NAKED MOLE-RATS: WHO NEEDS SEX DIFFERENCES?

Forger N. G.
Department of Psychology and Center for Neuroendocrine Studies, Amherst, MA, 01003 USA

Sex differences are nearly ubiquitous among mammals; they presumably evolved, and are maintained, to support sex differences in physiology and behavior. Most of what we know about sex differences in the nervous system, however, comes from studying a small number of relatively non-social species (e.g., rats and mice). Many species live socially and exhibit some form of cooperative breeding. Sexual differentiation in such species might differ from that in common lab models, in terms of the timing, extent, or cellular mechanisms. We are testing this hypothesis by examining naked mole-rats (*Heterocephalus glaber*).

Naked mole rats are eusocial rodents that exhibit the strictest reproductive hierarchy of any mammal. They are native to Africa and live in large colonies containing up to 250 individuals; only one female in each colony breeds (the queen), and she mates with one, two, or at most three males. The remaining colony members are non-reproductive subordinates, who show no sexual behaviors, but help with pup care, foraging, maintaining the burrow system, and colony defense. Subordinates are not sterile, however, and can become reproductive if removed from their natal colony. It is estimated that, in nature, <1% of all naked mole-rats ever become breeders.

We find a striking lack of sex differences in naked mole-rats. The external genitalia are remarkably monomorphic, as are the striated muscles associated with the genitals.1,2 We also find no sex differences in breeders or subordinates in cell size, cell number, or volume of the principal nucleus of the bed nucleus of the stria terminalis (BNST), paraventricular nucleus (PVN), ventromedial nucleus (VMH), medial amygdala (MeA), or Onuf’s nucleus in the spinal cord (a homologue of the rat spinal nucleus of the bulbocavernosus).2,3 Vasopressin innervation of the brain also does not differ between the sexes.4 However, we do find several breeding status-related changes: breeders, regardless of sex, have more neurons in Onuf’s nucleus and the VMH, and a larger volume of the BNST, MeA, and PVN than subordinates.2,3 Breeders also have more vasopressin than subordinates in the dorsomedial hypothalamus and (unexpectedly) fewer androgen-receptor expressing cells in every brain region examined.4,5 This suggests that a change in social status triggers considerable neural remodeling in naked mole-rats and indicates that status, rather than sex, has a predominant role in determining neural structure.

We reason that the relative reduction in sex differences in naked mole-rats is related to their social structure. Sexual differentiation during perinatal life (as in rats and mice) may not be necessary for the large majority of animals that will never reproduce, and neural sex differences may even be detrimental in a society where males and female helpers perform identical functions. We are currently testing this hypothesis by examining sex differences in mole-rat species with different social structures.

But what about the lack of sex differences among breeding naked mole-rats? Male and female breeders show sex differences in sexual behavior, and only the females lactate. Our results suggest that gross morphological sex differences are not necessary for these sex differences in behavior and remind us how little we actually know about what those “extra” cells or larger volumes buy males (or females, depending on brain region) in other species.

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Reference list