Pubertal Hormones Modulate the Addition of New Cells to Sexually Dimorphic Brain Regions – *Eman I. Ahmed*

By: Ryan D. Eliasnik

"The original hypothesis [organizational-activational] posited that exposure to steroid hormones early in development masculinizes and defeminizes neural circuits, programming behavioral responses to hormones in adulthood…However, recent work from our laboratory and others demonstrates that steroid-dependent organization of behavior also occurs during adolescence, prompting a reassessment of the developmental time-frame within which organizational effects are possible. In addition, we present evidence that adolescence is part of a single protracted postnatal sensitive period for steroid-dependent organization of male mating behavior that begins perinatally and ends in late adolescence…**The implications for human adolescent development are also discussed, especially with respect to how animal models can help to elucidate the factors underlying the association between pubertal timing and adult psychopathology in humans.**"

"We recently discovered that gonadal hormone modulation of cell number and cell group volume is a potential mechanism for the active maintenance of sexual dimorphisms during adolescent development (Ahmed 2008)."

Abstract

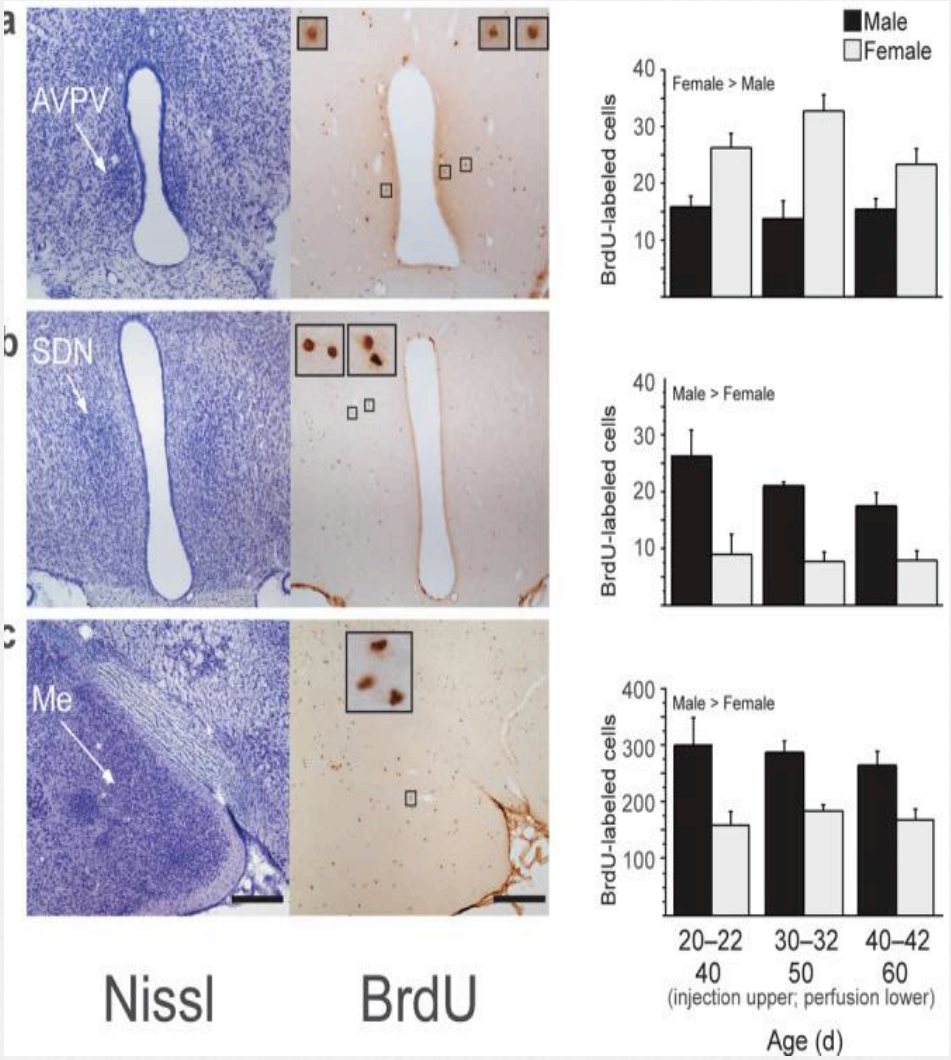
"New cells, including neurons, arise in several brain regions during puberty in rats. Sex differences in pubertal addition of cells coincide with adult sexual dimorphisms: for each region, the sex that gains more cells during puberty has a larger volume in adulthood. Removing gonadal hormones before puberty eliminates these sex differences, indicating that **gonadal steroids direct the addition of new cells during puberty to maintain and accentuate sexual dimorphisms in the adult brain.**"

Experiment

- "It has been presumed that once established perinatally, sexual dimorphisms in cell number are passively maintained throughout life. Here we challenge this view by providing evidence that sexual dimorphisms are *actively* maintained, and that pubertal hormones contribute to the postnatal preservation of sexual dimorphisms via sex-specific modulation of new cells added to sexually dimorphic brain regions."
- Male & Female rats received injections of BrdU (cell birthdate marker) on 3 consecutive days at one of three postnatal ages corresponding to pre-puberty, early puberty, and mid-puberty.
- Brains were collected/analyzed 20 days later at adulthood

Experiment

- BrdU-Immunoreactive cells in 3 sexually dimorphic brain nuclei were analyzed: the anteroventral periventricular nucleus (AVPV) of the hypothalamus, the sexually dimorphic nucleus of the preoptic area (SDN), and the medial amygdala (Me).
- AVPV – Larger and more BrdU-iR prevalent in Females
- SDN and Me – Larger and more BrdU-iR prevalent in Males

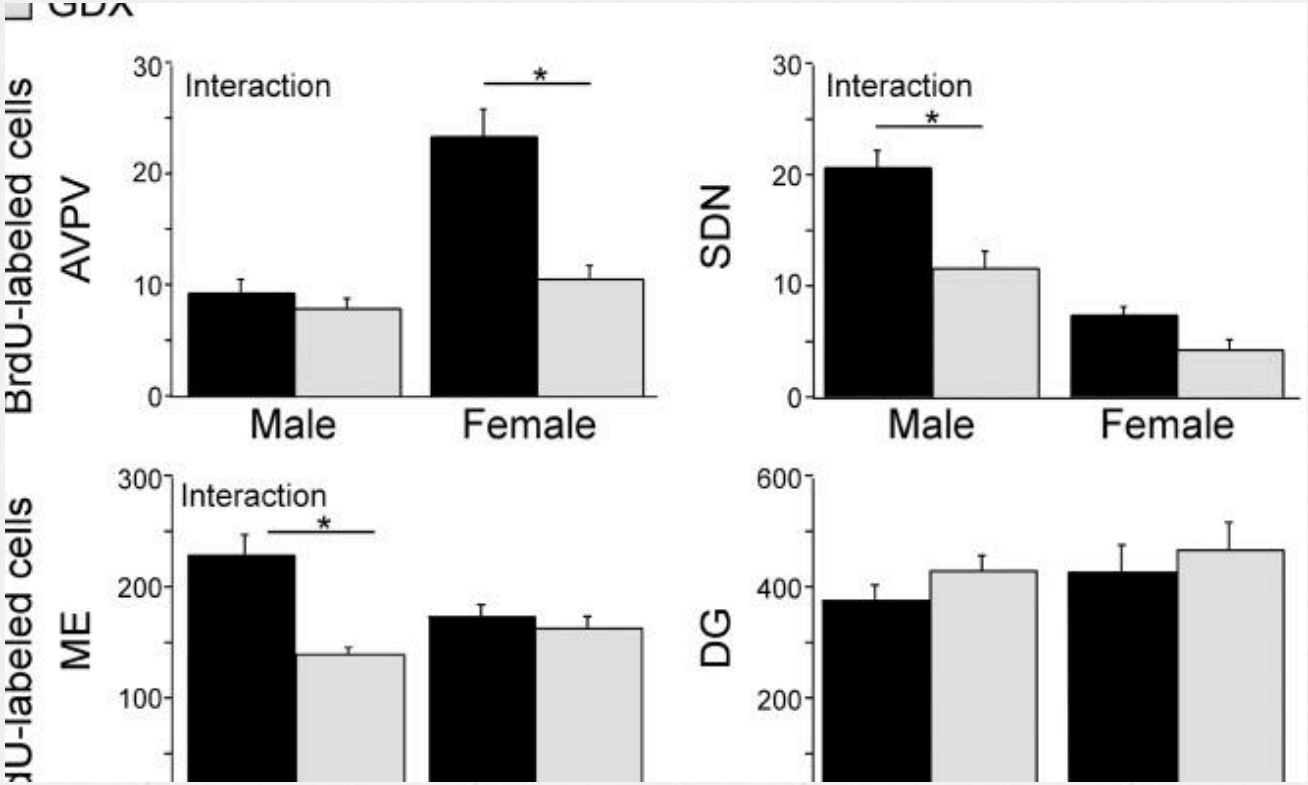


*New cells were added during puberty to the AVPV, SDN, and Me

*BrdU is incorporated into DNA during the S phase of the cell cycle and were later visualized to identify cells replicating at the time of the BrdU administration

Quantitative analysis of BrdU-labeled cells revealed that significantly more cells were added to AVPV in females than in males and significantly more cells were added to the SDN and Me in males than in females

The Effect of Pre-pubertal Gonadectomy on the Number of BrdU-Labeled cells depends on Sex and Brain Region



Result

The data provides strong evidence that sex-biased, hormone-modulated, and brain region-specific addition of new cells is an active mechanism for maintaining, or in some cases, establishing, structural and functional sexual dimorphisms in the face of brain remodeling during adolescence.

"In summary, new cells are added to the rat brain during puberty, and sex differences in the number of newly added cells correspond to sex differences in adult volume in each region. Furthermore, pubertal gonadal hormones influence the addition of new cells, presumably by promoting cell genesis and/or survival in sexually dimorphic structures in a sex-specific manner. Thus, hormone-modulated addition of cells to sexually dimorphic neural structures after the perinatal period is an active mechanism for maintaining functional sex differences during adolescence and into adulthood" – Eman Ahmed

The End