

Why and How to Measure the Hypothalamic-Pituitary- Adrenocortical System



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Early Adverse Experiences



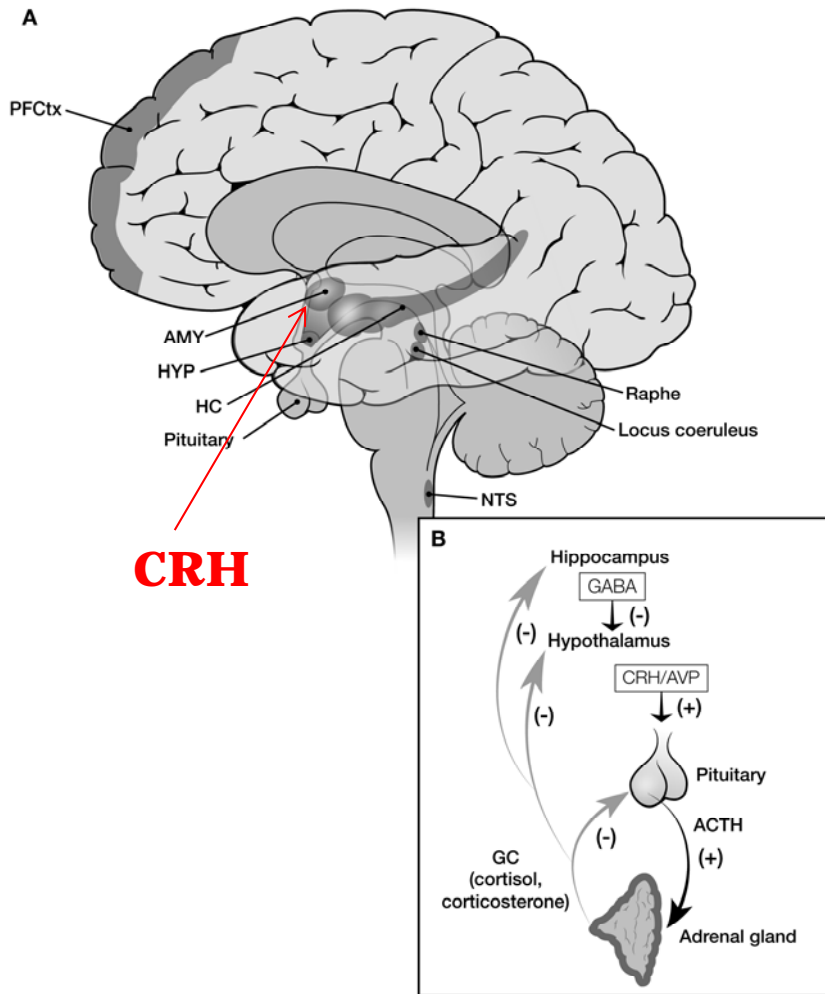
- **Seriously disturbed attachment relationships, neglect, physical abuse, sexual abuseincrease the risk of poor developmental outcomes**
- **Probabilistic. Individual Differences**
- **Effects require mechanisms by which such experiences get “under the skin”**
- **Steroid hormones provide one such mechanism**

Steroids: Mechanisms of Action



- Steroid hormones are lipid soluble. Enter cells throughout the body. Cross blood brain barrier readily.
- Once in the cell, bind to specific receptors.
- Bound hormone-receptor complex transported to nucleus where it interacts with DNA “Hormone receptive elements” (HREs) to regulate gene expression.
- Steroid hormones are “gene transcription factors”
- Positioned to shape the physical development of brain and body; adapt the organism to their context or life stage

The Hypothalamic-Pituitary-Adrenocortical System



- Cortisol is produced by the HPA system
- Hypothalamus stimulated to produce CRH and AVP
- CRH and AVP stimulate anterior pituitary to produce ACTH
- ACTH stimulate adrenal cortex to produce cortisol

Why Measure Activity of HPA Axis



- The activity of this system plays a role in the development of behavioral and emotional problems and physical and mental health
- To provide an index of how stressed the person is

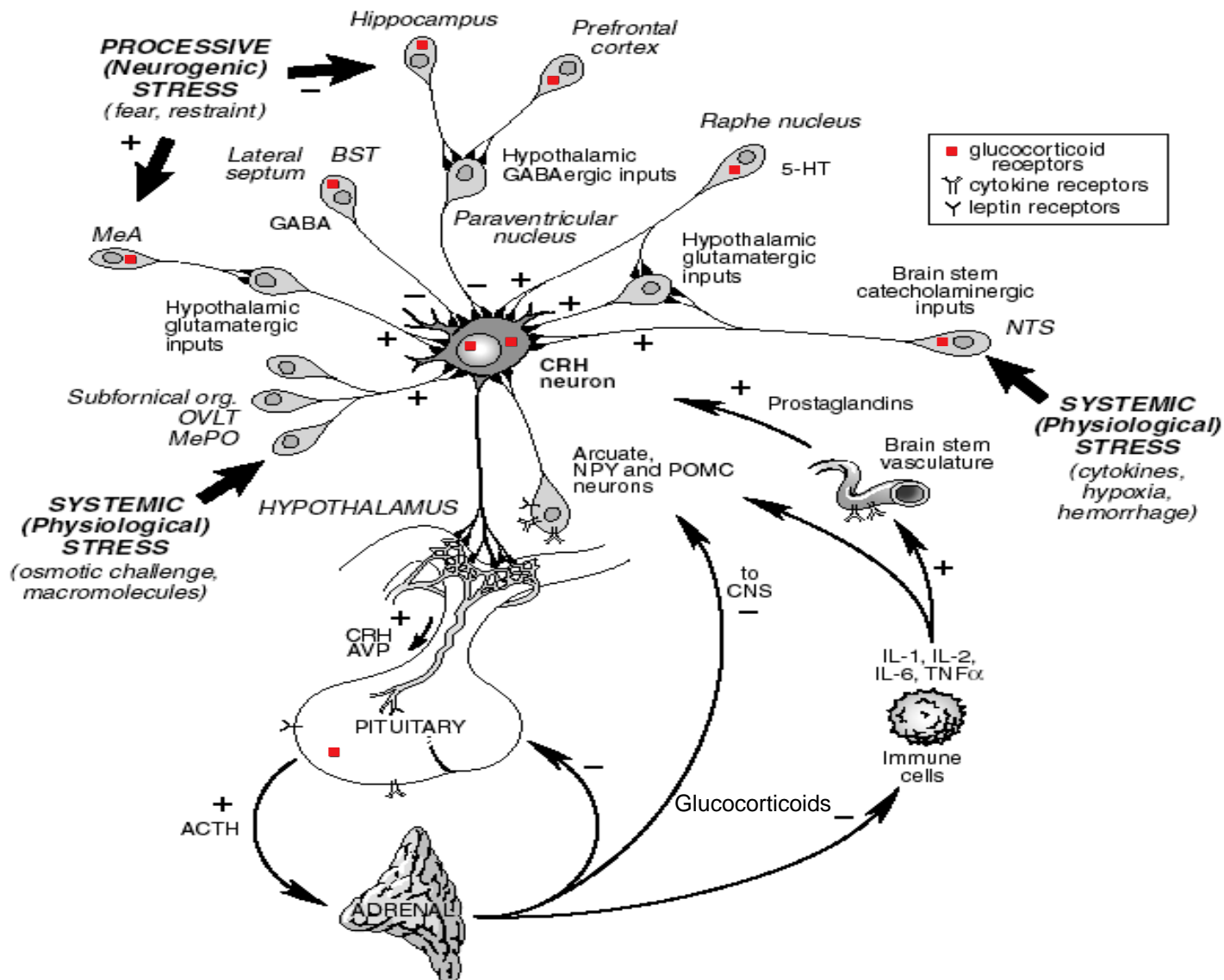
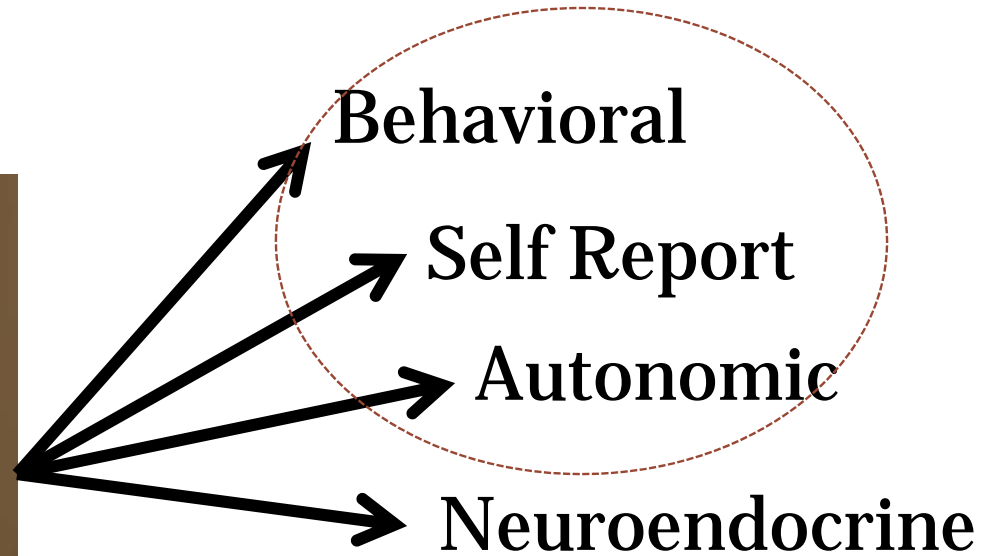
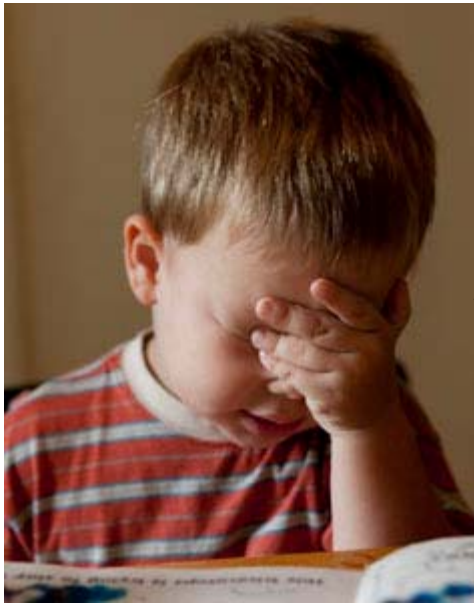
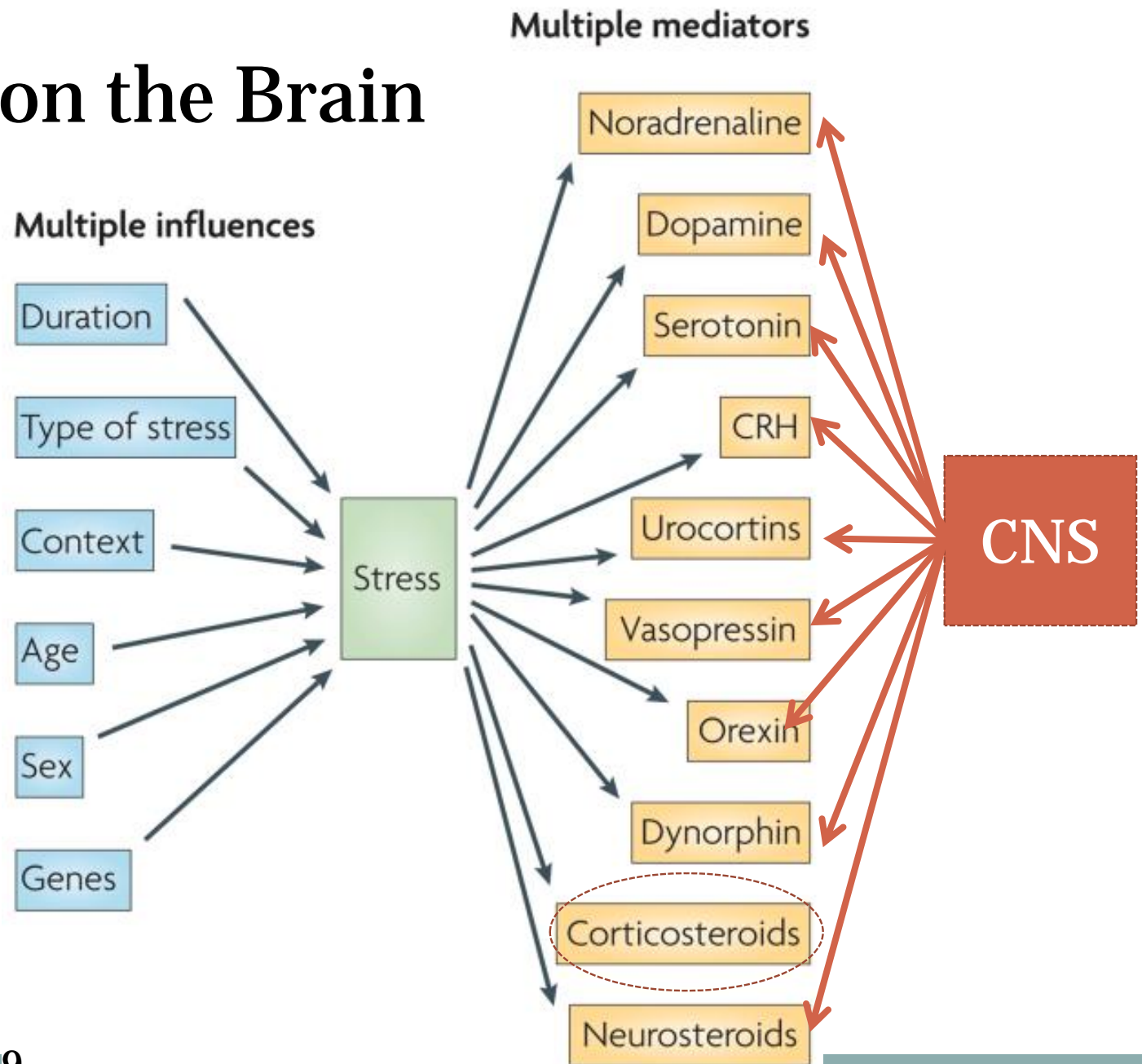


Figure 7-26. Regulation of the hypothalamic-pituitary-adrenal axis. ACTH, adrenocorticotropic hormone; AVP, arginine vasopressin; BST, bed nucleus of the stria terminalis; CNS, central nervous system; CRH, corticotropin-releasing hormone; CRIF, corticotropin release-inhibiting factor; GABA, γ -aminobutyric acid; 5-HT, 5-hydroxytryptamine; IL-1, interleukin-1; MeA, medial amygdala; MePO, medial preoptic; NPY, neuropeptide Y; NTS, nucleus of the tractus solitarius; OVLT, organum vasculosum of the lamina terminalis; POMC, pro-opiomelanocortin.

Indices of Stress/Distress Rarely Cohere



Effects on the Brain

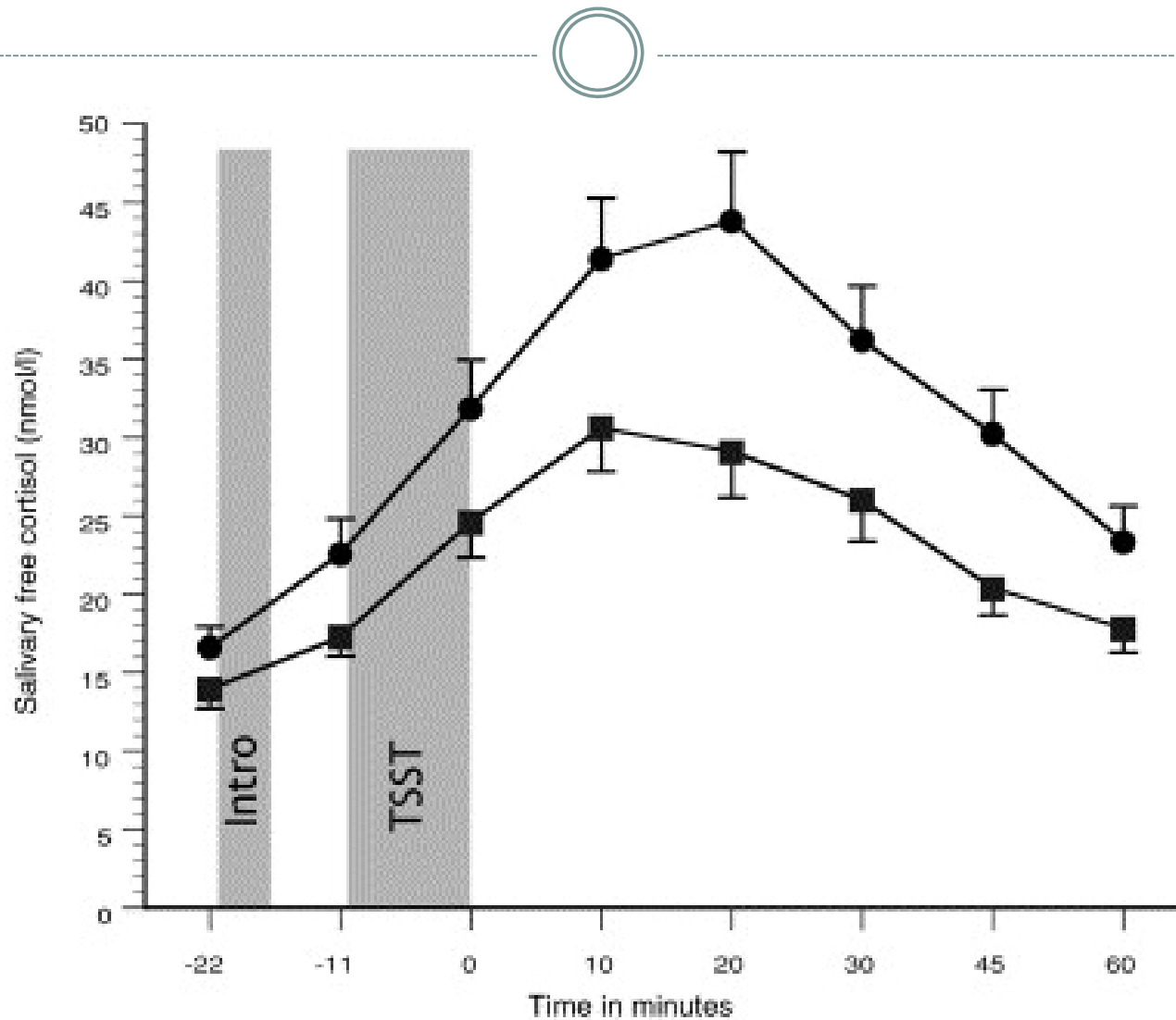


What Aspects of the System to Measure?

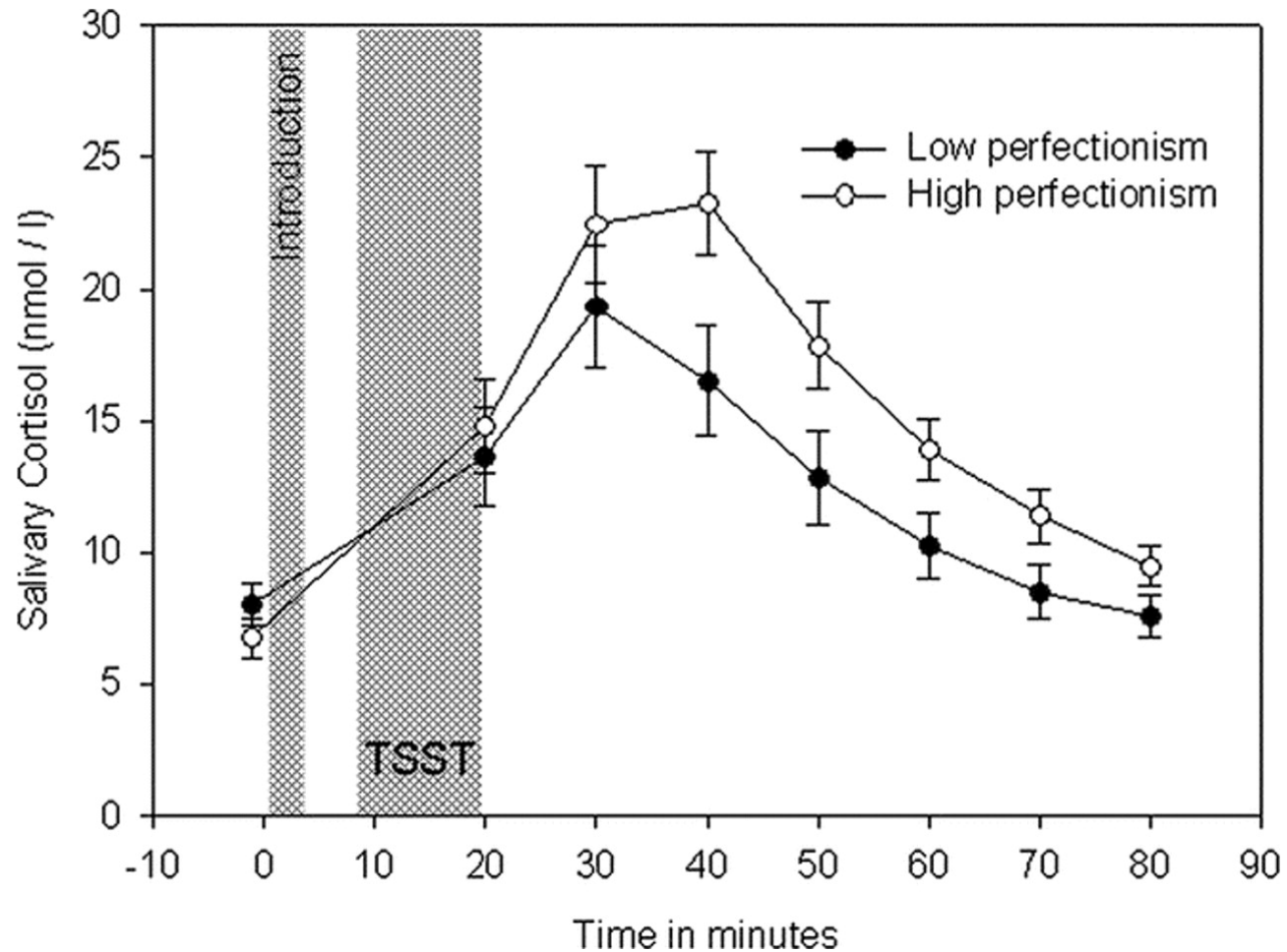


- **Stress Response**
 - Occupy GR which produces most of the catabolic and potentially destructive effects of cortisol
- **Basal Activity**
 - Occupy MR which produce growth promoting impacts of cortisol; timing during day (diurnal rhythm pattern) critical to healthy functioning
- **Cumulative Measures of Production**

Cortisol Stress Response

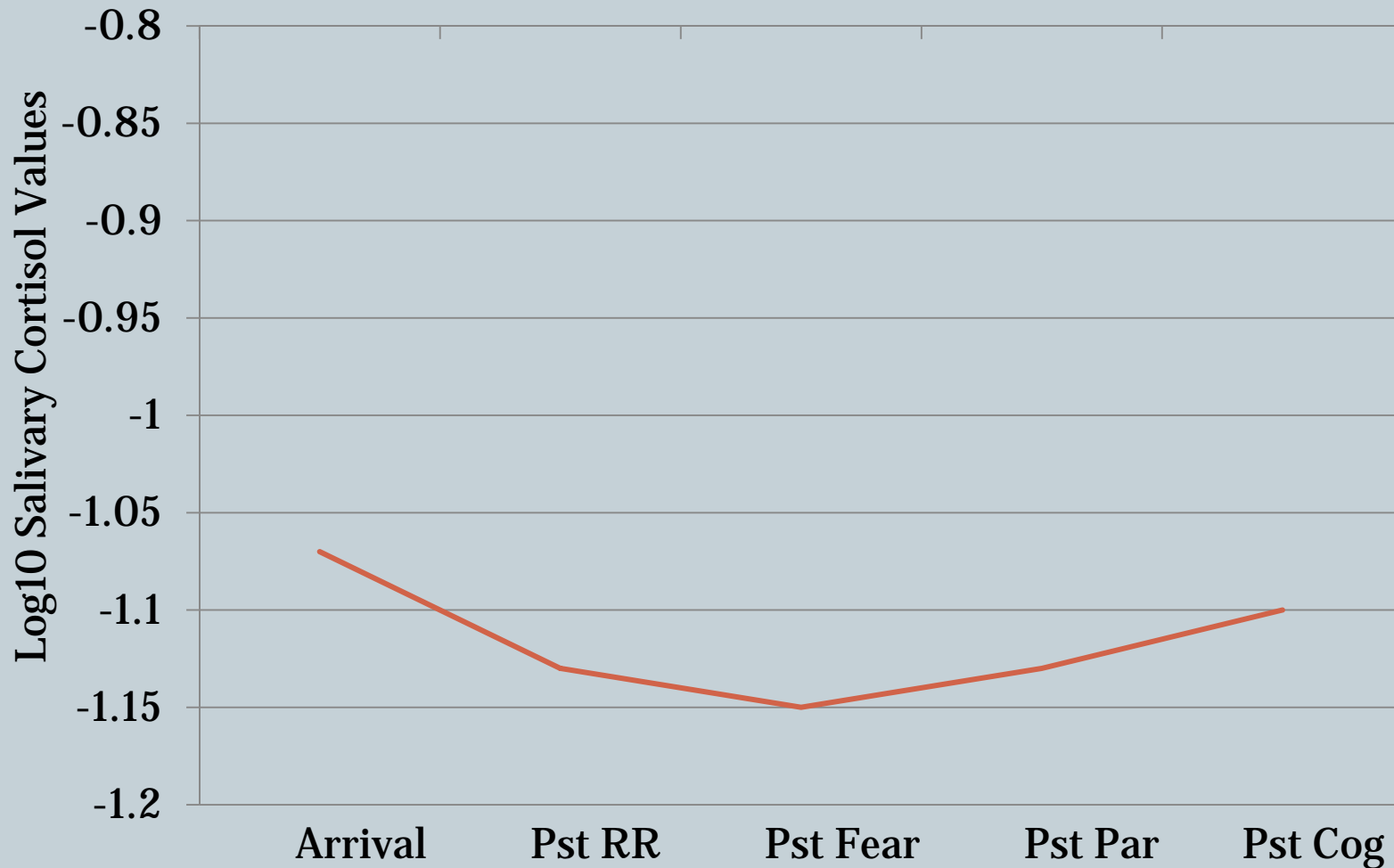


Cortisol Stress Response

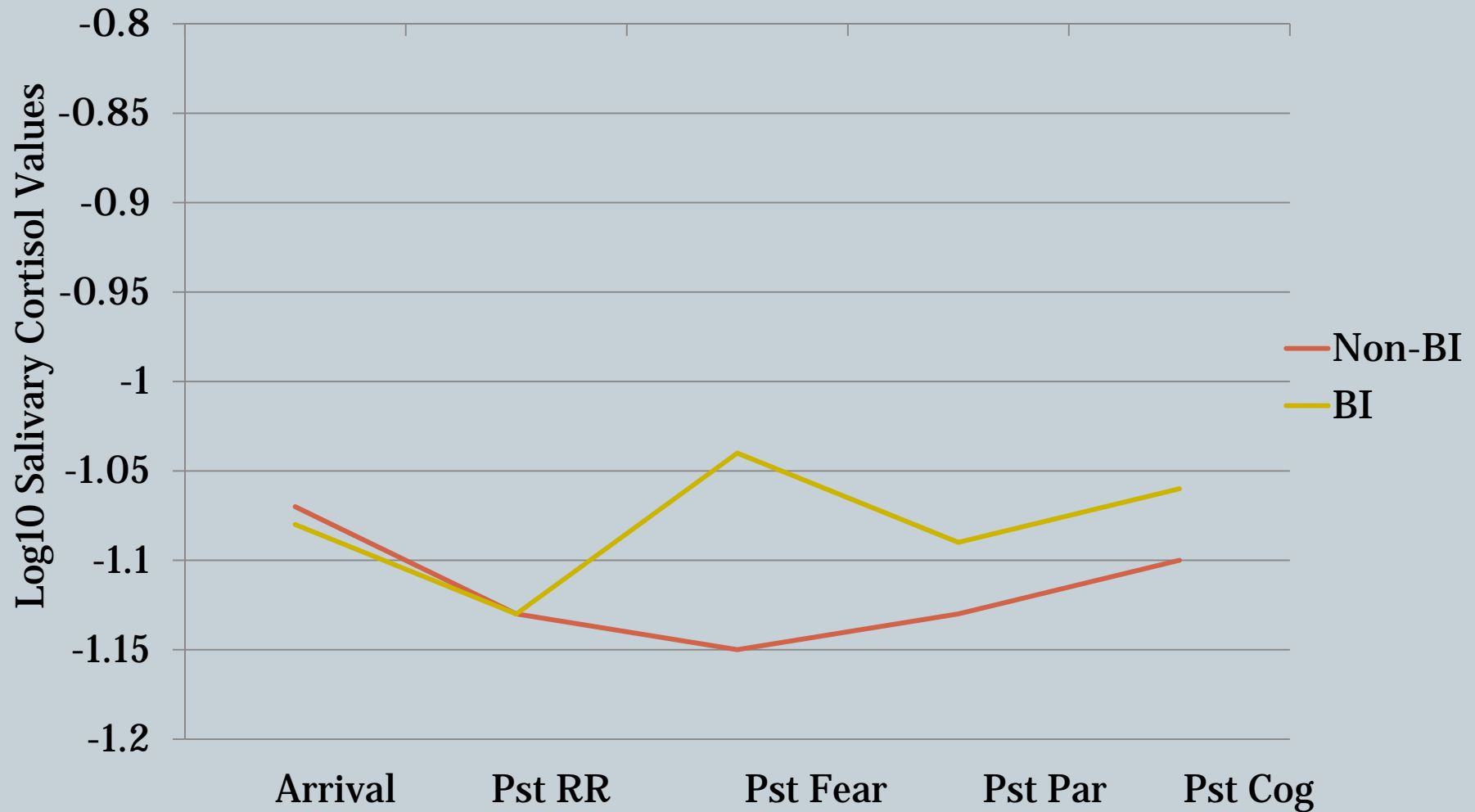


Stressor ? Tasks with Preschoolers

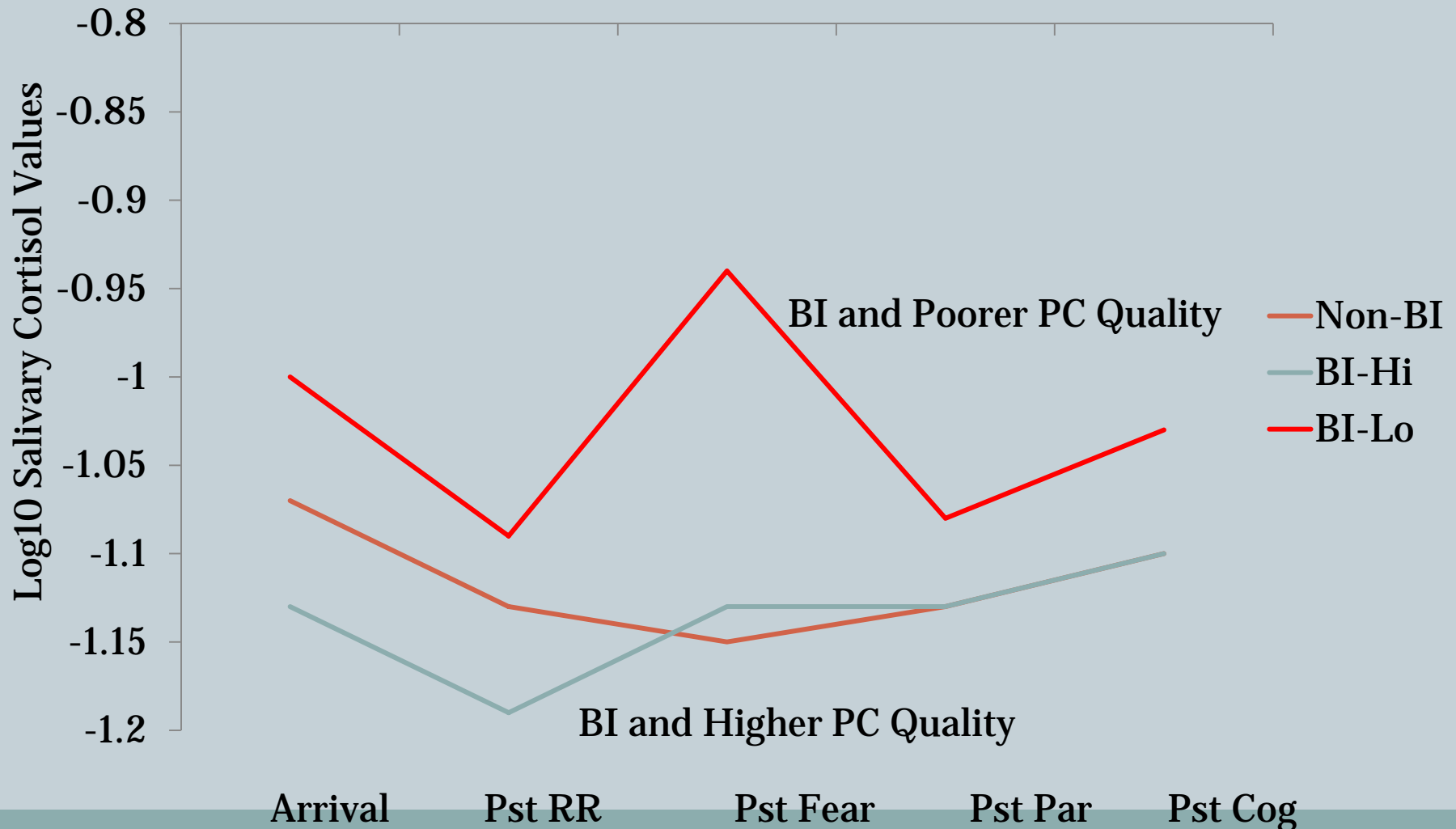
Lab Tab Temperament Vignettes



Stressor ? Tasks with Preschoolers



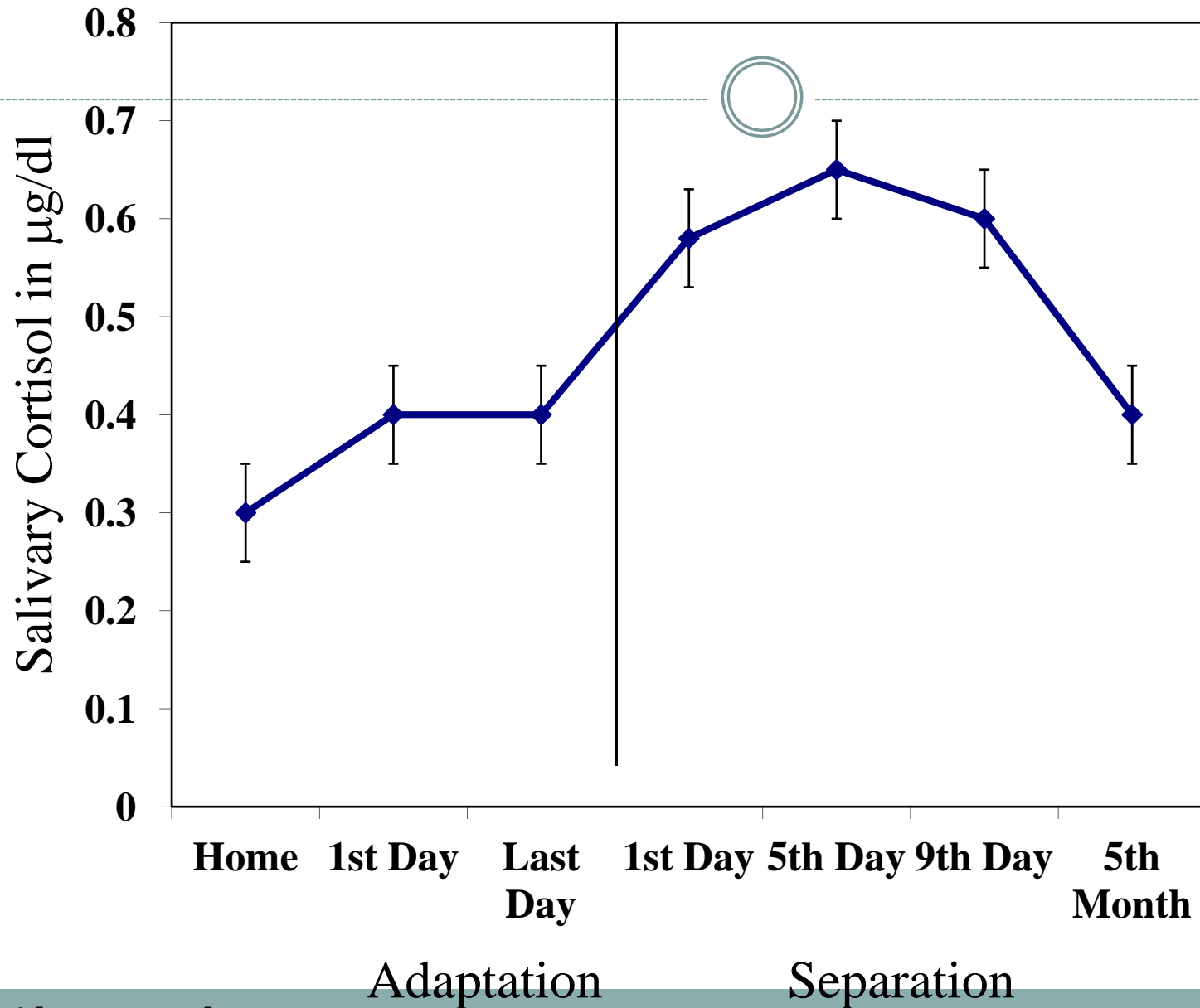
Stressor ? Tasks with Preschoolers

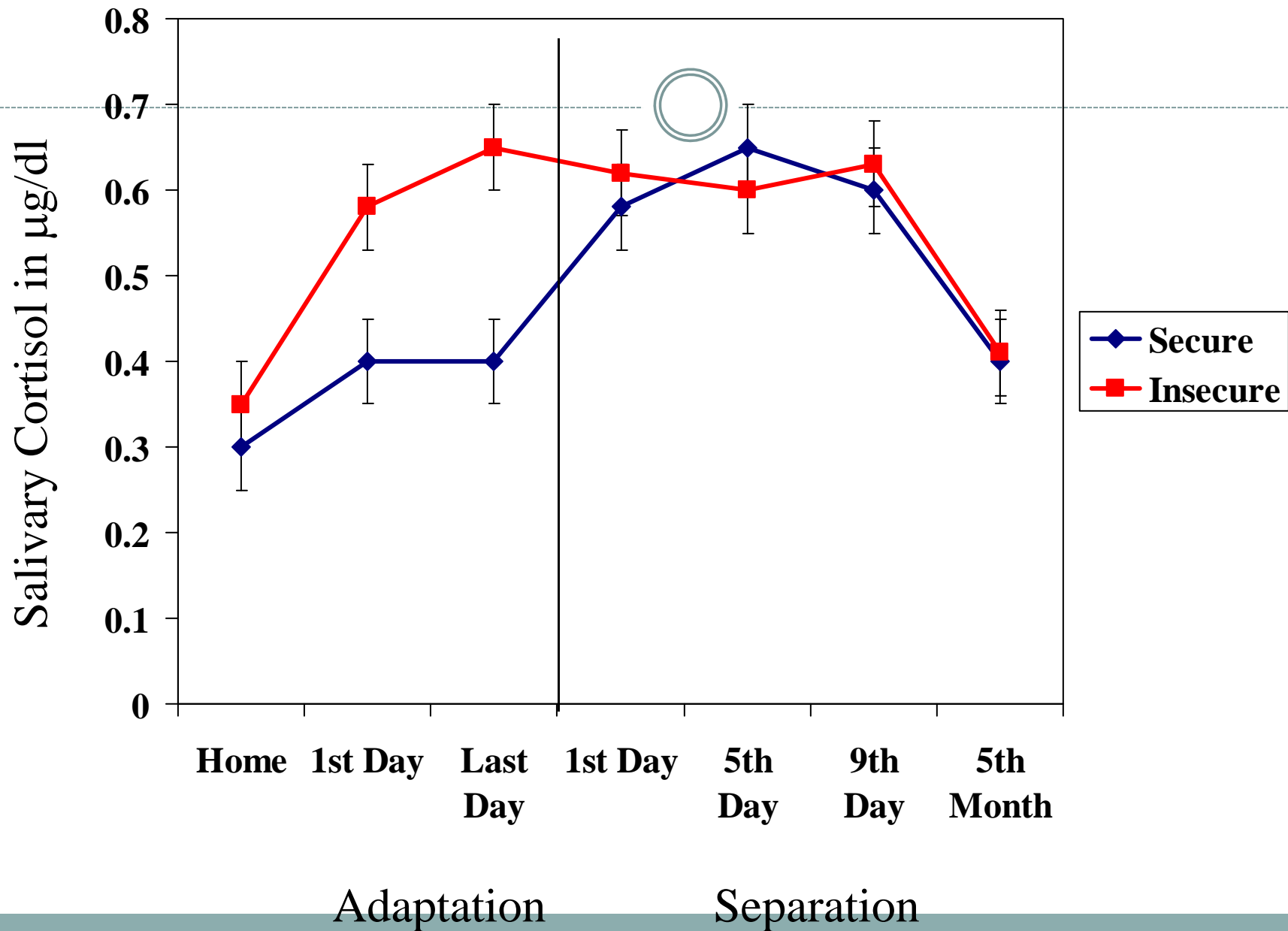




Separation Paradigms

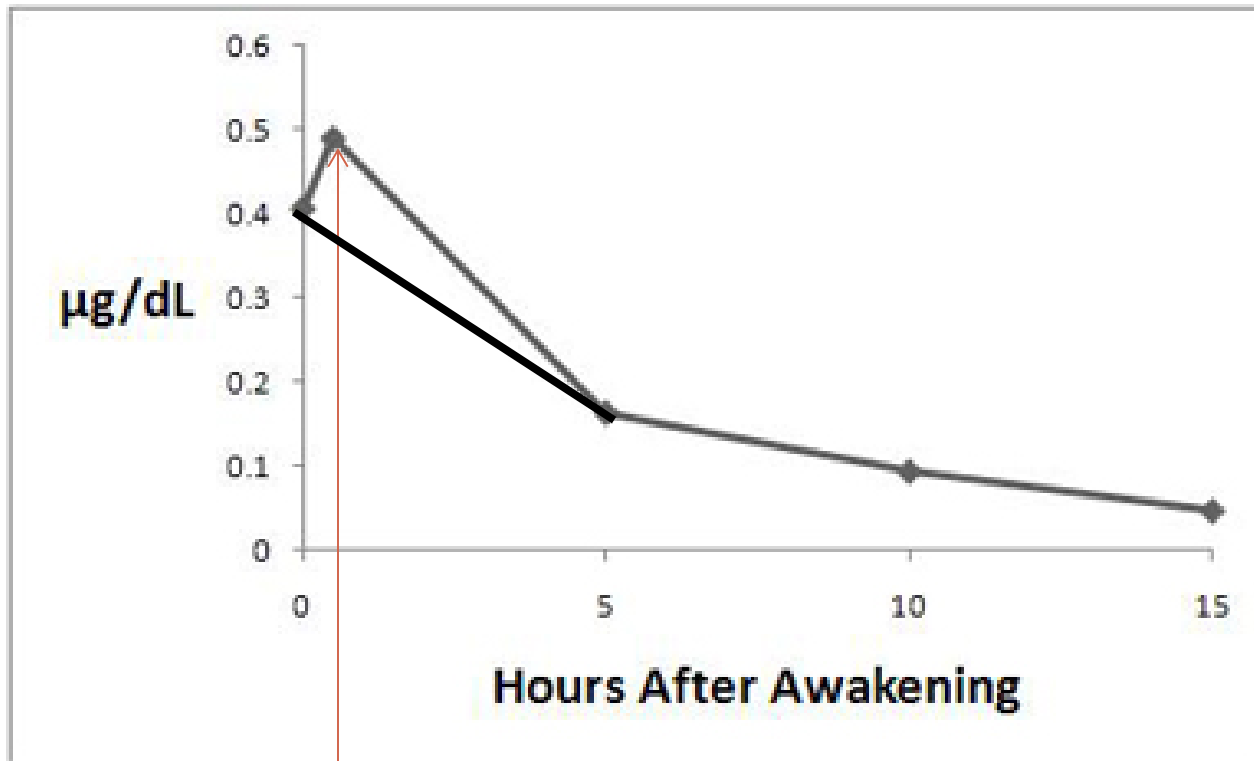
Toddlers in Secure Relationships at Entry to Child Care





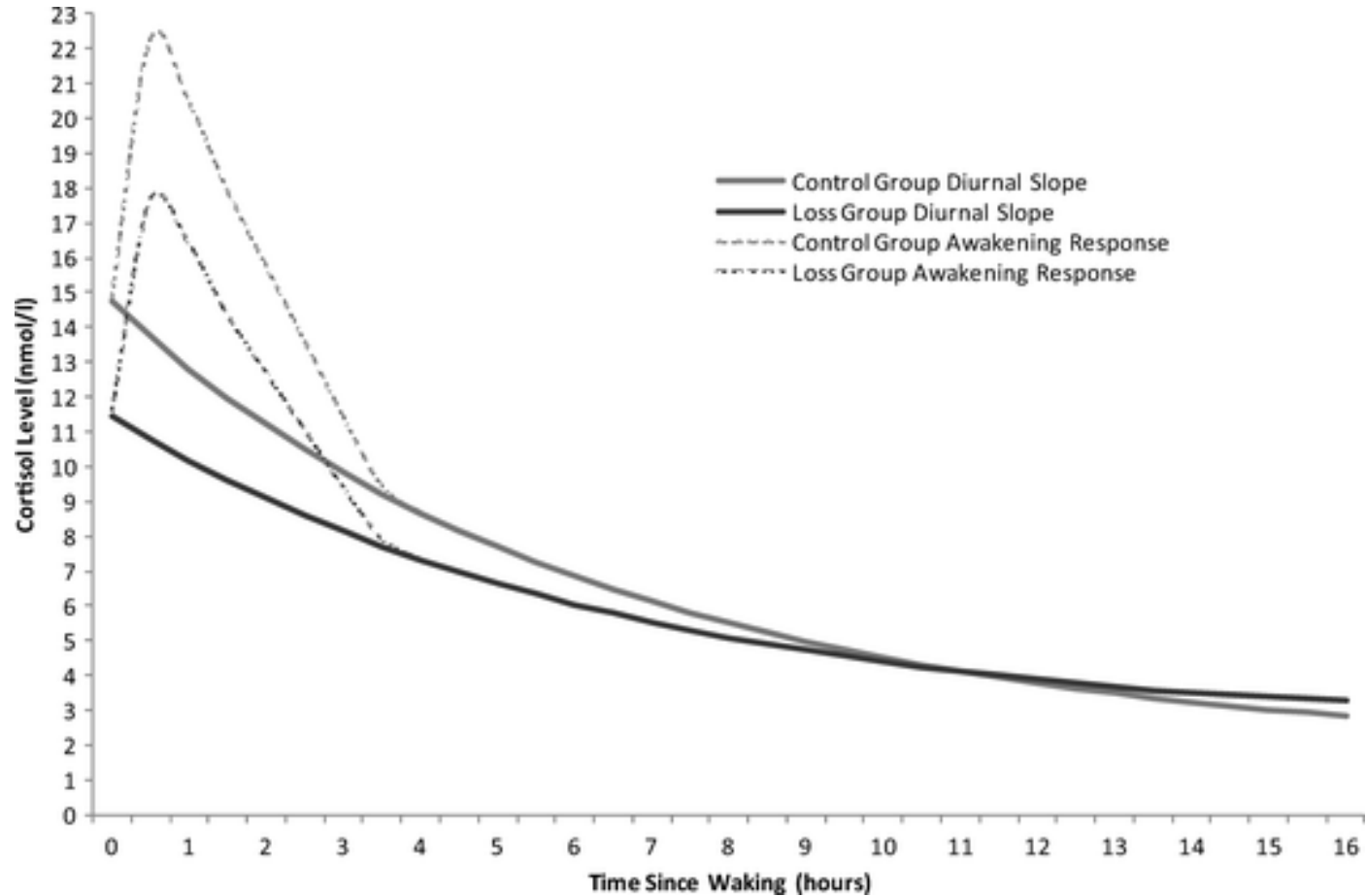
Basal Activity

Diurnal Rhythm

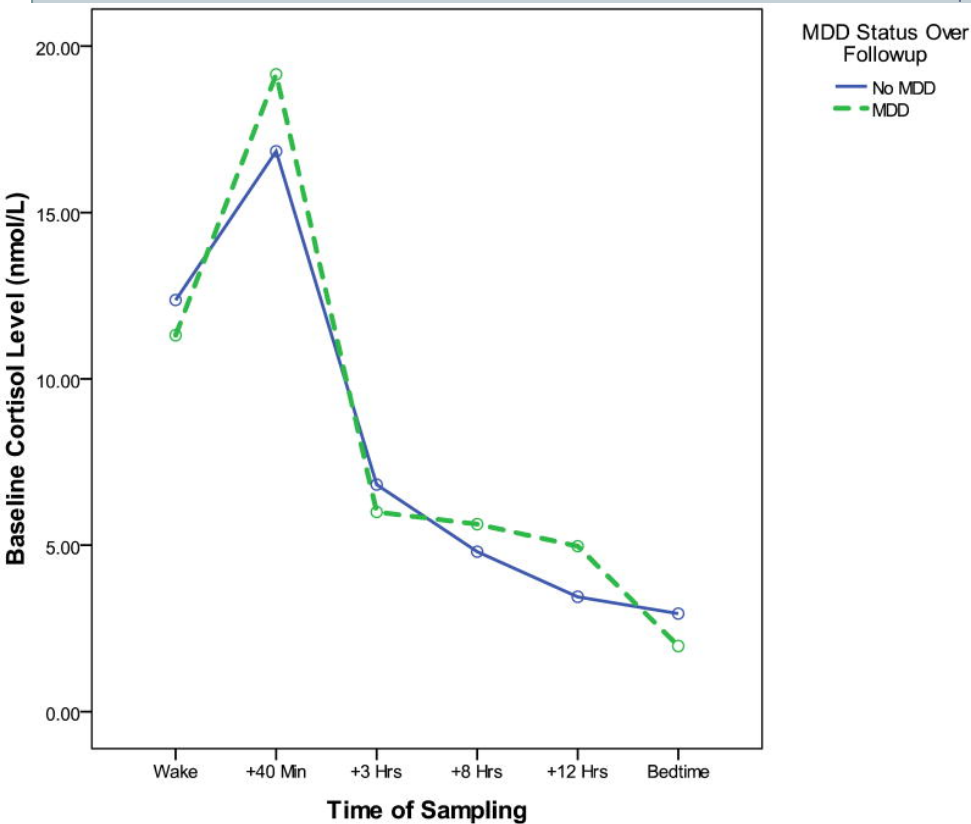


Cortisol Awakening Response

CAR and Diurnal Separately Regulated



CAR Predicts MDD a Year Later in Adolescents at Risk Because of High Negative Emotionality

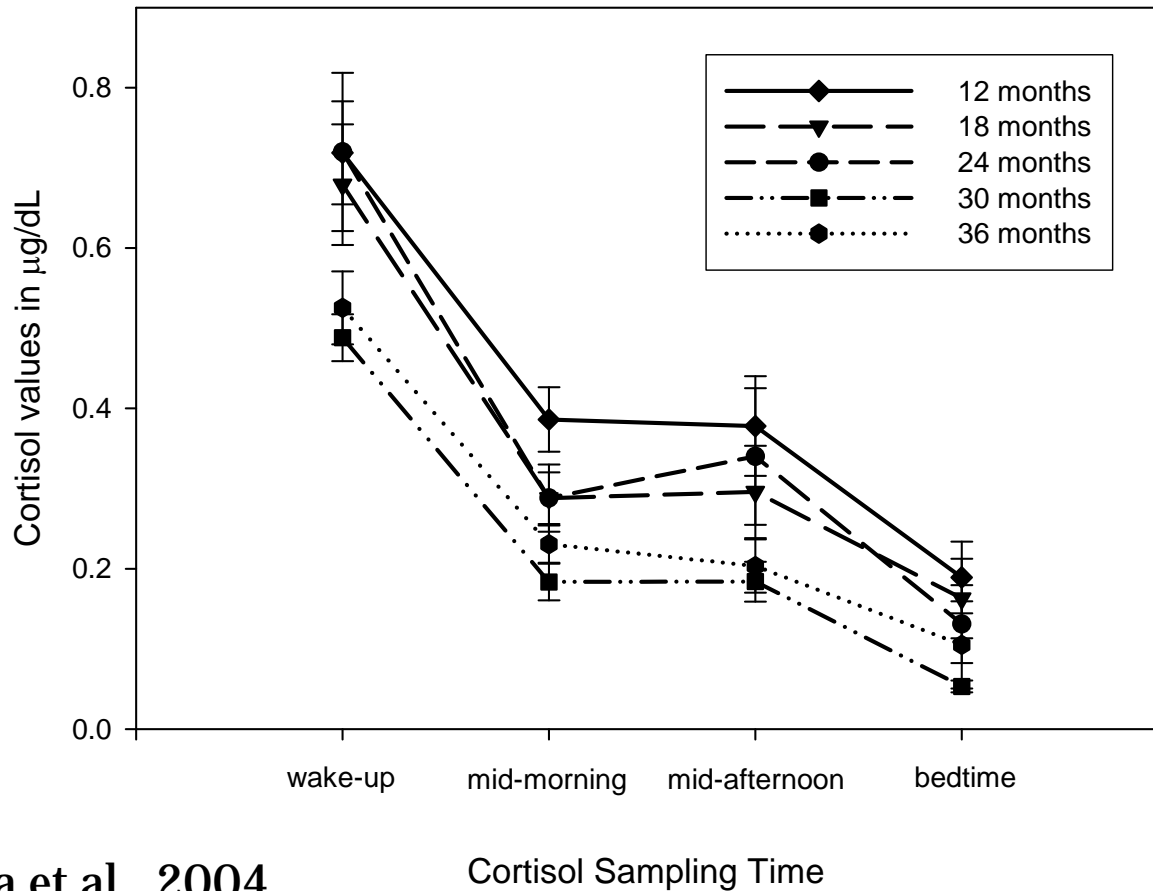


- Actigraphy to know when they really woke up
- Trak Caps to know when they really took the sample
- Repeated days of assessment to model error
- Multi-level modeling to capture dynamics appropriately
- Many, many ways to monitor and encourage compliance

Daytime Activity and Daily Rhythm



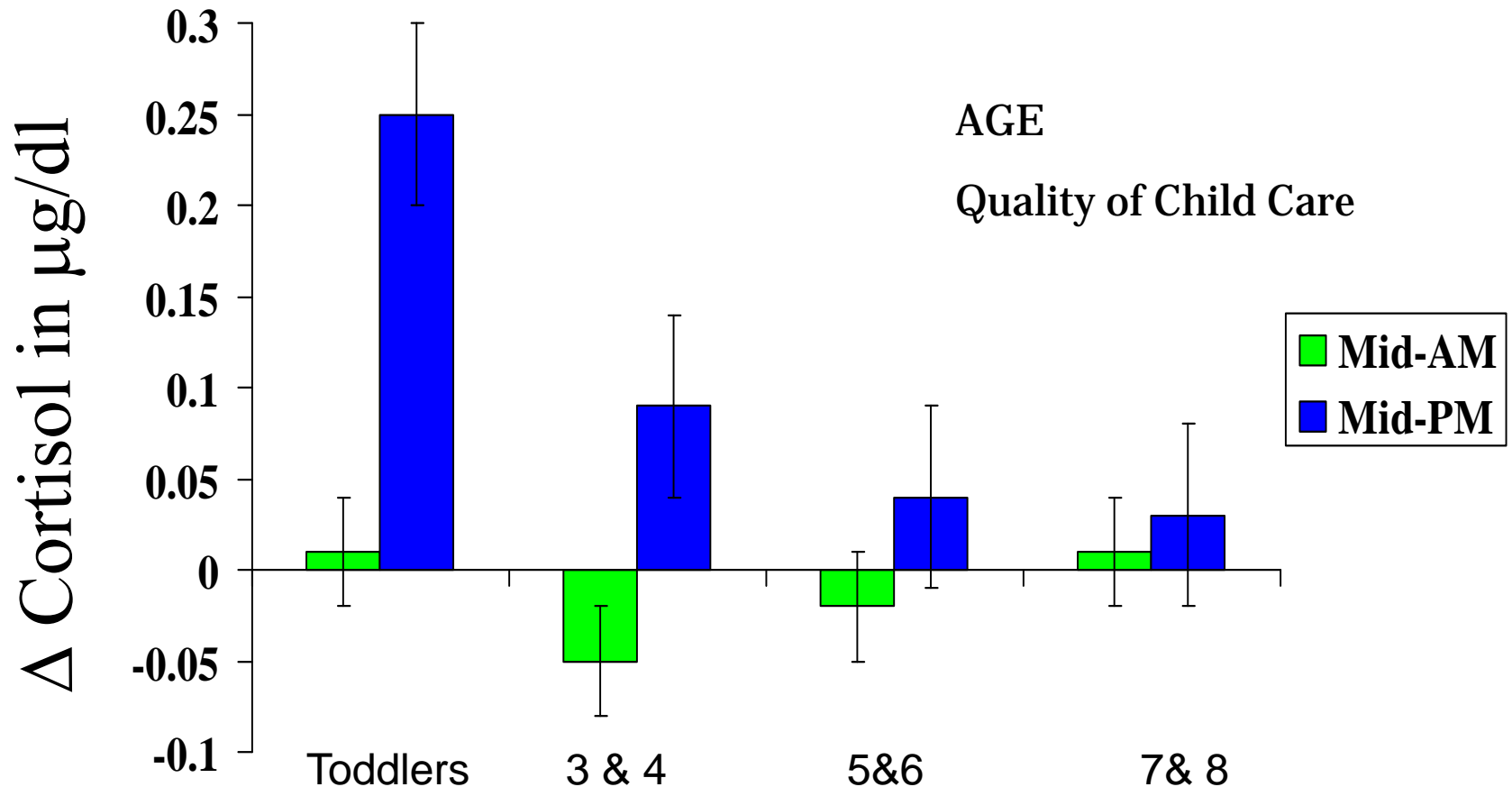
Development of Diurnal Rhythm in Infants and Preschoolers



Watamura et al., 2004

Cortisol Sampling Time

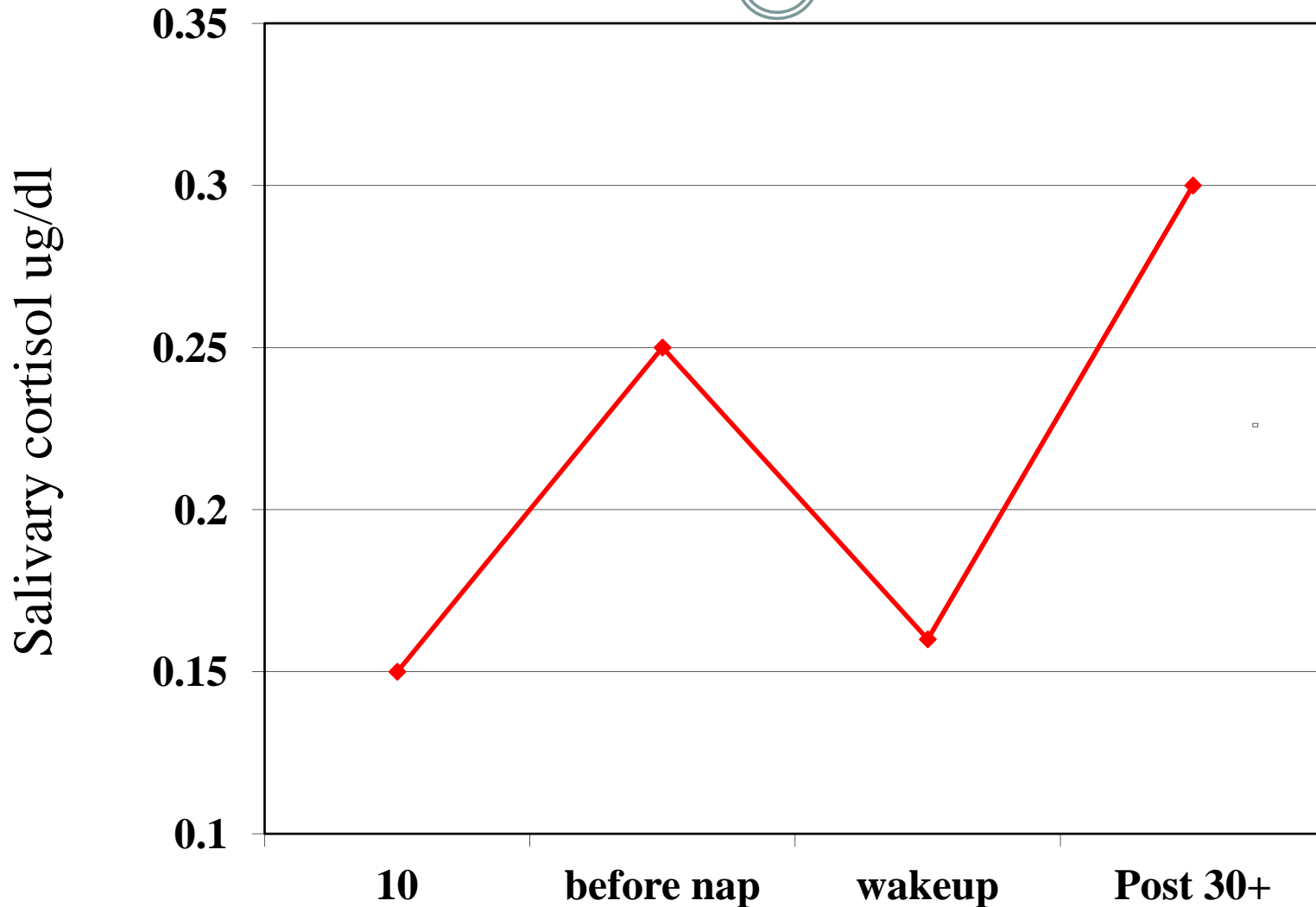
Difference from Home Values for Children in Full-Day Center-based Care



Dettling, et al. (1999). *Psychoneuroendocrinology*, 24(5), 505-518.

Watamura, et al. (2003). *Child Development*, 74, 1006-1020.

Child Care Cortisol Increase Needs Attention to Wake/Nap Schedule

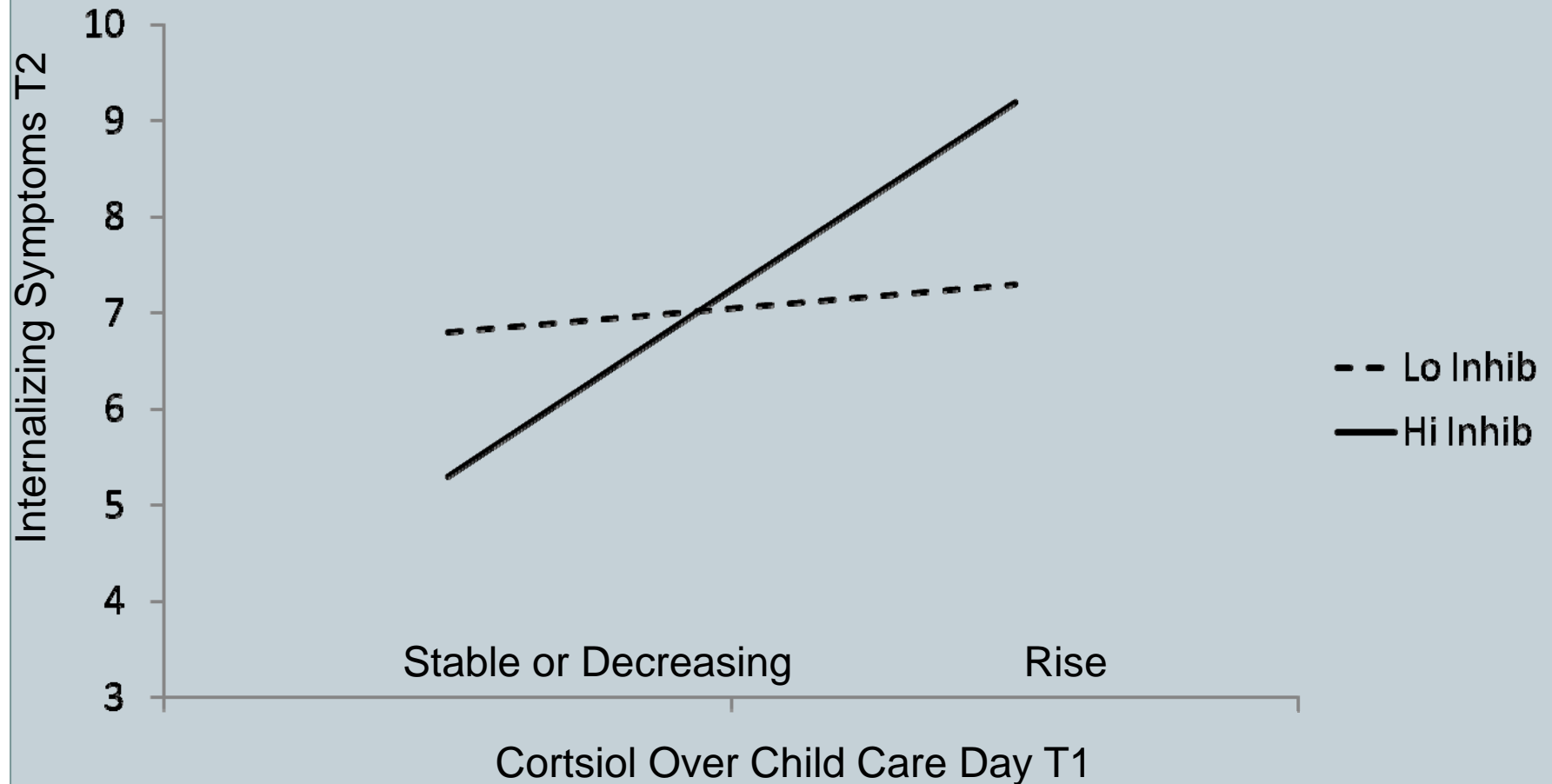


Glucocorticoids Often Play a Facilitative Role



- **Main Effects or Moderated Effects?**
- **Effect of cortisol should differ by the emotional and physiological state of the individual**
 - **Temperament**
 - **Genetics**

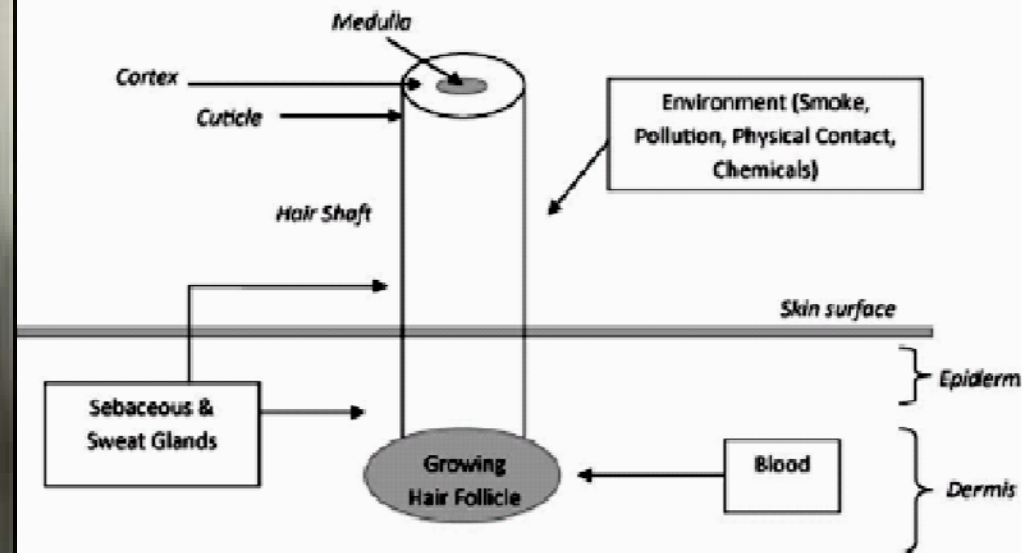
Sequelae of Rising Cortisol at Child Care: Moderated by Behaviorally Inhibited Temperament



Measuring Cortisol in Hair



R. Gow et al. / *Forensic Science International* 196 (2010) 32–37



Pros and Cons



- Potentially useful measure if the question is about cumulative cortisol exposure over time
- This might be of concern in studies of maltreated children where you cannot get measure during the period of abuse, for example
- We know from the available studies that hair measures will pick up large changes in cortisol; we do not yet know how sensitive it is to small differences in cortisol
- We are still learning about factors that may need to be controlled for when hair cortisol measures are assessed.

Summary



- Cortisol measures the end product of the HPA axis; steroid hormone that influences physical and mental health.
- Different types of cortisol measures reveal different things about human functioning
- Cortisol is easy to measure; unfortunately, it is also easy to measure poorly.
- Respect the neurobiology of the systems, then it can provide important insights into the mechanisms through which early adversity “gets under the skin to impact physical and mental health”