

Social aspects of stress: Parental factors and the epigenome

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EPA, Arlington, September 2015

Profound effects of parental experiences on offspring phenotype

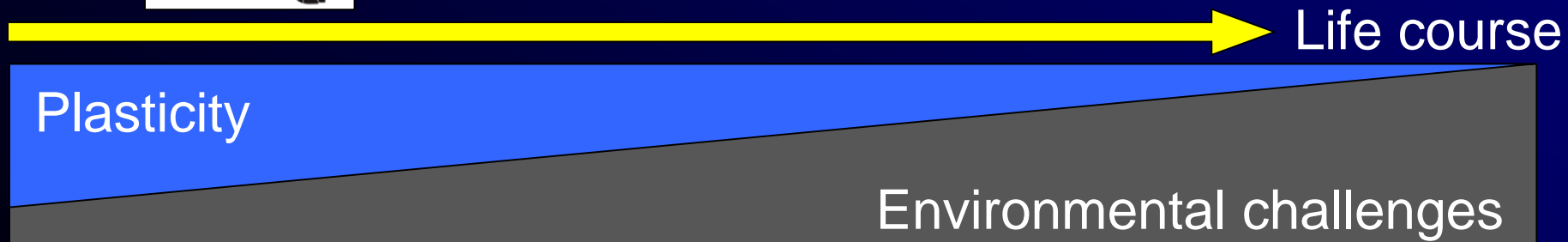


Stress
Fearfulness
Neuroplasticity

Diet
Stress
Parental Care



Stress
Anxiety/Depression
Substance abuse
Suicide

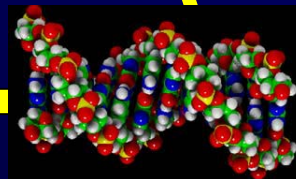
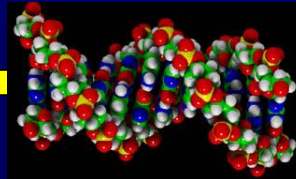


after Hanson ... Gluckman, Prog Biophys Mol Bio, 2011

Profound effects of parental experiences on offspring phenotype



Diet
Stress
Parental Care

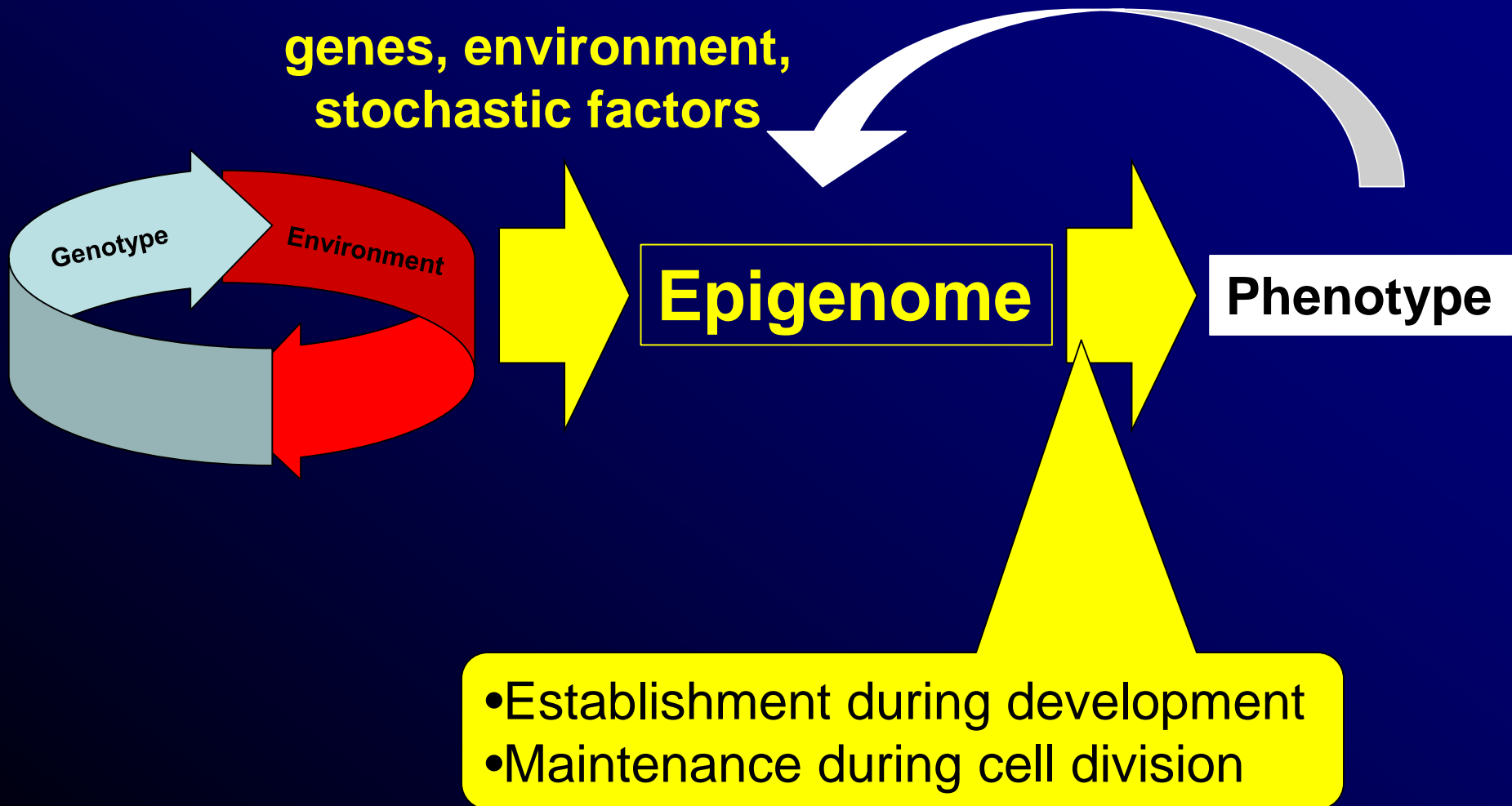


Stress
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Gene Expression Programming

Epigenetic programming of phenotype

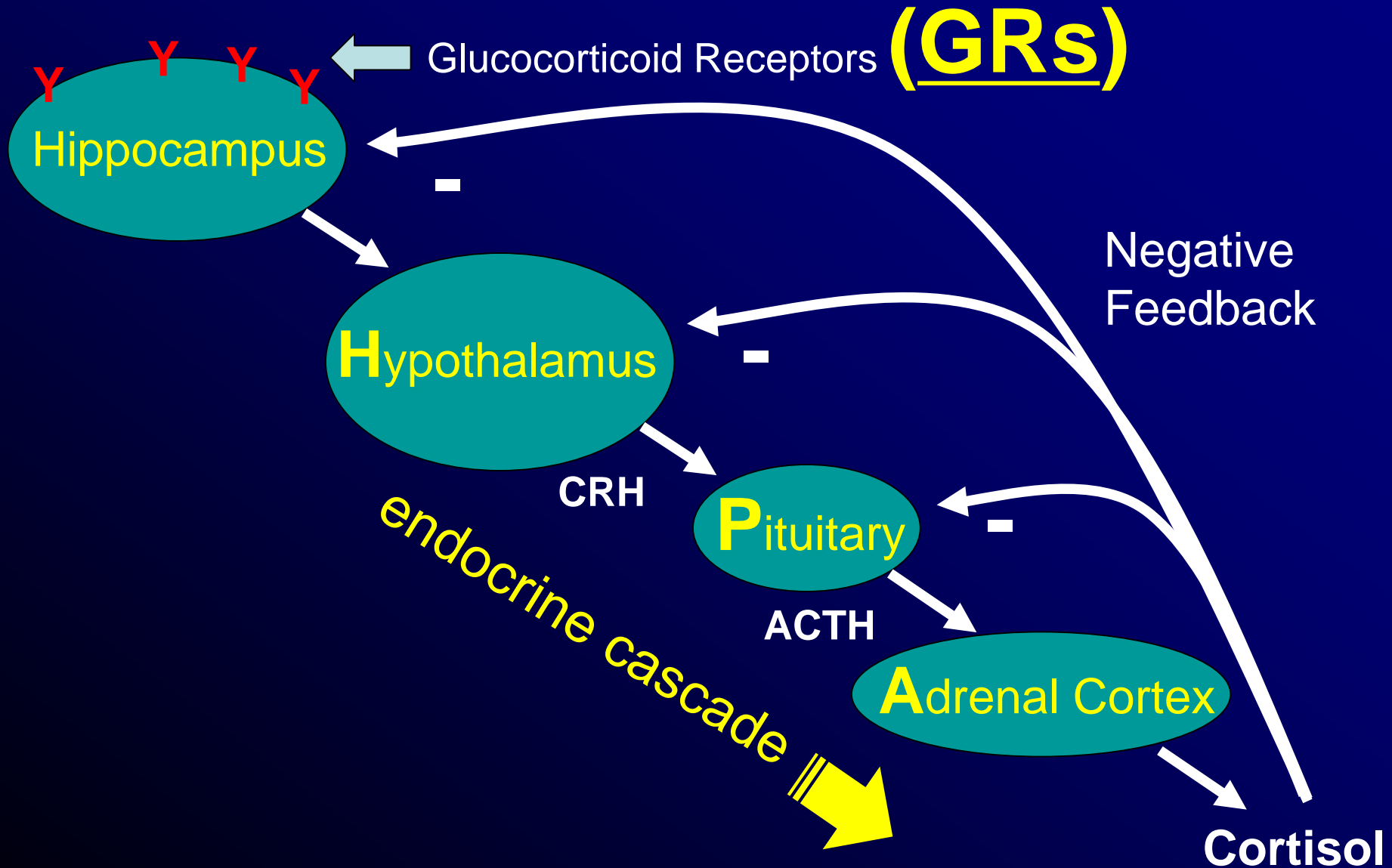


Suicide

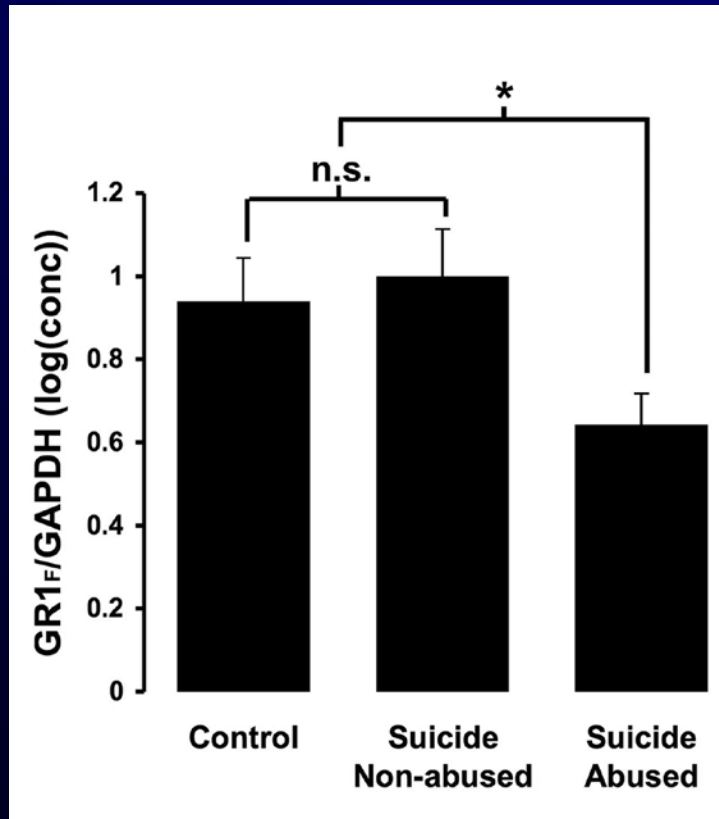
- A leading cause of death worldwide.
- Linked to, but not predicted by mental disorders (e.g. depression)
- Changes in gene expression in the brain of unclear etiology.
- **Childhood adversity: alters the response to stress and increases suicide risk later in life.**



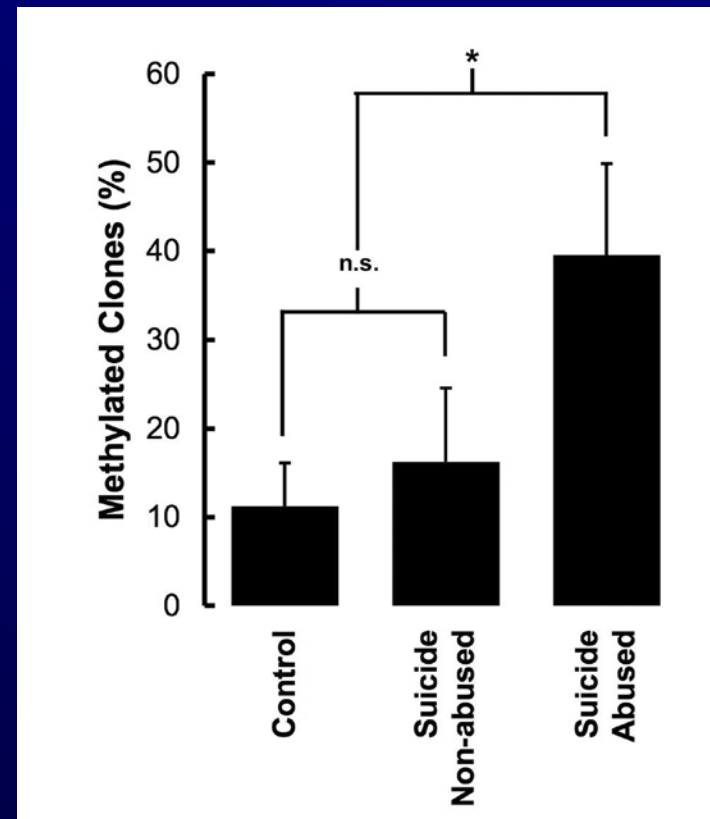
Glucocorticoid signaling: The stress response



Epigenetic regulation of the GR gene in postmortem hippocampus



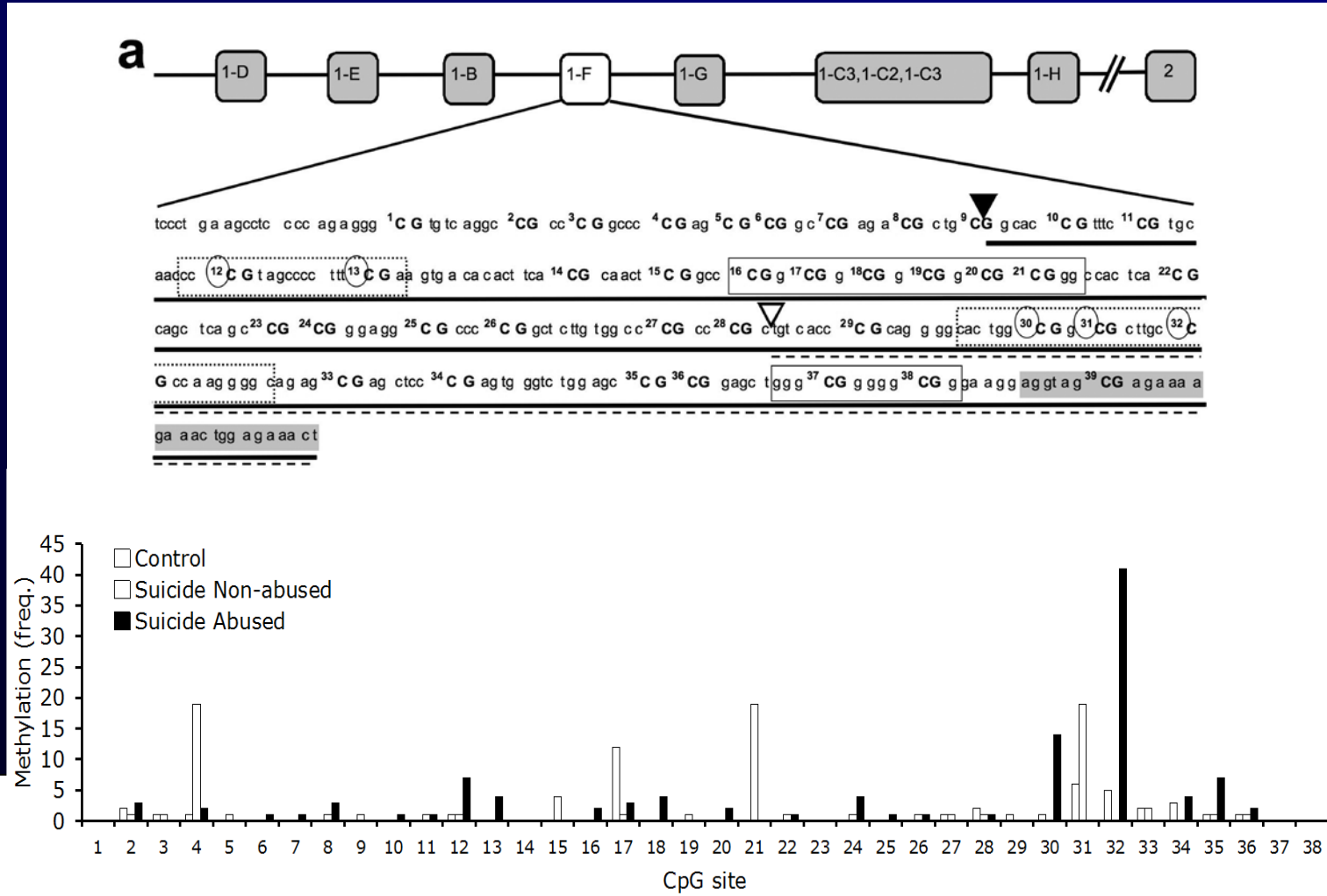
Expression



DNA Methylation

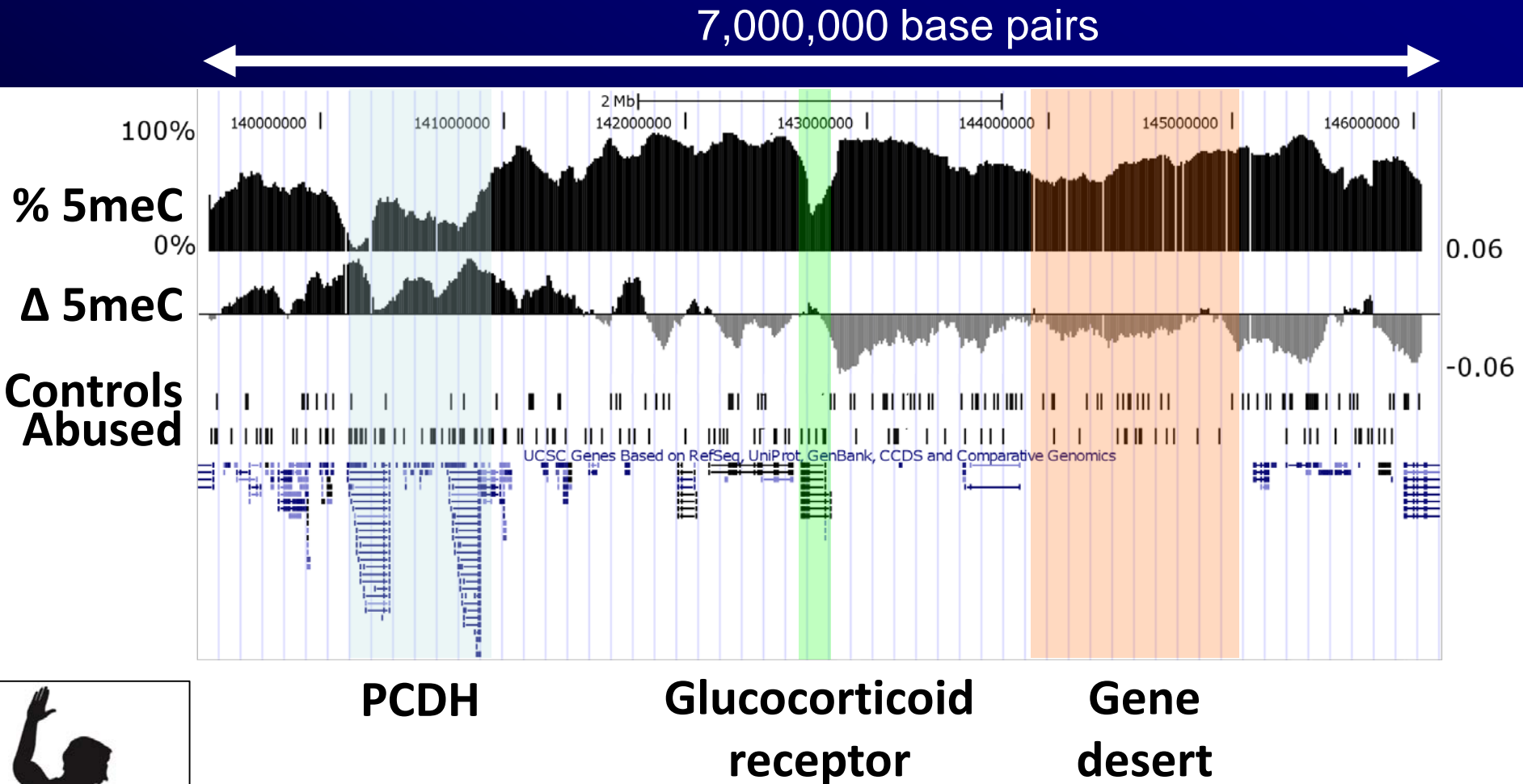


DNA methylation of the GR gene in human brain associates with childhood abuse



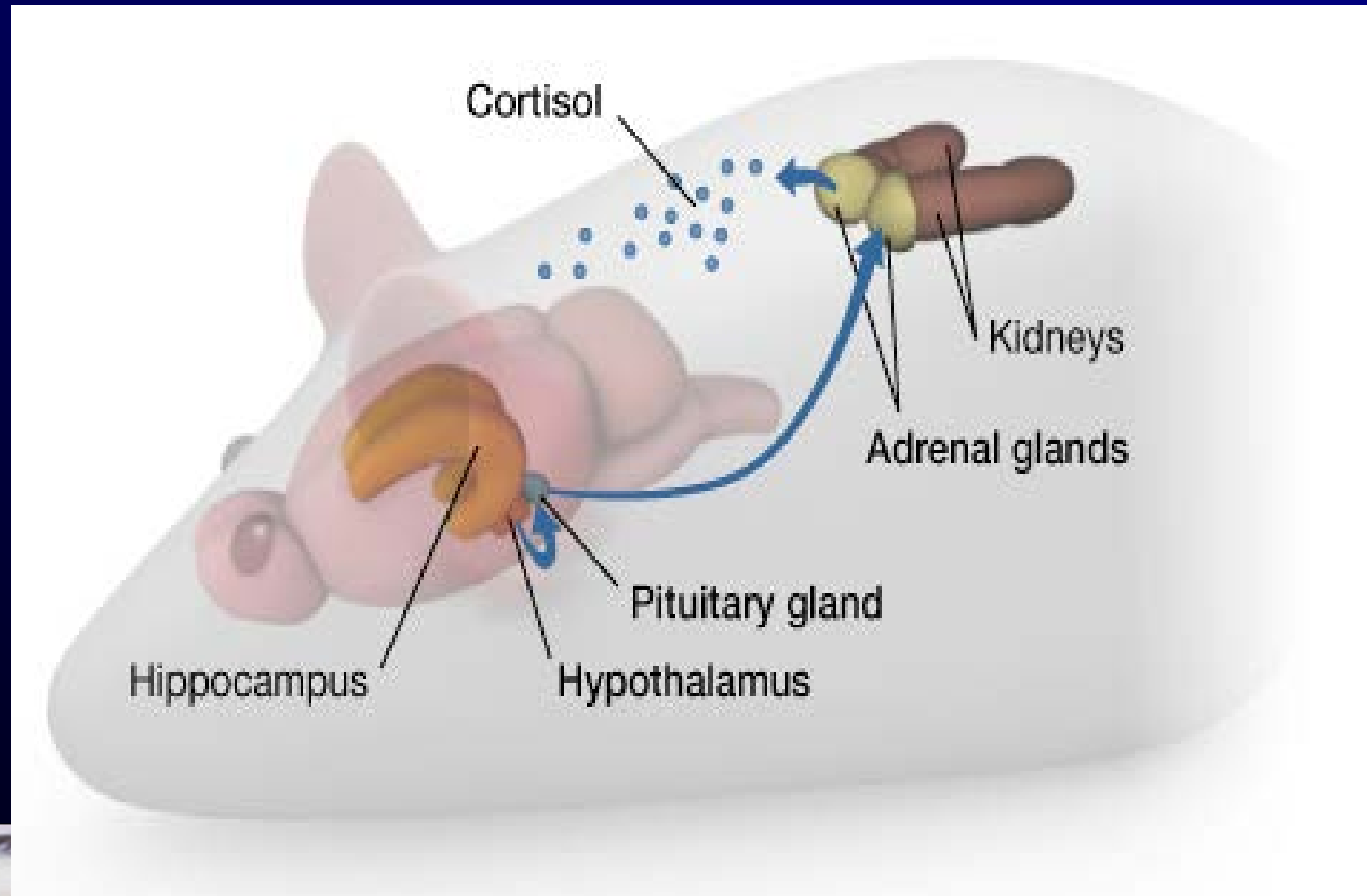
McGowan et al., Nature Neuroscience (2009)

A broad epigenetic response to early environment



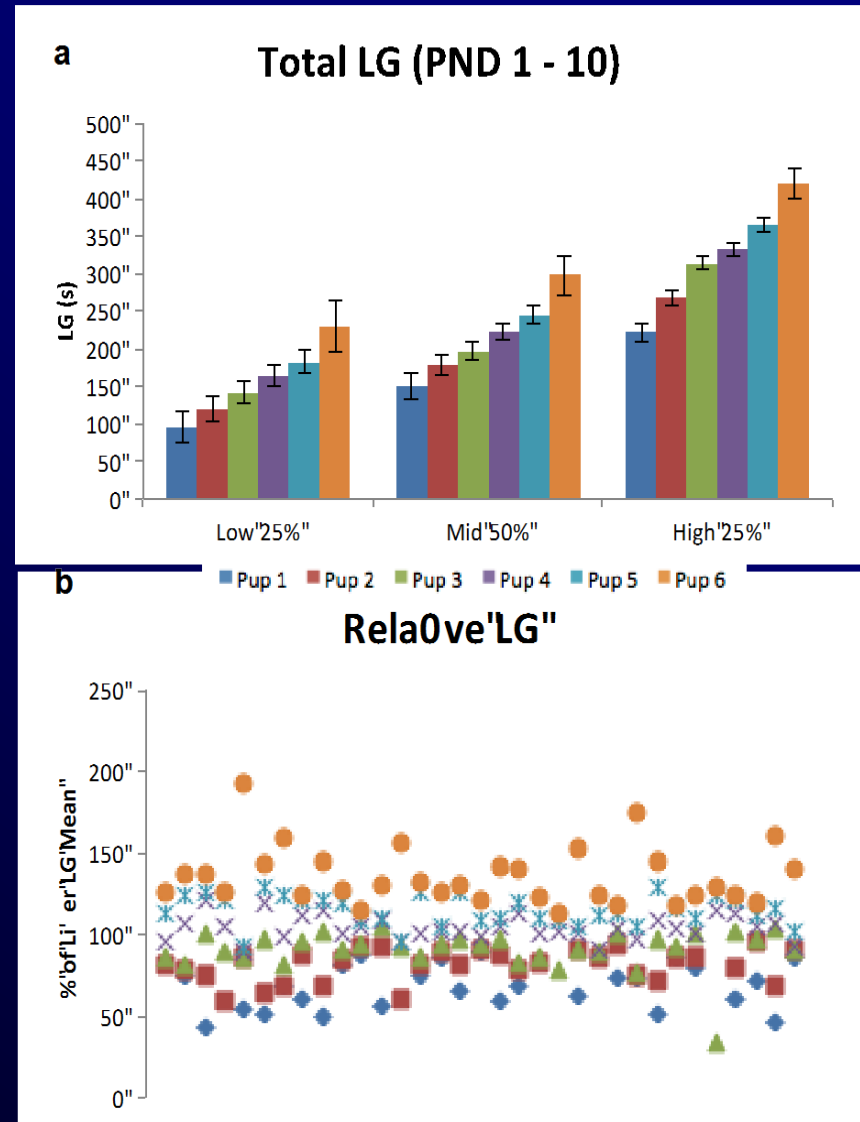
Suderman, McGowan* et al. PNAS (2012)*

Glucocorticoid signaling: The stress response



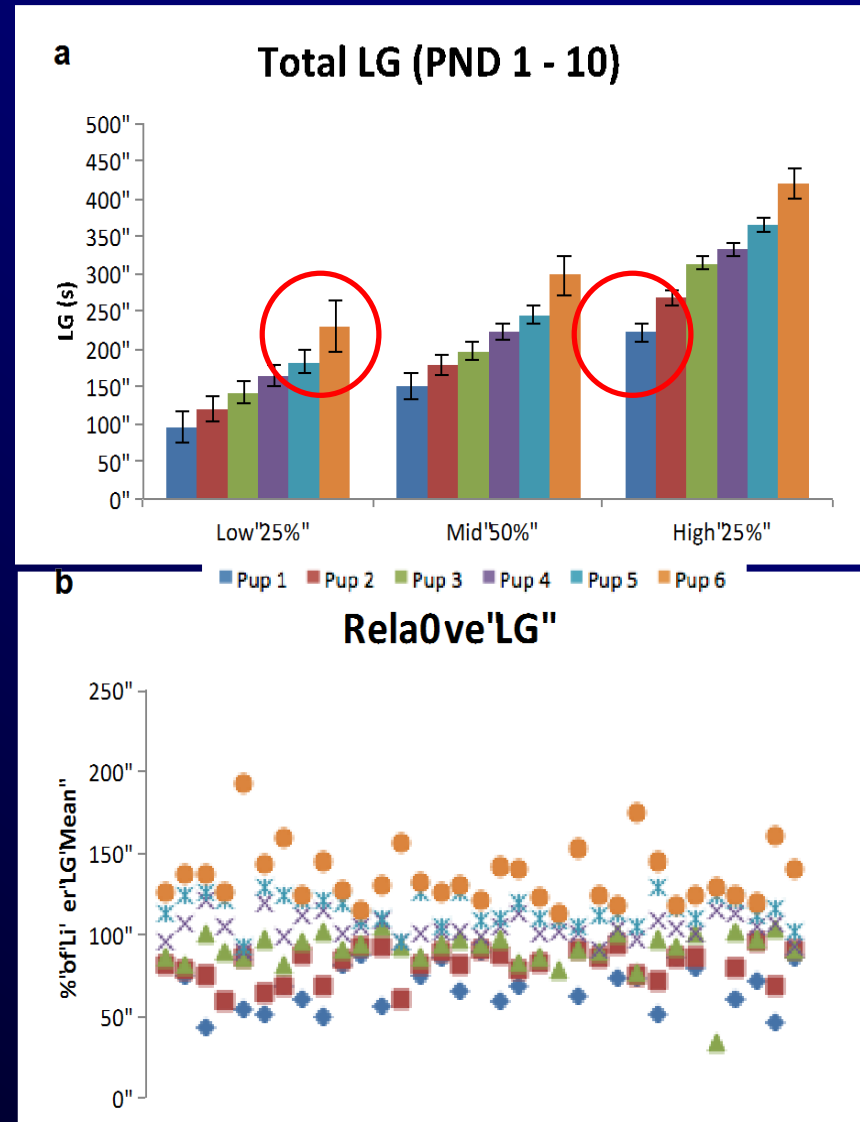
Rodents show natural variations in maternal care both within and between litters

In rats, maternal care consists mainly of Licking and Grooming (LG).

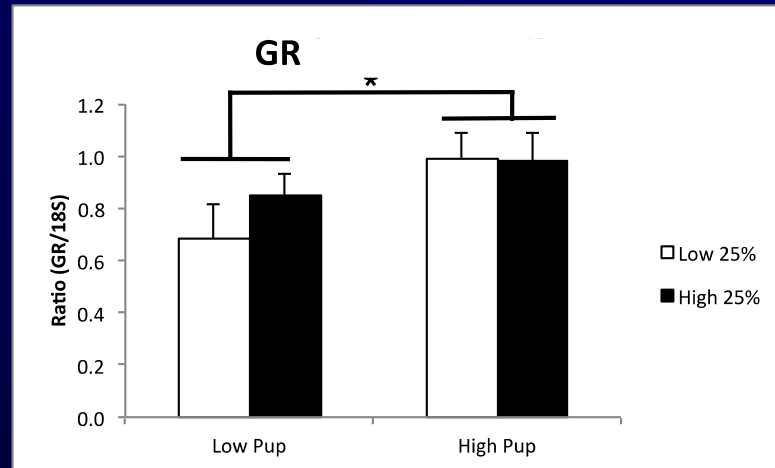


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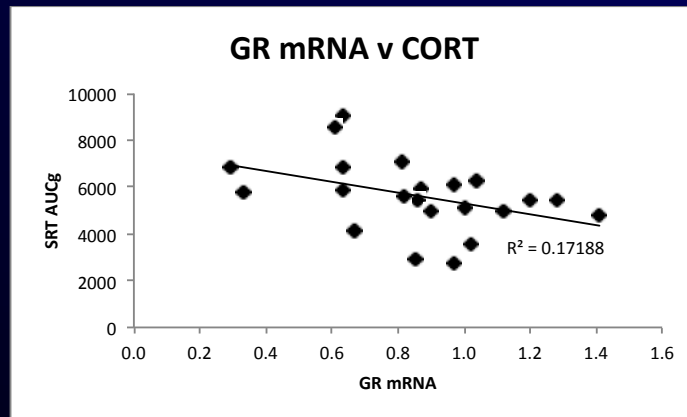
In rats, maternal care consists mainly of Licking and Grooming (LG).



Effects of natural variations in maternal care on stress-related phenotype

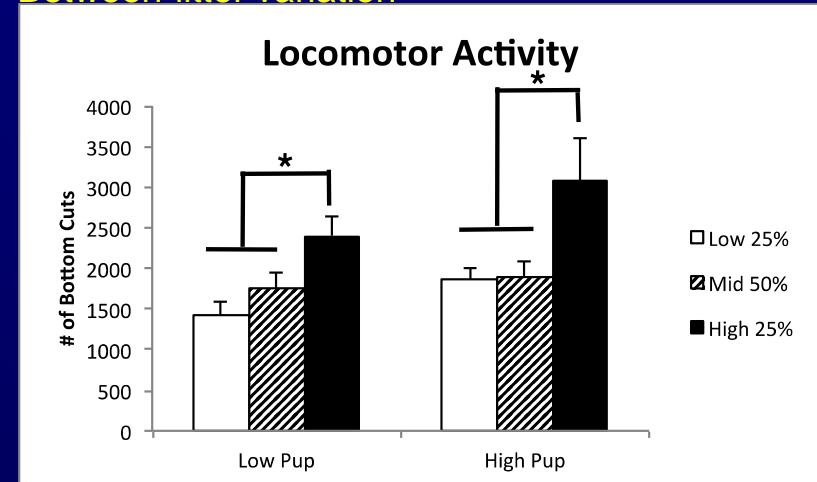


GR gene expression

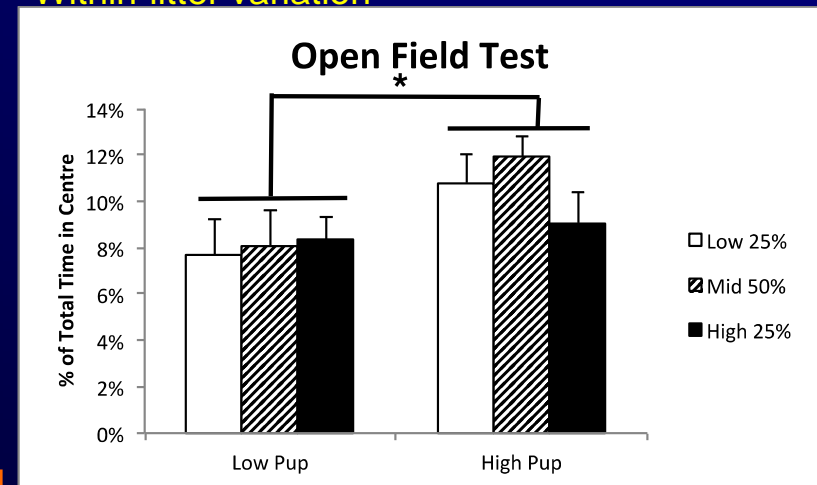


Stress response

Between-litter variation

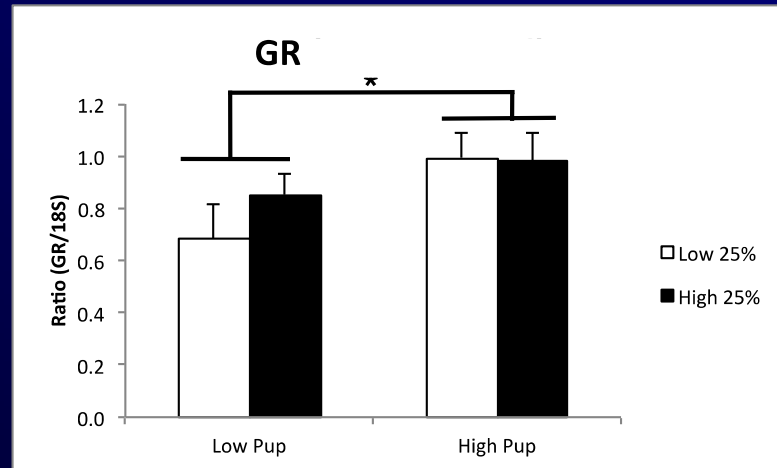


Within-litter variation

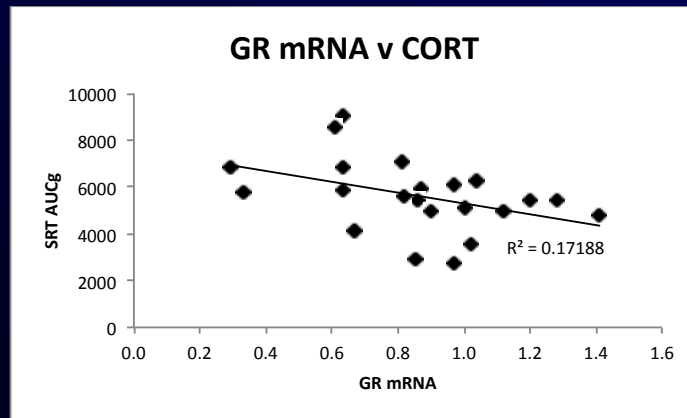


Anxiety behaviours

Effects of natural variations in maternal care on stress-related phenotype

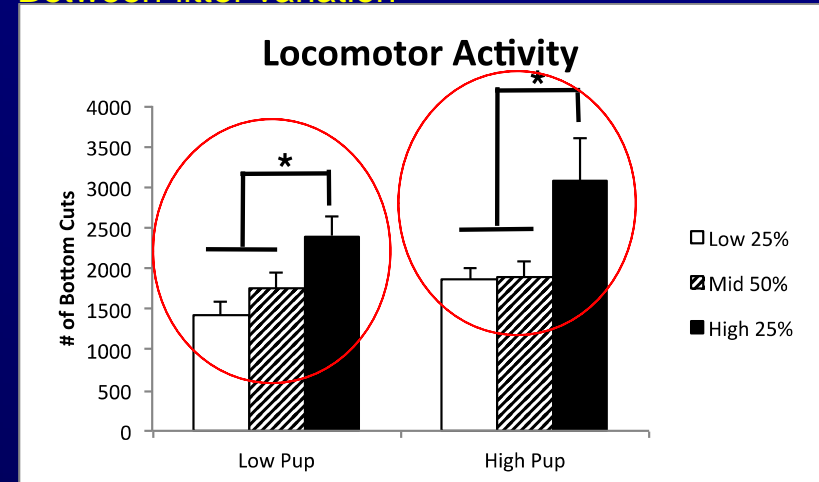


GR gene expression

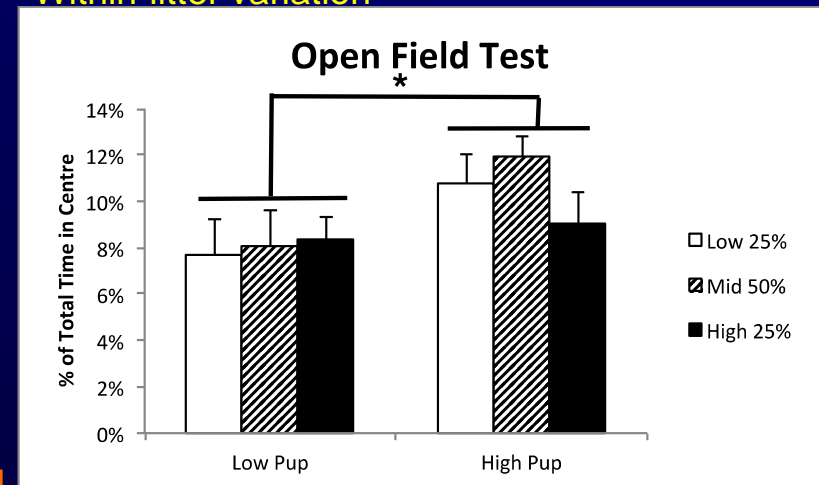


Stress response

Between-litter variation

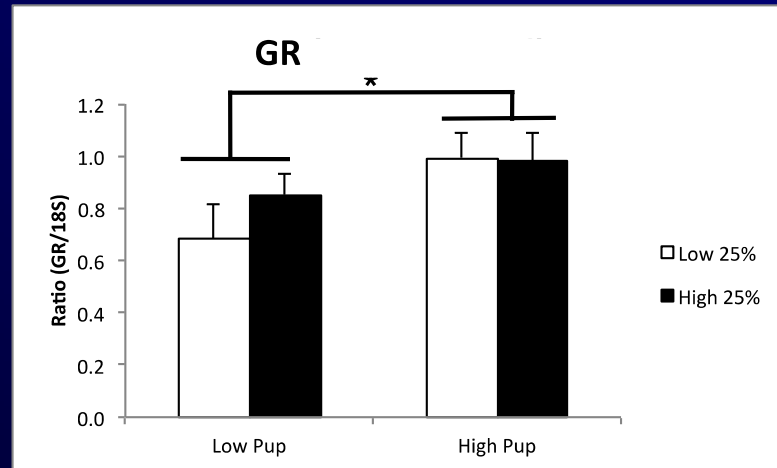


Within-litter variation

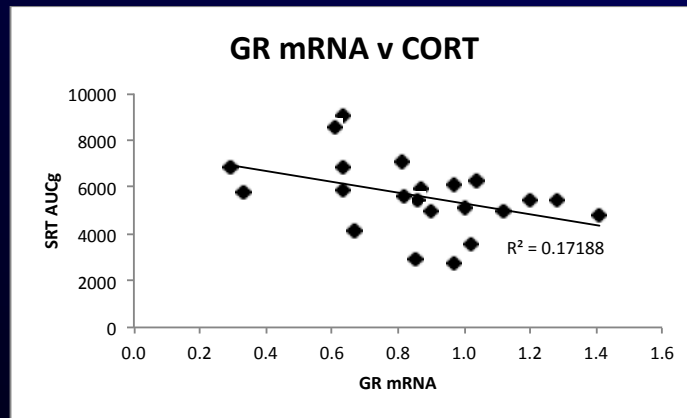


Anxiety behaviours

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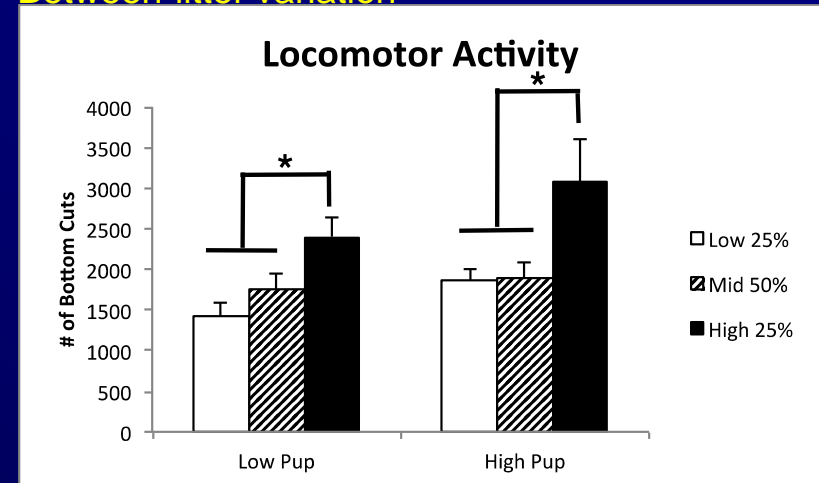


GR gene expression

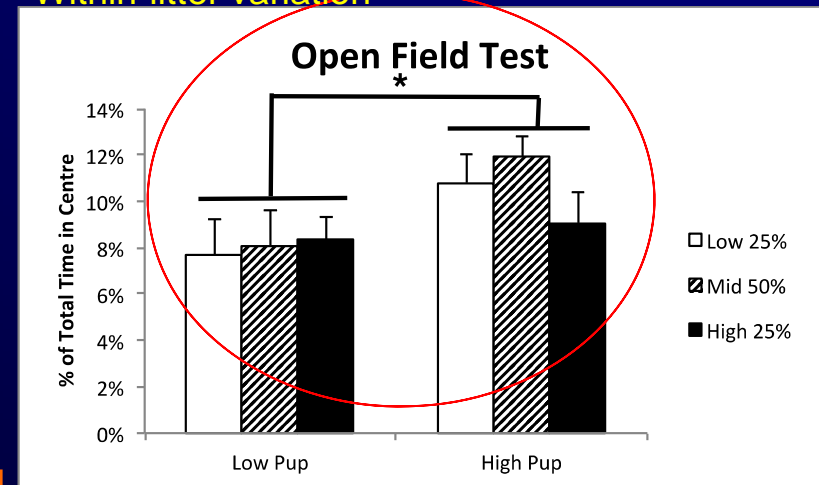


Stress response

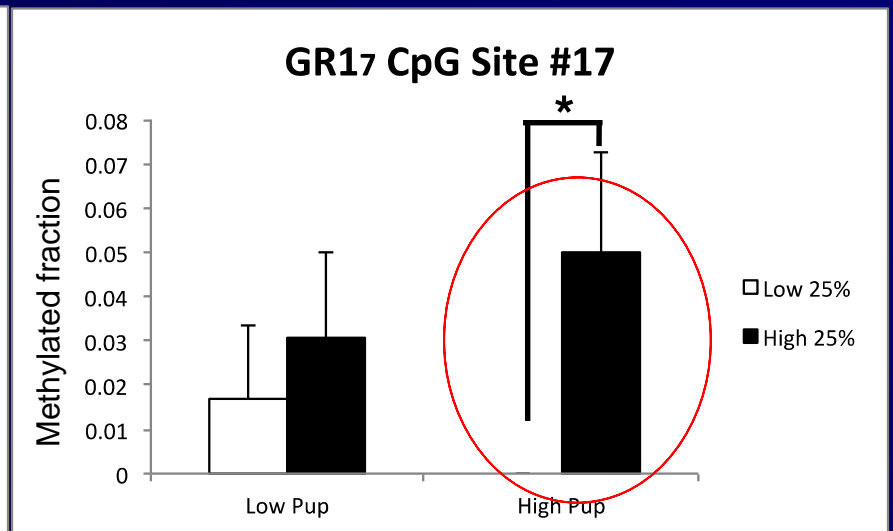
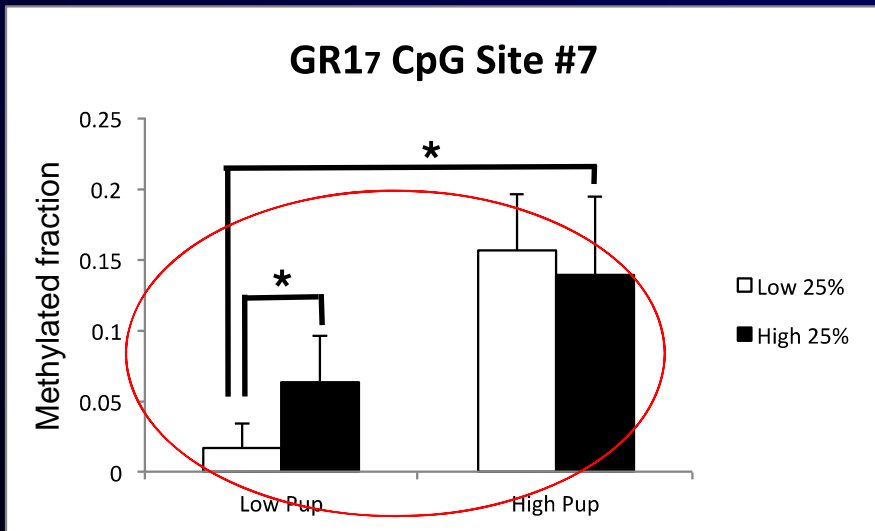
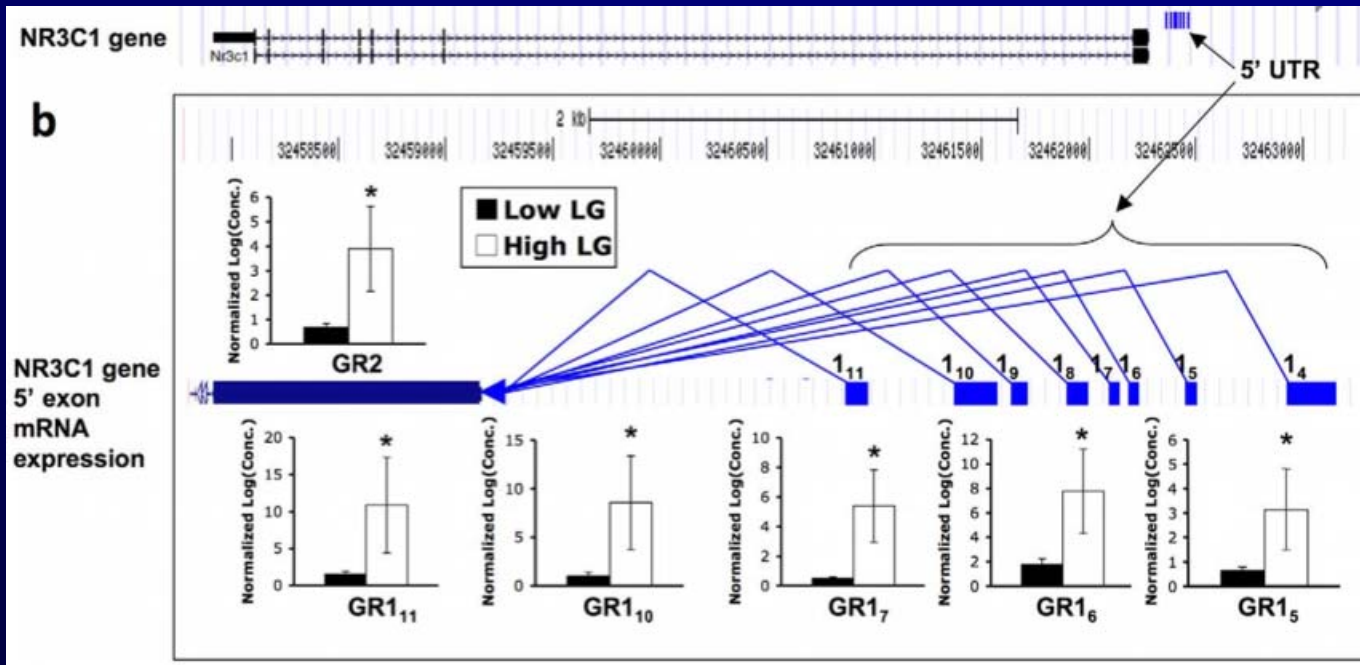
Between-litter variation



Within-litter variation



Anxiety behaviours



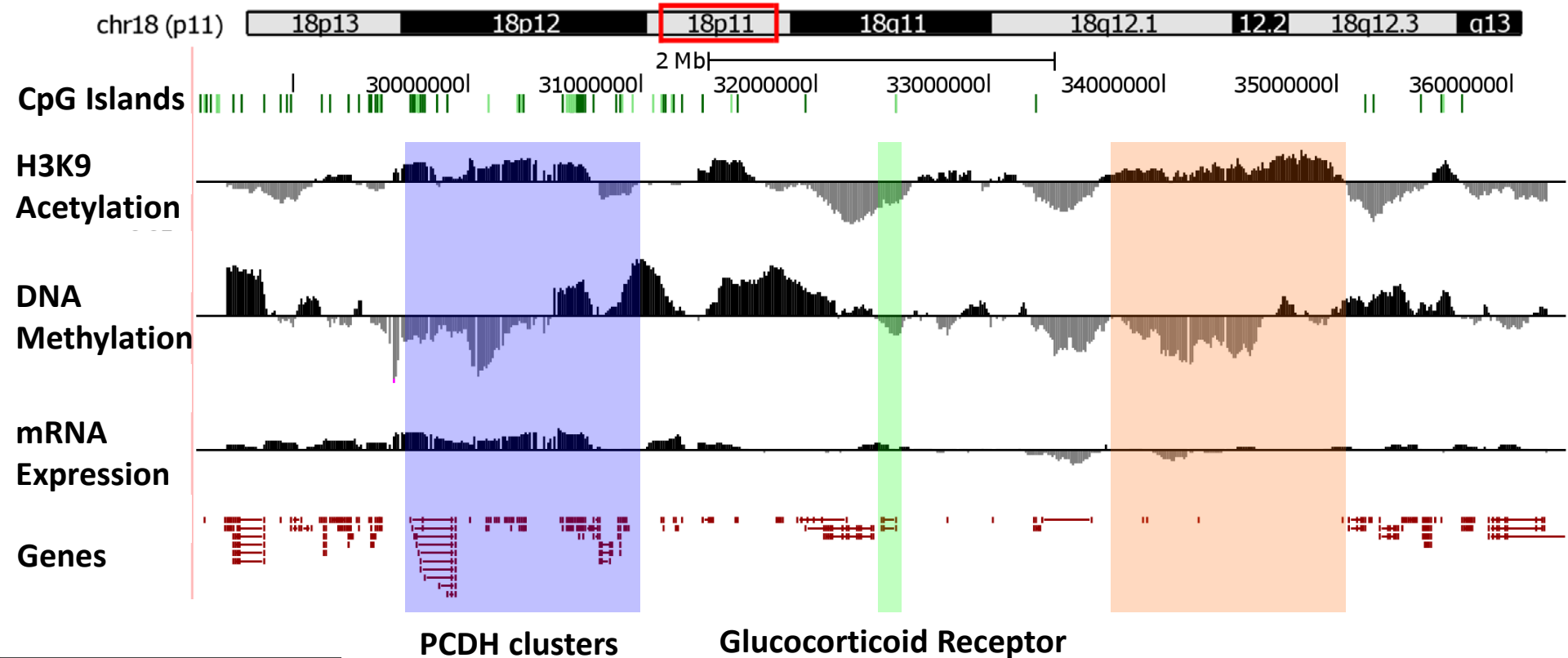
Within-litter variation

Between-litter variation

Within-litter variation of DNA methylation and gene expression of GR

A broad epigenetic response to early environment

7,000,000 base pairs



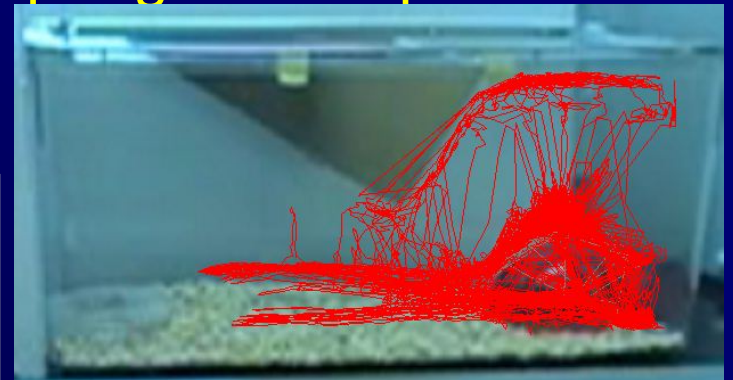
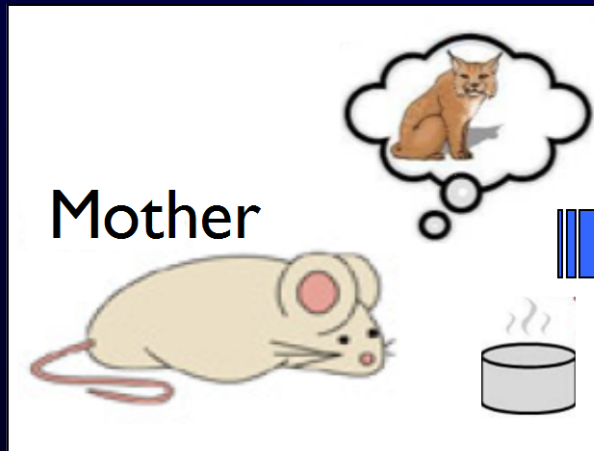
- Statistical dependencies in DNA methylation across 100,000 base pairs of DNA sequence.

McGowan et al. PLoS One (2011)

Maternal programming of the response to predator odor



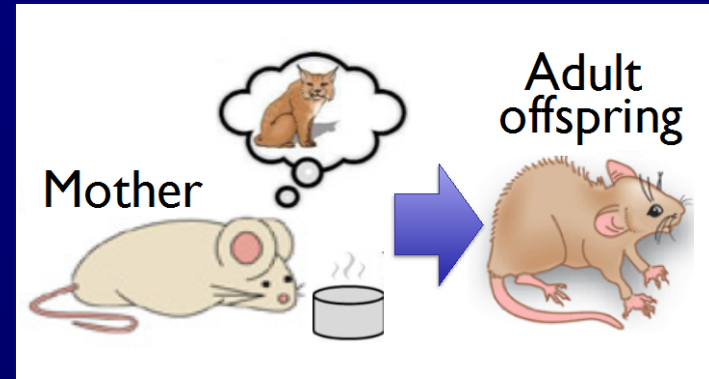
Offspring from exposed moms



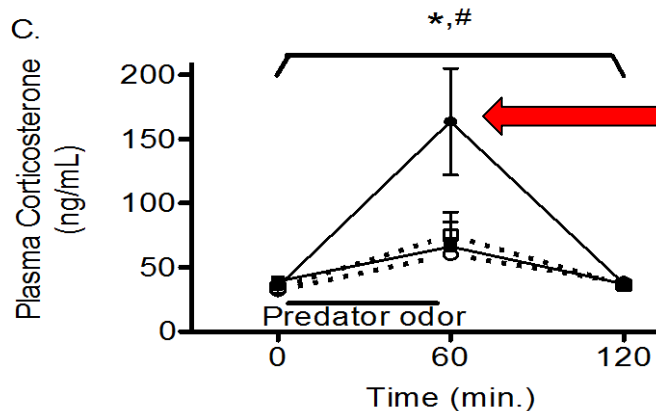
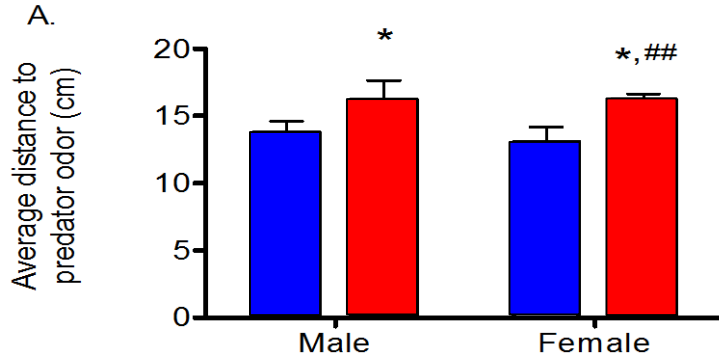
Control offspring



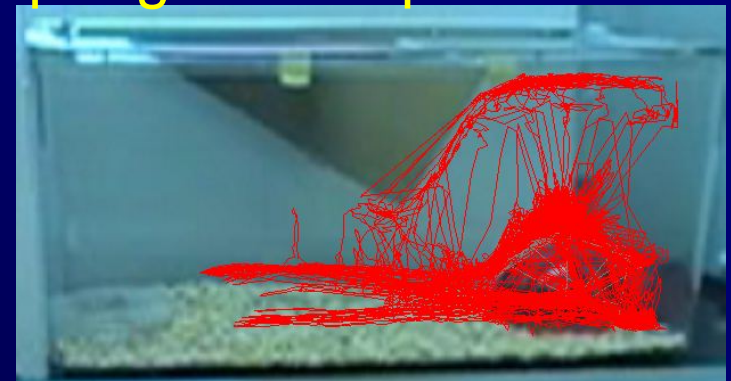
Maternal programming of the response to predator odor



Offspring from exposed moms



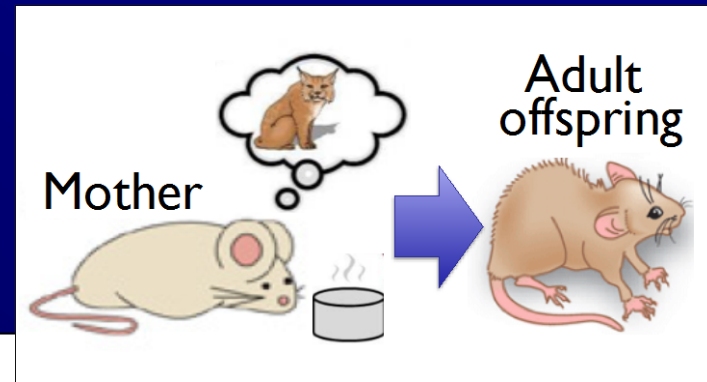
Female Offspring from predator-exposed dams



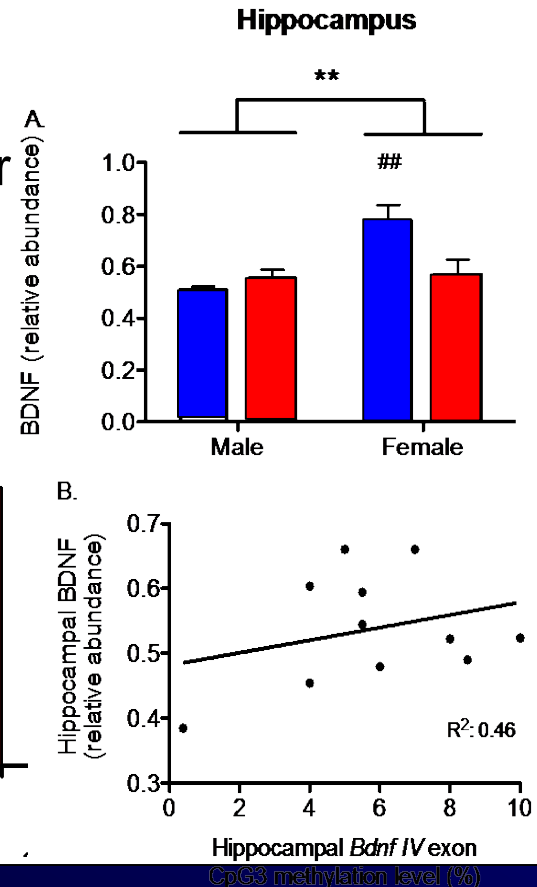
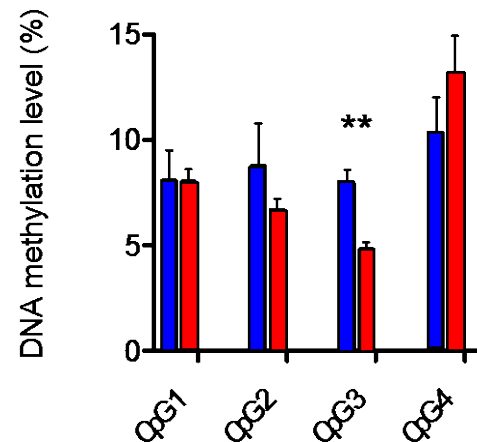
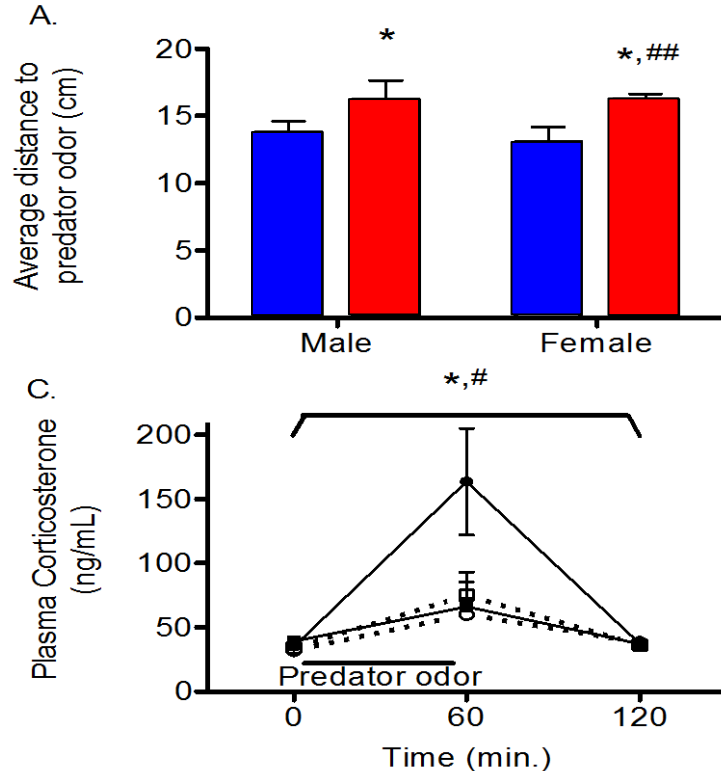
Control offspring



Maternal programming of the response to predator odor



Brain-derived Neurotrophic Factor (BDNF):



Social aspects of stress: Parental factors and the epigenome

Evolution may have shaped offspring to use parental signals to 'forecast' the quality of the environment (R. Hinde).



Mechanisms of plasticity in development:

- Adaptation
- Mismatch
- Developmental constraint
- Pathology

