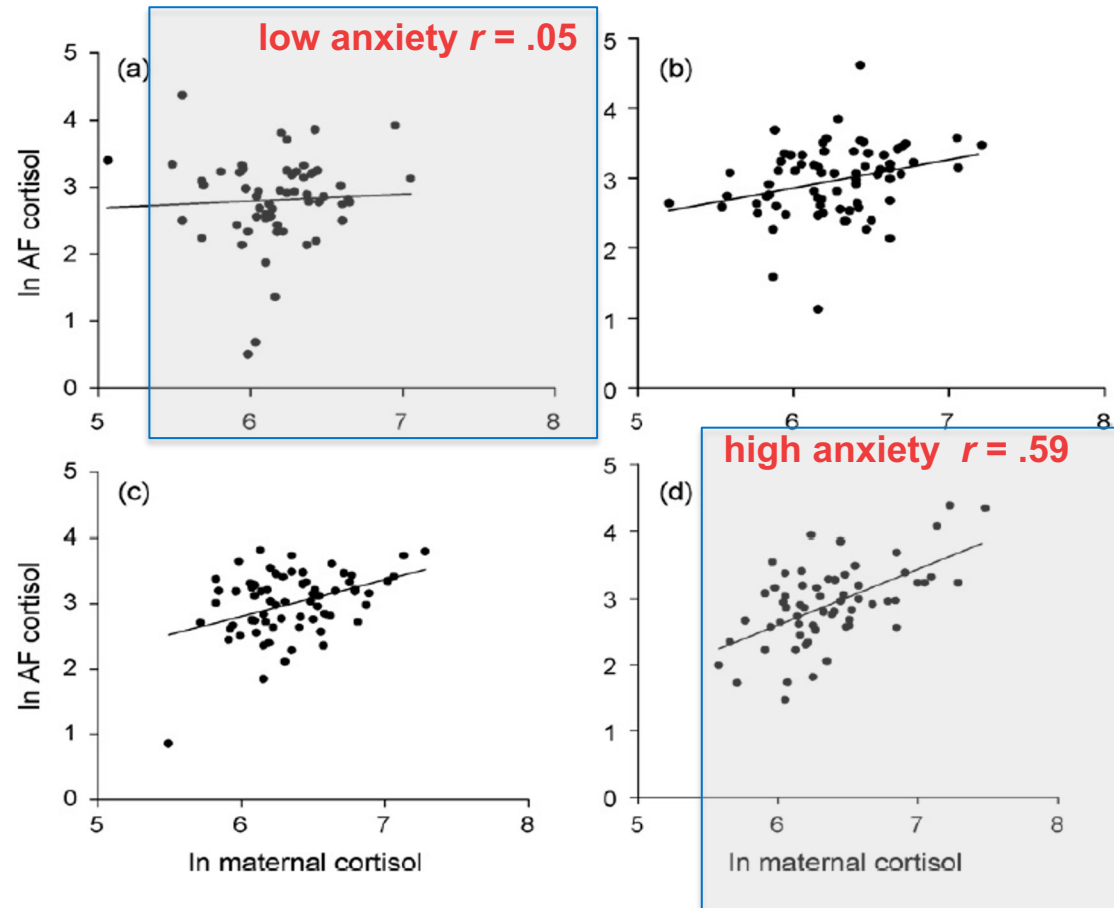
Major effector of stress response system

Prenatal cortisol exposure influences development

- Hyperactivity in the amygdala
- Neuronal migration, neurotransmitter activity, synaptic plasticity
- Alters set point of stress hormone regulation
- Heightened anxiety behaviors in the offspring (Seckl & Holmes, 2007)

Maternal Anxiety Moderates the Association between Maternal Plasma & Amniotic Fluid Cortisol

Glover, V. et al., 2009, *Psychoneuroendocrinology*



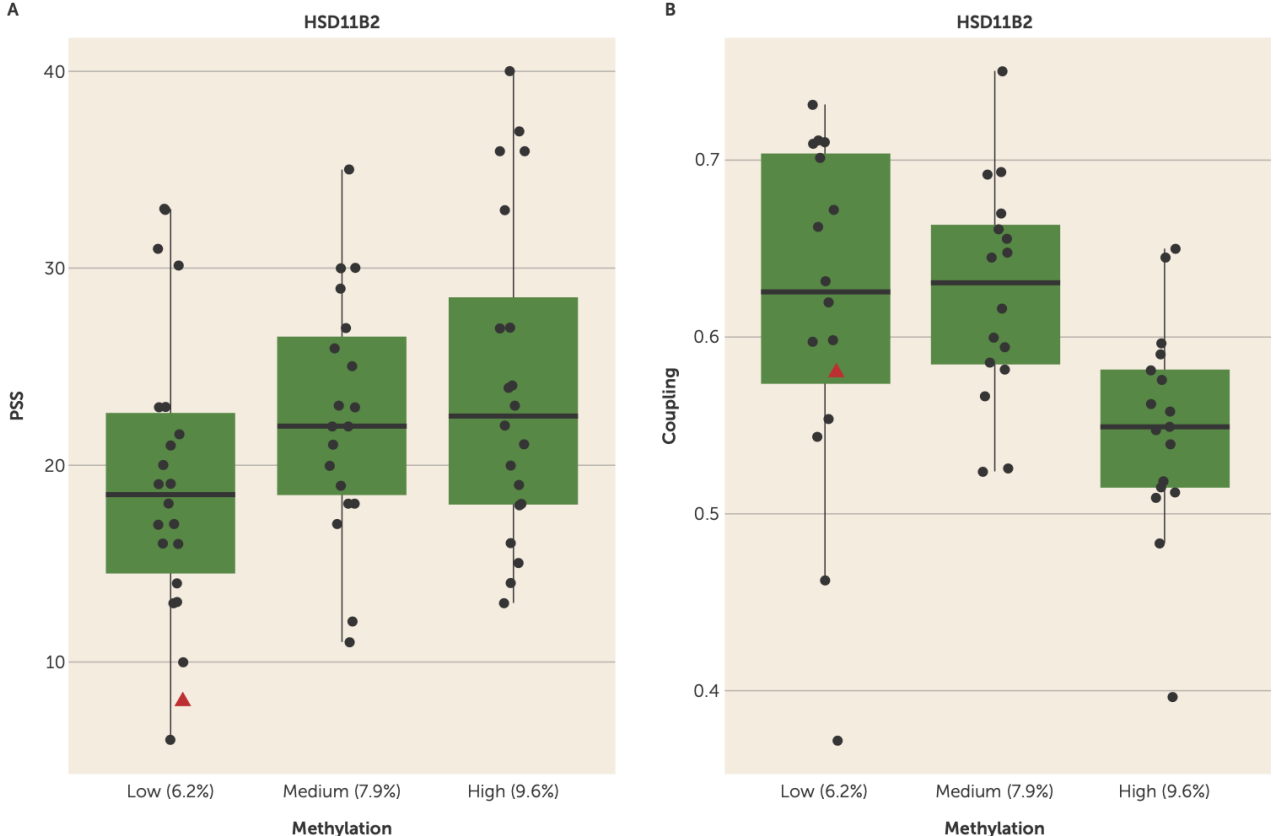
Distress During Pregnancy: Epigenetic Regulation of Placenta Glucocorticoid-Related Genes and Fetal Neurobehavior

Catherine Monk, Ph.D., Tianshu Feng, M.S., Seonjoo Lee, Ph.D., Izabela Krupska, M.A., Frances A. Champagne, Ph.D., Benjamin Tycko, M.D., Ph.D.

Am Journal Psychiatry 2016



FIGURE 2. Tertiles of *HSD11B2* Promoter Region Methylation in Relation to the Perceived Stress Scale and Fetal Coupling^a



Triangles= participant with donor egg baby



Multigenerational adversity impacts on human gut microbiome composition and socioemotional functioning in early childhood

Francesca R. Querdasi^{a,1} , Craig Enders^a, Neerja Karnani^b, Birit Broekman^b , Chong Yap Seng^{b,c}, Peter D. Gluckman^{b,d} , Lourdes Mary Daniel^{e,f}, Fabian Yap^{g,h,i}, Johan G. Eriksson^{b,c,j,k}, Shirong Cai^b, Mary Foong-Fong Chong^l , Jia Ying Toh^b , Keith Godfrey^{m,n} , Michael J. Meaney^{b,o,p}, and Bridget L. Callaghan^{a,1}

Discussion

This study demonstrated intergenerational and direct exposure impacts of adversity on the gut microbiome of 2-y-old children, and also showed that child microbiomes were related to behavior. We found distinct taxa that were differentially abundant as a function of each adversity, with no overlap between the adversities. This suggests that exposure to adversity at different stages of life (preconception, prenatal, postnatal) each have a distinct impact on the gut microbiome composition of 2-y-old children. Moreover, when

Prenatal Programming: Future



About the HEALthy Brain and Child Development (HBCD) Study

The HBCD Study is the largest, long-term study of early brain and child development in the United States

- Range of prenatal exposures
- Multi modal MRI
- EEG
- Observation-based outcomes
- Parent-child interaction



ENVIRONMENTAL INFLUENCES ON CHILD HEALTH OUTCOMES (ECHO) PROGRAM

Environmental influences on Child Health Outcomes (ECHO) Program

[About the ECHO Program](#)

[Director's Page](#)

[Program Components](#)

[Funding](#)

[Announcements](#)

[Information and Updates](#)

[ECHO Program Staff](#)



De-identified ECHO data is now available to the scientific community



ECHO helps test new approaches to treat babies born with Neonatal Opioid Withdrawal Syndrome (NOWS)



ECHO

Environmental influences on Child Health Outcomes

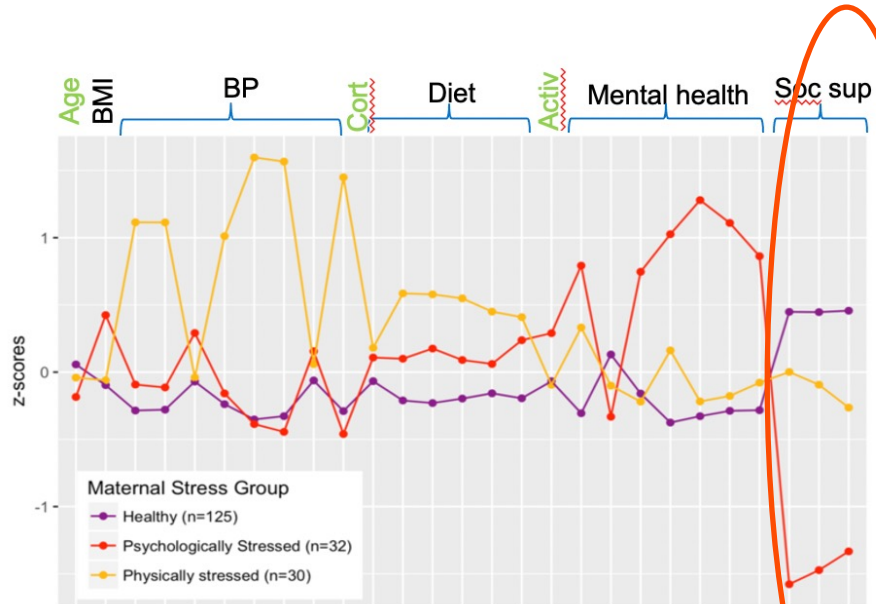
A program supported by the NIH

Learn more about ECHO:

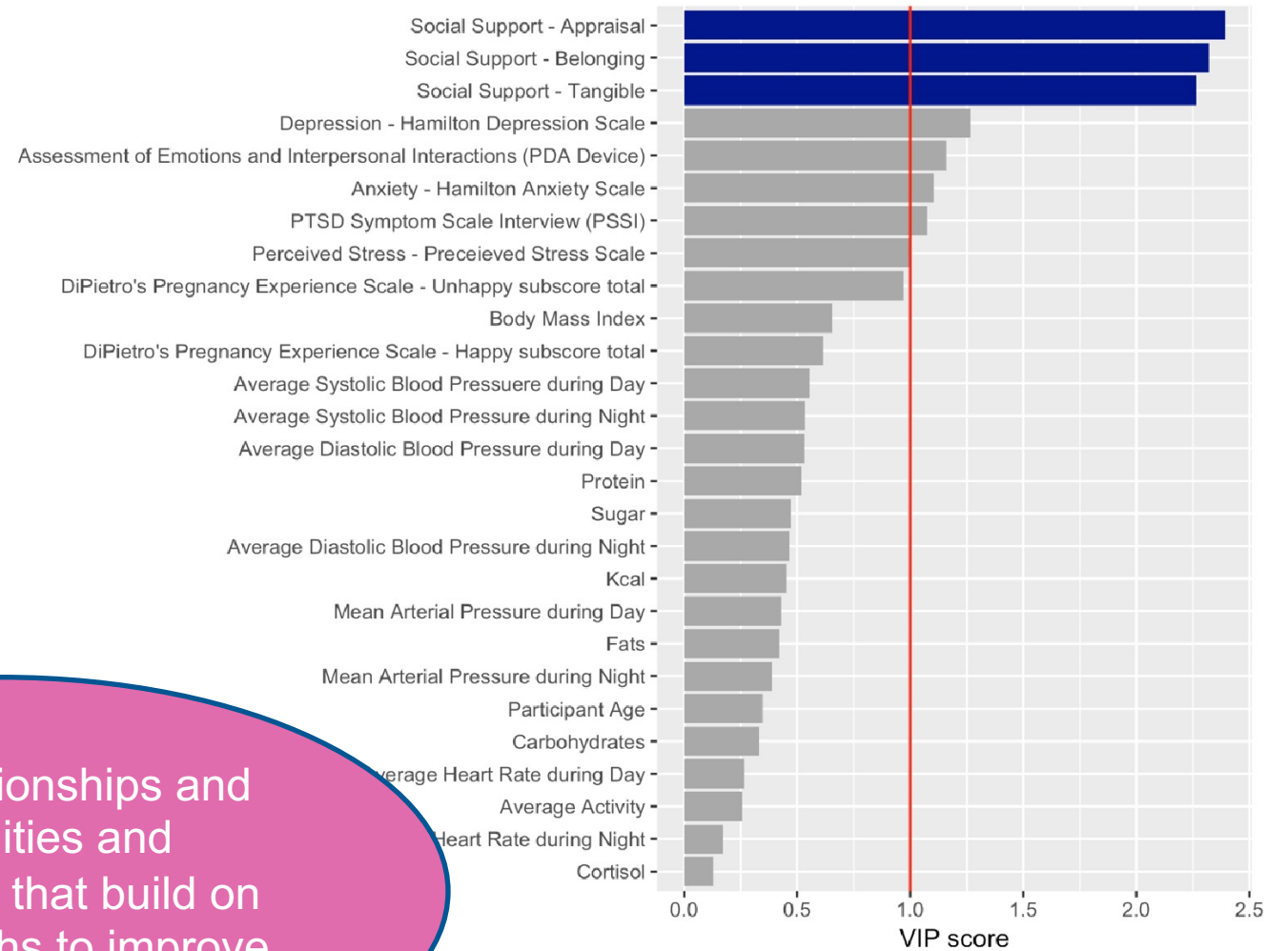
For more details about the ECHO Program, please use the menu on the left to navigate this ECHO NIH website. To learn more about our research and find information for families, stakeholder organizations, and researchers, please visit the [ECHO Coordinating Center website](#)

Resiliency Factors

VIP Analysis

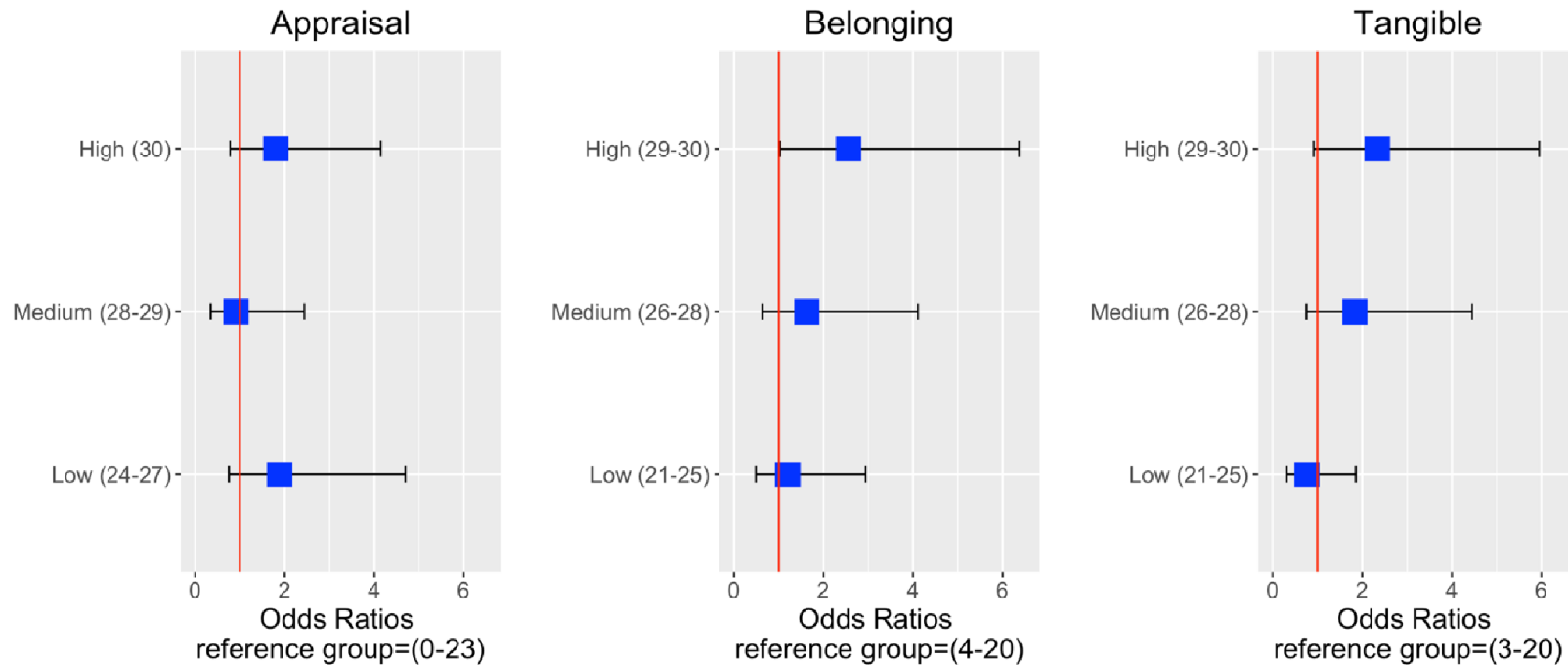


Role of relationships and communities and interventions that build on these strengths to improve maternal and child health



Resiliency Factors

Odds ratios of male fetus and their 95% confidence intervals by social support variables relative to the lowest social support levels.



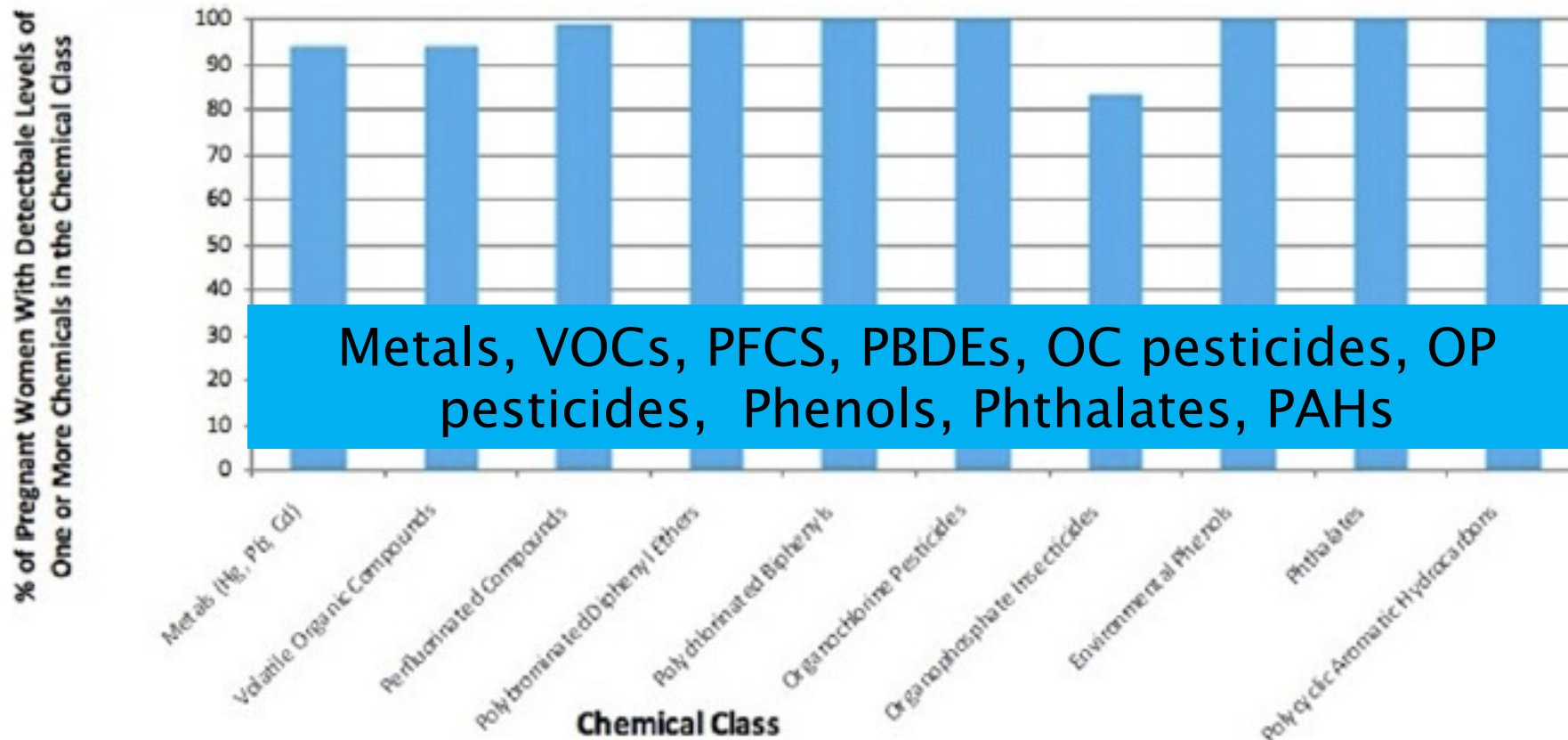
The Environment



Exposure to chemicals with potential reproductive harm now the norm

FIGURE 2

Environmental chemicals in pregnant women in the United States



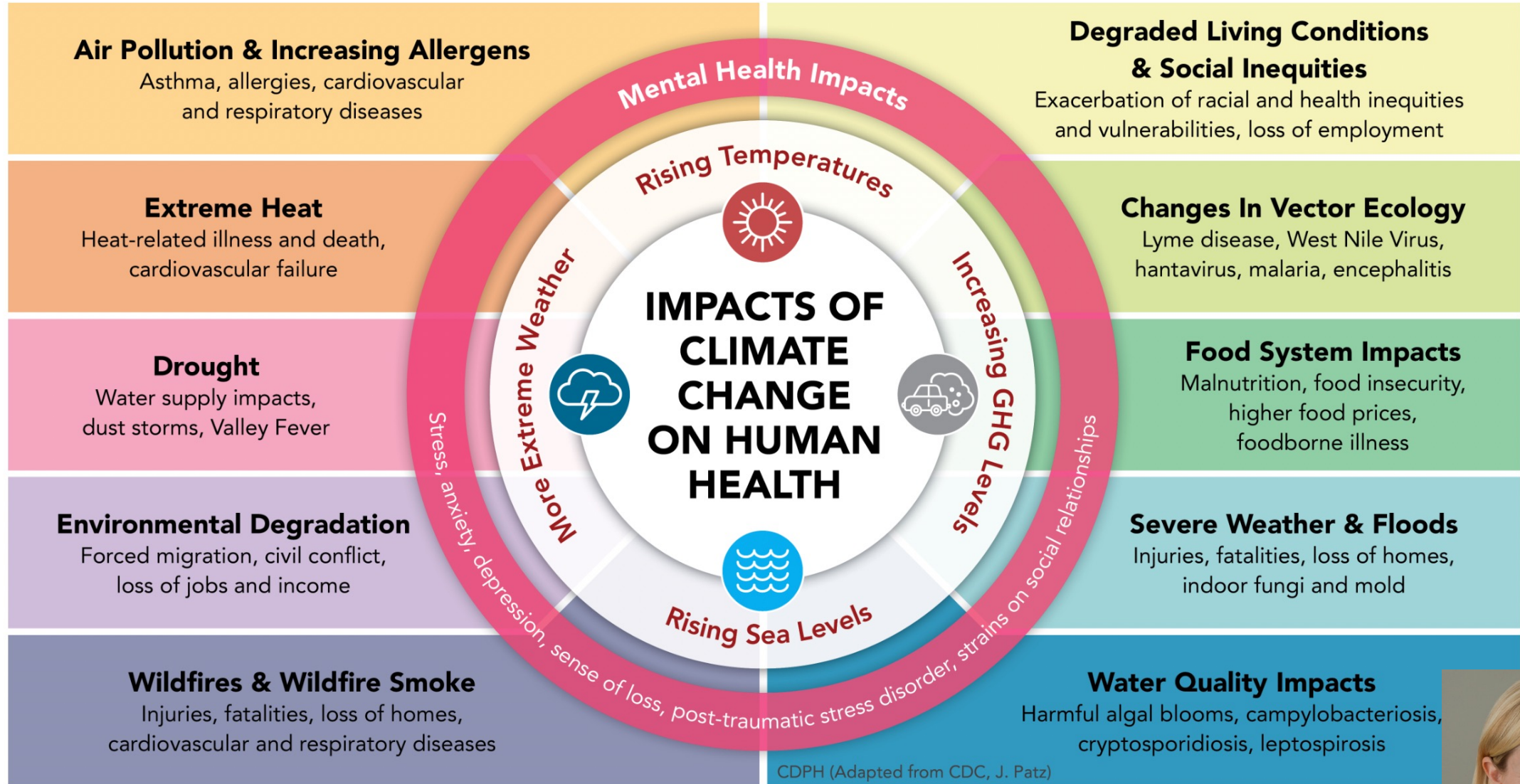
Adapted, with permission from Woodruff et al.³⁰

Sutton. *Toxic matters. Am J Obstet Gynecol* 2012.

Slide courtesy of Blaire Wylie



Climate change



Prenatal Programming: Caveats



COMMENT

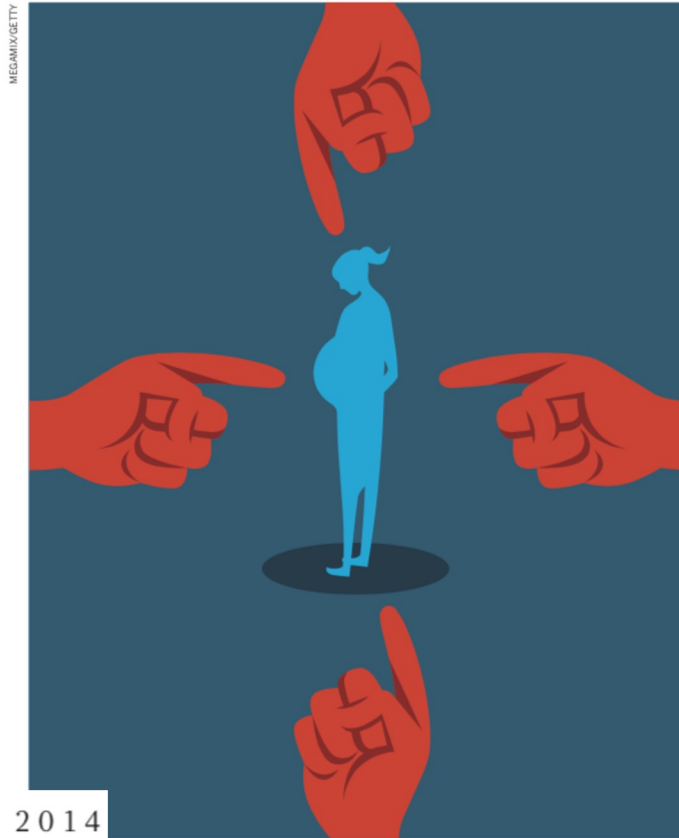
HISTORY How James Watt moved from steam engines to sculpture **p.134**

RESILIENCE A treatise on the social roots of disasters **p.135**



CLIMATE CHANGE Threatened white possum is Australia's harbinger **p.136**

LAB LIFE Ethics codes could protect field workers from harassment **p.136**



2 | NATURE | VOL 512 | 14 AUGUST 2014

Don't blame the mothers

Careless discussion of epigenetic research on how early life affects health across generations could harm women, warn **Sarah S. Richardson** and colleagues.

From folk medicine to popular culture, there is an abiding fascination with how the experiences of pregnant women imprint on their descendants. The latest wave in this discussion flows from studies of epigenetics — analyses of heritable changes to DNA that affect gene activity but not nucleotide sequence. Such DNA modification has been implicated in a child's future risk of obesity, diseases such as diabetes, and poor response to stress.

Headlines in the press reveal how these findings are often simplified to focus on the maternal impact: 'Mother's diet during pregnancy alters baby's DNA' (BBC), 'Grandma's Experiences Leave a Mark on Your Genes' (*Discover*), and 'Pregnant 9/11 survivors transmitted trauma to their children' (*The Guardian*). Factors such as the paternal contribution, family life and social environment receive less attention.

Questions about the long shadow of the uterine environment are part of a burgeoning field known as developmental origins of health and disease (DOHaD)¹. For example, one study revealed² that 45% of children born to women with type 2 diabetes develop diabetes by their mid-twenties, compared with 9% of children whose mothers developed diabetes after pregnancy.

DOHaD would ideally guide policies that support parents and children, but exaggerations and over-simplifications are making scapegoats of mothers, and could even increase surveillance and regulation of pregnant women. As academics working in DOHaD and cultural studies of science, we are concerned. We urge researchers, press officers and journalists to consider the ramifications of irresponsible discussion.

ALARMING PRECEDENTS

There is a long history of society blaming mothers for the ill health of their children. Preliminary evidence of fetal harm has led to regulatory over-reach. First recognized in the 1970s, fetal alcohol syndrome (FAS) is a collection of physical and mental problems in children of women who drink heavily during pregnancy. In 1981, the US Surgeon General advised that no level of alcohol consumption was safe for pregnant women. Drinking during pregnancy was stigmatized and even criminalized. Bars and restaurants were required to display warnings that drinking ▶

- **Most women and children are unaffected (fathers/partner have influence too)**

- **These maternal experience factors are a few of thousands of points of variability and not randomly distributed (look to society for change)**

- **Effects are modifiable throughout development**



ZERO TO THREE
Early connections last a lifetime

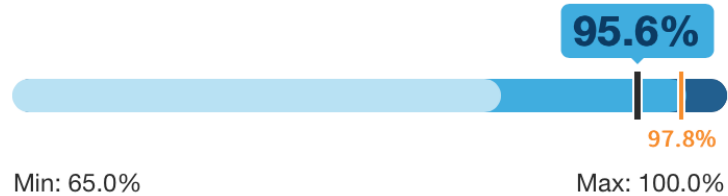


Make their potential our priority.

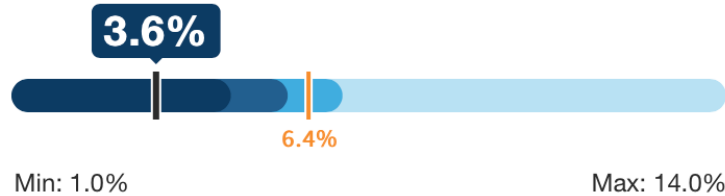
California

National Avg

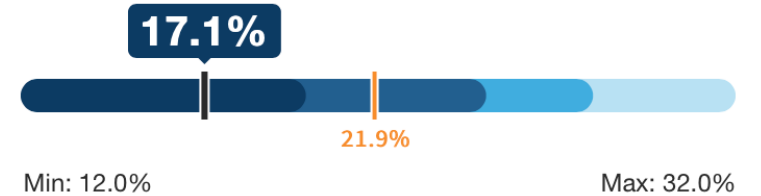
WIC Coverage



Late or no prenatal care received



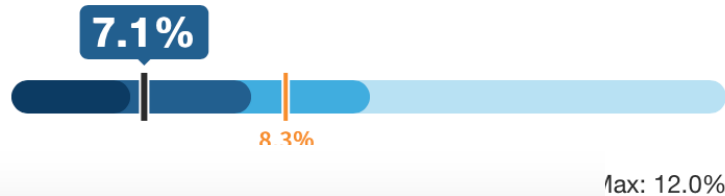
Mothers reporting less than optimal mental health



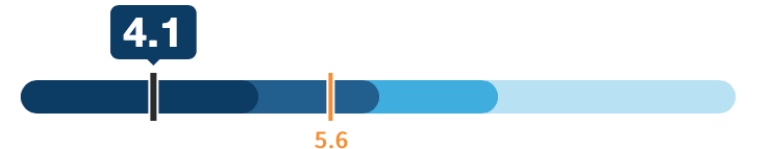
Babies born preterm



Babies with low birthweight



Infant mortality rate (deaths per 1,000 live births)





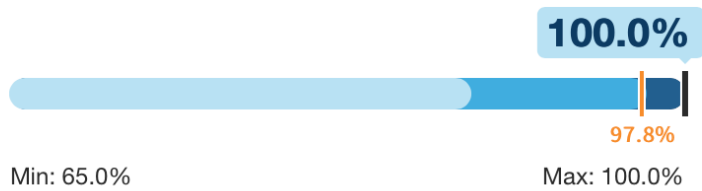
ZERO TO THREE
Early connections last a lifetime



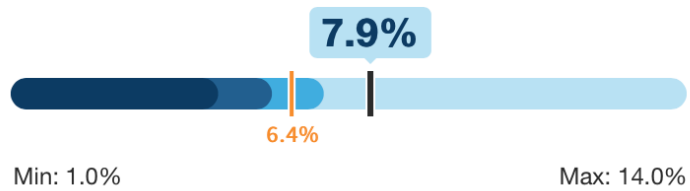
Make their potential our priority.

Alabama | National Avg

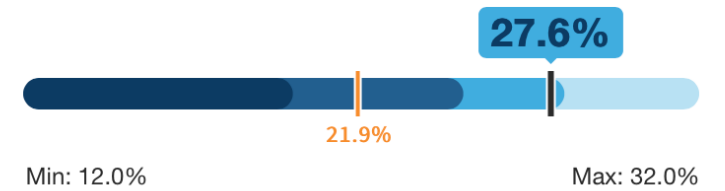
WIC Coverage



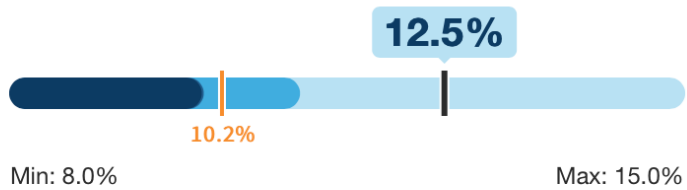
Late or no prenatal care received



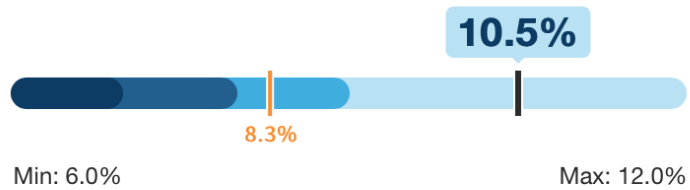
Mothers reporting less than optimal mental health



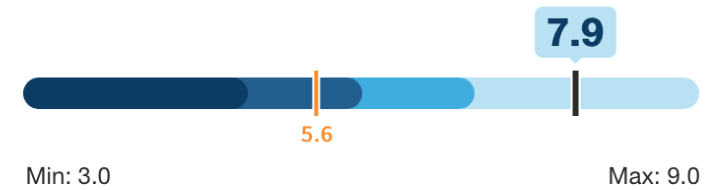
Babies born preterm



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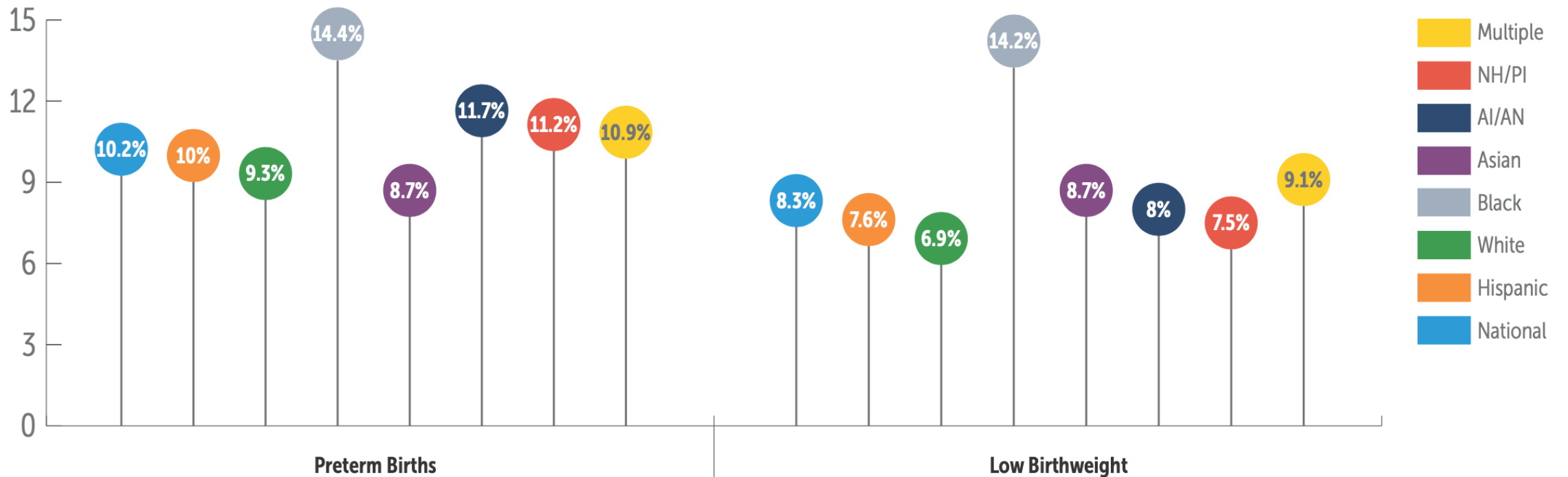


ZERO TO THREE
Early connections last a lifetime



Make their potential our priority.

NEGATIVE BIRTH OUTCOMES BY RACE AND ETHNICITY Figure 6.



Conceptual Model: Adaptation versus Teratogenic

Early life stress, prenatal secondhand smoke exposure, and the development of internalizing symptoms across childhood

Mariah DeSerisy^{1,2*}, Jacob W. Cohen^{2,3}, Jordan D. Dworkin^{2,3}, Jeanette A. Stingone¹, Bruce Ramphal⁴, Julie B. Herbstman^{5,6}, David Pagliaccio^{2,3} and Amy E. Margolis^{2,3}

Fetal Heart Rate Reactivity Differs by Women's Psychiatric Status: An Early Marker for Developmental Risk?

CATHERINE MONK, PH.D., RICHARD P. SLOAN, PH.D., MICHAEL M. MYERS, PH.D., LAUREN ELLMAN, B.A., ELIZABETH WERNER, B.A., JIYEON JEON, B.A., FELICE TAGER, PH.D., AND WILLIAM P. FIFER, PH.D.

Conceptual Model: Adaptation versus Teratogenic

The Wellcome Foundation Lecture, 1994.
The fetal origins of adult disease

D. J. P. BARKER

MRC Environmental Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton, SO16 6YD, U.K.

SUMMARY

Recent findings suggest that many human fetuses have to adapt to a limited supply of nutrients and in doing so they permanently change their physiology and metabolism. These 'programmed' changes may be the origins of a number of diseases in later life, including coronary heart disease and the related disorders: stroke, diabetes and hypertension.

Proceedings of the Royal Society (1995)



Adaptation
concept
useful in
clinical work

Figure 1. A schematic representation of the developmental pathways concept. (A) Continuity of maladaptation, culminating in disorder. (B) Continuous positive adaptation. (C) Initial maladaptation followed by positive change (resilience). (D) Initial positive adaptation followed by negative change toward pathology.

Psychopathology as an Outcome of Development Sroufe & Cicchetti, 1997

Conceptual Model: Adaptation versus Teratogenic

THE JOURNAL OF CHILD
PSYCHOLOGY AND PSYCHIATRY



Journal of Child Psychology and Psychiatry 52:4 (2011), pp 356–367

doi:10.1111/j.1469-7610.2011.02371.x

Annual Research Review: Prenatal stress and the origins of psychopathology: an evolutionary perspective

Vivette Glover

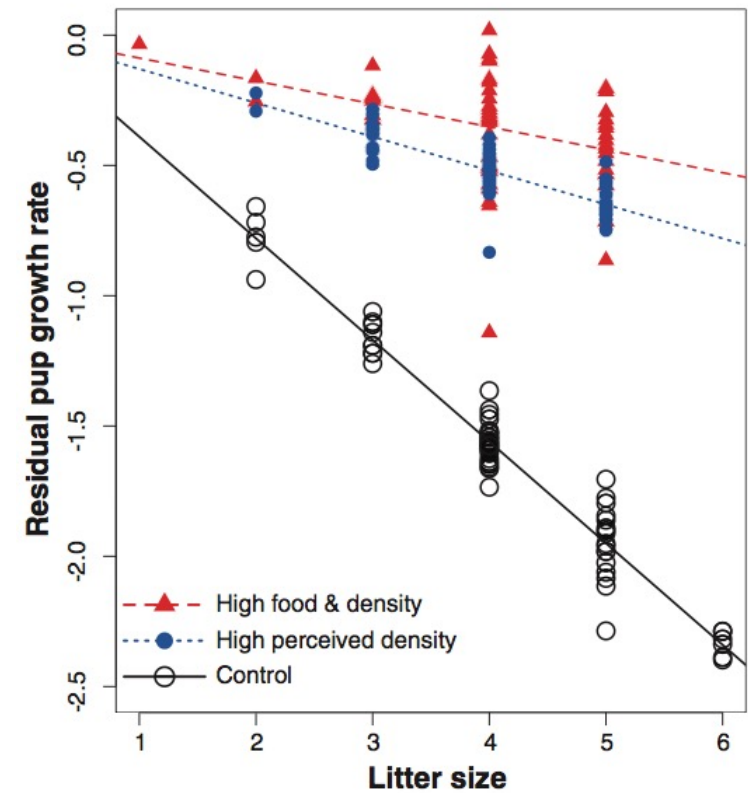
Institute of Reproductive and Developmental Biology, Imperial College London, UK

Conceptual Model: Adaptation versus Teratogenic

Density Triggers Maternal Hormones That Increase Adaptive Offspring Growth in a Wild Mammal

Ben Dantzer,^{1*†} Amy E. M. Newman,² Rudy Boonstra,³ Rupert Palme,⁴ Stan Boutin,⁵ Murray M. Humphries,⁶ Andrew G. McAdam^{1,2}

www.sciencemag.org SCIENCE VOL 340 7 JUNE 2013





- *Development* begins before birth
- *Parenting* begins before birth
- The psychological birth of the parent

Parenting Begins before Birth

- Prenatal programming (biological process)
- Mentalization (psychological process)
 - Fraiberg, Fonagy, Slade
 - Reflective function
 - Attributions
- Adaptation in the parental brain (neuroplasticity)

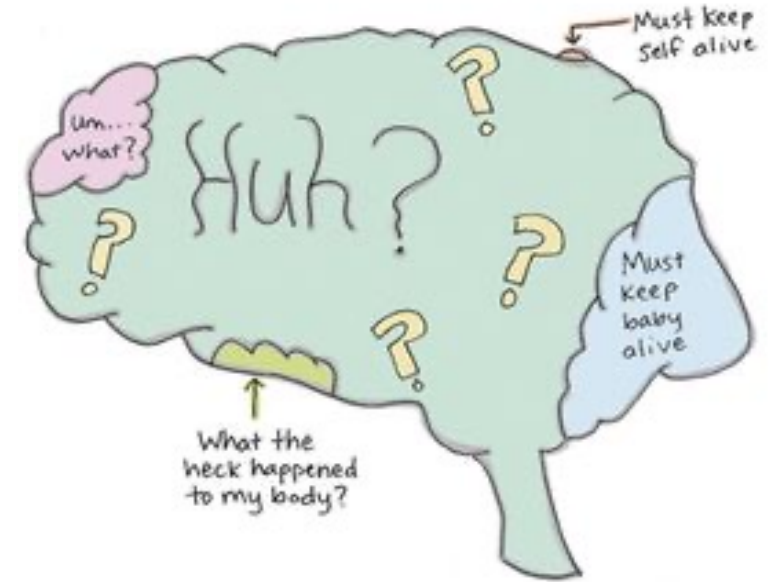
Parental Brain Changes

- Parenting, and the transition to it, as an important sensitive period in neural function, behavior, and health (Kim, P. & Enos, S. lab website)

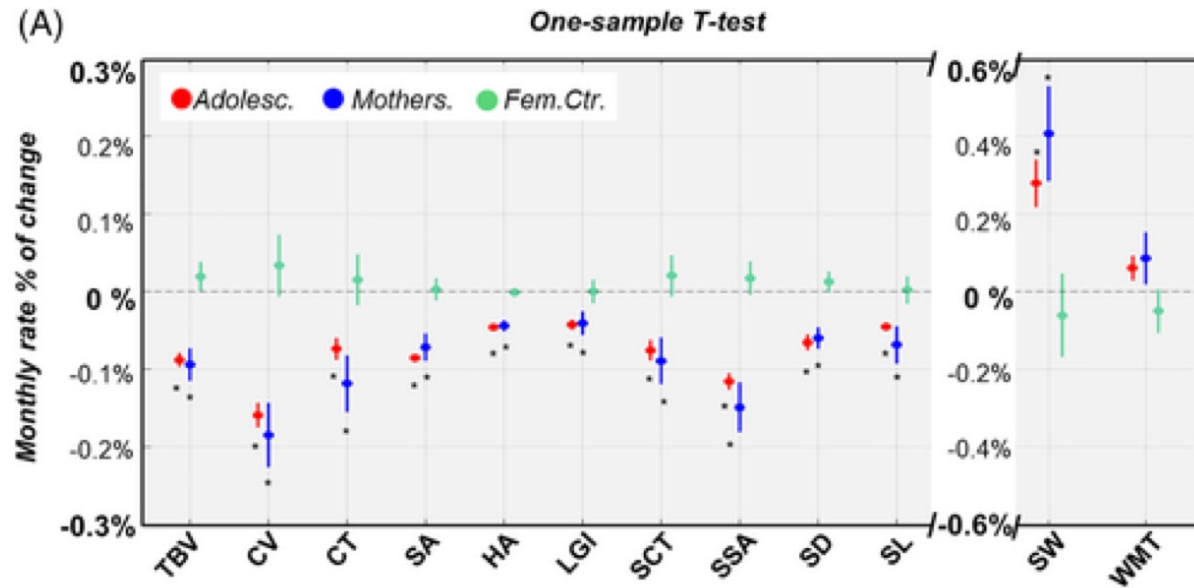
Adaptation to pregnancy and parenting

A developmental period in adulthood

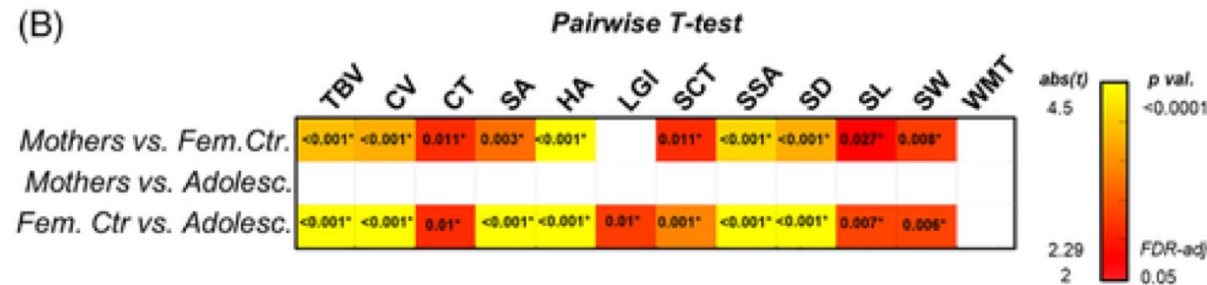
- Huge shift in cognition and behavior to facilitate caregiving
- Heightened neuroplasticity in perinatal period - during pregnancy, hormonally and psychologically driven; in postpartum, also changed by experience of caregiving (Carmona et al., 2019; Kim, 2016)
- Exposure to severe stress may disrupt adaptive changes to maternal brain (Kim et al., 2020)
- Evidence for neural basis of adaptive cognitive & behavioral changes: adaptation of reward system, and circuits processing emotions and executive function (Swain, 2011; Rutherford and Mayes, 2011)



Pregnant adults vs non-pregnant adolescents: similar degree of morphometric brain changes



Carmona et al., 2019, *Human Brain Mapping*



Pregnancy leads to long-lasting changes in human brain structure

Elseline Hoekzema^{1-3,8}, Erika Barba-Müller^{1,8}, Cristina Pozzobon⁴, Marisol Picado¹, Florencio Lucco⁴, David García-García⁵, Juan Carlos Soliva¹, Adolf Tobeña¹, Manuel Desco⁵, Eveline A Crone^{2,3}, Agustín Ballesteros⁴, Susanna Carmona^{1,5,6,9} & Oscar Vilarroya^{1,7,9}

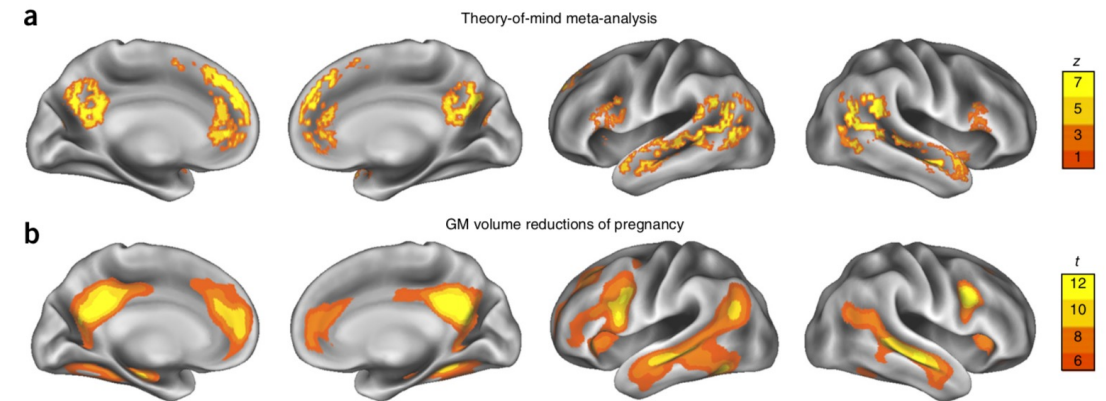


Figure 4 Similarity between theory-of-mind network and GM volume changes of pregnancy. **(a)** The theory-of-mind network as extracted from the meta-analysis by Schurz *et al.*²². Statistical map of permutation-based z-values of the pooled meta-analysis was provided by Schurz *et al.*²² and displayed using Caret software. **(b)** Reductions in GM volume ($P < 0.05$, FWE-corrected) in the group of women who were pregnant between sessions in the current study.

- GMV reduction in areas associated with Theory of Mind ability.
- Reduction associated with mother-infant attachment and lack of hostility (on self-report scale)

Adaptive reorganization of brain structure across postpartum months

- Kim et al. (2010): Increases in GMV in superior, middle, and inferior prefrontal cortex, parietal lobe, limbic, and cerebellar structures from 2-4 weeks to 3-4 months postpartum.
- Higher degree of change > more positive perceptions of infants
- Luders et al. (2020): same pattern of changes from 1-2 days to 4-6 weeks postpartum; additionally show increase in precuneus, middle occipital gyrus, and caudate
- Brain changes with evolving adjustment to motherhood & development of caregiving behaviors



Available online at www.sciencedirect.com

ScienceDirect

Journal homepage: www.elsevier.com/locate/cortex



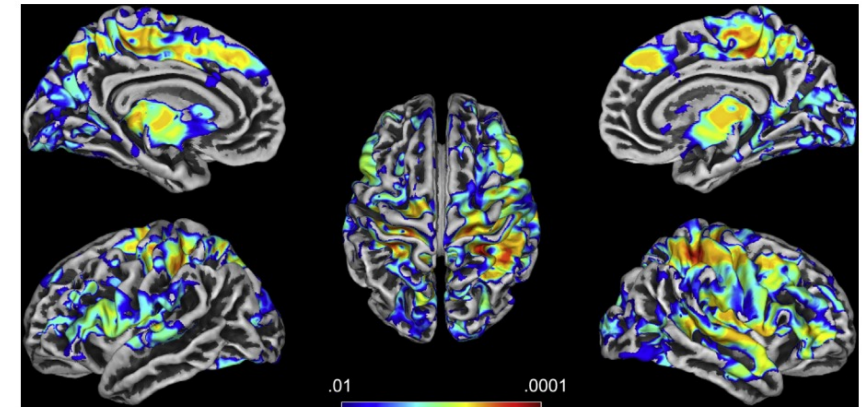
Note

From baby brain to mommy brain: Widespread gray matter gain after giving birth



Eileen Luders ^{a,b,1}, Florian Kurth ^{a,1}, Malin Gingnell ^{c,d}, Jonas Engman ^c, Eu-Leong Yong ^d, Inger S. Poromaa ^{e,*} and Christian Gaser ^f

^a School of Psychology, University of Auckland, Auckland, New Zealand



Change in voxel-wise gray matter between immediate postpartum (within 1-2 days of delivery) and late postpartum (at 4e6 weeks after delivery) at $p \leq .01$

Enhanced Learning during Pregnancy

MEMORY

2022, VOL. 30, NO. 5, 519–536

<https://doi.org/10.1080/09658211.2021.2019280>



Evidence for cognitive plasticity during pregnancy via enhanced learning and memory

Bridget Callaghan^a, Clare McCormack^{b,c}, Nim Tottenham^{c*} and Catherine Monk^{c,d,e,f,†}

^aDepartment of Psychology, The University of California, Los Angeles, CA, United States; ^bCenter for Science and Society, Columbia University, New York, NY, United States; ^cIrving Medical Center, Department of Obstetrics and Gynecology, Columbia University, New York, NY, United States; ^dDepartment of Psychology, Columbia University, New York, NY, United States; ^eIrving Medical Center, Department of Psychiatry, Columbia University, New York, NY, United States; ^fNew York State Psychiatric Institute, New York, NY, United States

Expert Review

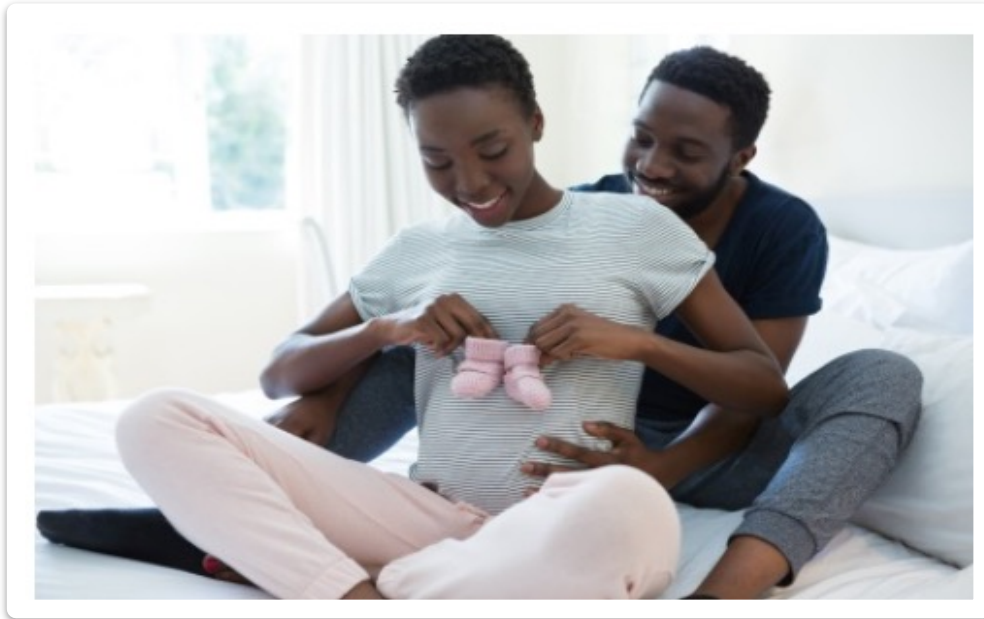
The transition to parenthood in obstetrics: enhancing prenatal care for 2-generation impact



Catherine Monk, PhD; Sona Dimidjian, PhD; Ellen Galinsky, MS; Kimberly D. Gregory, MD, MPH;
M. Camille Hoffman, MD, MSc; Elizabeth A. Howell, MD, MPP; Emily S. Miller, MD, MPH; Cynthia Osborne, PhD, MPP;
Cynthia E. Rogers, MD; Darby E. Saxbe, PhD; Mary E. D'Alton, MD

*American Journal of Obstetrics & Gynecology – Maternal Fetal
Medicine; August, 2022*

Active Consideration: Enhancing the Perinatal Ecosystem for 2-Gen Impact



Transition to Parenthood

- To make a difference in the lives of children (and parents), beginning after birth is too late
- At birth, game is just beginning, but the die has been cast (*Dr. Charles Marmar*).
- Two generation approach
 - Prenatal period is time of rapid development of the fetal brain that outpaces any other stage of the lifespan; during the first year, the brain continues to develop at an amazing rate (*Gilmore, J.H., Knickmayer, R. C., & Gao, W. (2018) Nature Reviews Neuroscience*)
 - Parenting, and the transition to it, as an important sensitive period in neural function, behavior, and health (*Kim, P. & Enos, S. lab website*)
 - *Plasticity in the brains of parents and the child*

Concrete Goals

- A better understanding of the tasks, needs, mindsets, skills, and contexts that are important to expectant parents
- Creation of accessible content that would help expectant parents and ultimately their children thrive

Process to Date

- Process to date to reach goals & focus of this meeting today
 - Established a Research Advisory group, interviewed these 7 experts in the area of TtP prior to convening larger meeting of experts, listening sessions with parents



Questions We Use as Scaffolding for discussions



1. What is known about the transition to parenthood
 - A. for typical families, including expectant mothers
Fathers/partners?
Extended families
 - B. What is known about the transition to parenthood for at-risk families, including expectant mothers
Fathers/partners?
Extended families
2. What are the **factors** that have been found to make the biggest difference in a successful transition, including parental efficacy and child well-being?
 - o developmental needs such as a
 - o sense of belonging and
 - o being connected,
 - o feelings of competence
 - o and respect,
 - o developing a vision for the future)
3. How important is it to help prospective parents think about the kind of parents **they want to be? How they were parented?**
4. What **information** is it important for them to learn?

Questions We Used as Scaffolding for the Interviews

5. What **skills** (e.g., self-control, taking on challenges, critical thinking, etc.)?
6. What are the ways prospective parents can **best learn** this information and skills?
7. What are some of the most successful interventions?
 - A. What are they?
 - B. What is known **how** these interventions work and for whom that make the biggest difference?
8. When are the key **times** where interventions seem to make the biggest difference?
9. What are the **gaps in our knowledge** and in available materials where BFF might make the biggest difference?
10. What other questions should we be asking?



1. What is known about the transition to parenthood for (A) typical families, including the expectant mother partner, and extended family

- **CONSENSUS**: Relatively little done in research until the past 10-20 years; Literature is beginning to acknowledge this period as critical for development as an adult (increased neuroplasticity); Overall a period with major emotional, social, and biological implications.

1. What is known about the transition to parenthood for (B) for at-risk families including the expectant mother, partner, and extended family?

- **CONSENSUS:** Many ways to define 'at-risk' (adolescent, mental health problems, premature birth, contextual & environmental stress); It is imperative that these individuals receive additional support and intervention, doing so from a strengths-based perspective

2. What are the factors (including developmental needs) that have been found to make the biggest difference in a successful transition, including parental efficacy and child well-being?

- **CONSENSUS**: Social support (every interview mentioned this); Adequate psychoeducation around expected changes while acknowledging there is no 'normal'; Contextual stress and how it is (or isn't) addressed

3. How important is it to help prospective parents think about the kind of parents they want to be?

- **CONSENSUS:** There is opportunity here. This orientation can bring intentionality to the transition and encouragement to thinking about their relationship & attachment to the child and who the child is and who they want to be as a parent; Negative: care needed to discuss prior difficult parenting
- *A recent postpartum mother: I want my son to have his own chalkboard and chalk and to draw as he wants to, it doesn't have to be what I have drawn.*

4. What information is it important for them to learn?

- **CONSENSUS:** Psychoeducation including child developmental stages including fetal brain development and understanding prenatal programming, changes occurring within own brain and hormone levels (i.e., parental developmental stage), what to expect from transition & normalizing associated difficulties (no one can be perfect) – Psychoeducation helps a lot with building parental self-efficacy; How to go about building a support network (especially of other new parents)

5. What skills (e.g., self-control, taking on challenges, critical thinking, etc.)?

- **CONSENSUS:** Coping skills (around sleep deprivation, crying, cluster feeding, etc.); Emotion regulation; Communication in couples; Conflict resolution; Mindfulness; Cognitive Reframing; Awareness & Compassion for Oneself; Mapping & Promoting ACE (accomplishment, connection, enjoyment) activities; How to create a network (and how to be open to receiving support)

6. What are the ways prospective parents can best learn this information and skills?

- **CONSENSUS:** Video feedback is helpful in many aspects (learning how to communicate as a couple, reacting to infant); Group settings (builds a network and creates a sounding board); Taking advantage of existing frequency of Ob/Gyn visits

8. What are the key times where interventions seem to make the biggest difference?

- **CONSENSUS**: It is best to intervene as early as possible; these early opportunities can be used to introduce broad skills (i.e., mindfulness, awareness, cognitive reframing); individuals may be more attuned to the offered interventions because the child's birth is imminent. Antenatally is much preferred to postpartum – parents are more motivated and have more mental capacity/available time to learn. Leverage the brain's plasticity! However, it's never too late!
- **Earlier can work. Strike while iron cold(er).**

9. Where are there gaps in our knowledge and in available materials where BFF might make the biggest difference?

- **CONSENSUS**: Overall, more robust studies (larger sample sizes, varying design) around the entirety of the transition to parenthood are needed. More specifically, the role of fathers and their transition to parenthood (particularly how the paternal brain and hormones change) are large gaps in our knowledge of this period. Further studies specifying neurological changes during this transition period and pre and post intervention) would be helpful to gaining traction in this area.

Intentional Approach
become intentional learner, have agency

Asset Approach
everyone wants to be best parent to child

Opportunity Mindset Approach
time for self growth, new life stage

Opportunity for Positive Racial and
Cultural Socialization Approach

Developmental Needs

Developmental Knowledge
Psychological birth of the parent & of the child;
Developmental changes in parent and child
Exposure to 2-generation neuroplasticity

EF-Based Life Skills and Strategies

Transition to parenthood experience

Draft conceptual model:

Initial framework for thinking
about what is known, what is
not known, what is needed to
help parents and how to help
parents get what they need



*Faculty hires!
Postdoc positions!*

Transition to Parenthood Center Established with Funding from Bezos Family Foundation

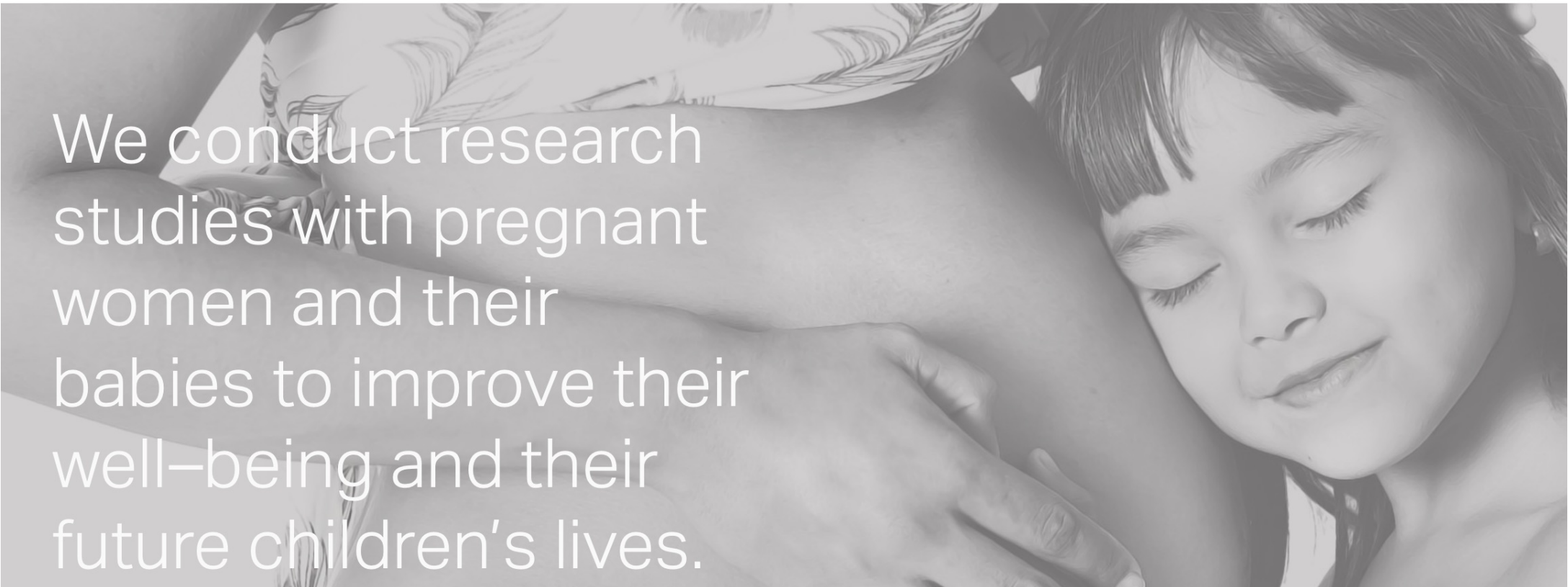
Center for the Transition to Parenthood: 2 Gen Impact

The Center's four missions:

- 1) Ongoing scientific discovery and innovation focused on TtP and DOHaD research
- 2) Transforming care through content development, demonstration projects, and national scale up
- 3) Becoming a national clearinghouse for TtP science and programs
- 4) Perinatal care ecosystem engagement with the overall process of science (clinical and developmental discoveries) driving new practice, and practice experiences informing science



"I like to think that each generation will need a little less therapy than the generation before."



We conduct research studies with pregnant women and their babies to improve their well-being and their future children's lives.

<https://www.perinatalpathways.org>



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Questions, Comments?

- Questions for you:
 - Is this information new, interesting, and compelling to you?
 - How would you answer some of our 'scaffolding' questions?



Thank you!