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Maria I. Dalamagka*

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Review Article

Dimorphic Behavior and cognition

Maria I. Dalamagka*

Anesthesiology department, General Hospital of Larisa, Greece

***Corresponding Author:** Maria I. Dalamagka, Anesthesiology department, General Hospital of Larisa, Greece.

Received date: September 21, 2024; Accepted date: October 16, 2024; Published date: November 29, 2024

Citation: Maria I. Dalamagka, (2024), Dimorphic Behavior and cognition, *Clinical Research and Clinical Trials*, 11(2); **DOI:10.31579/2693-4779/235**

Abstract:

Sexual differences in the structure and functions of the human brain have been the subject of much speculation ever since the time of Greek antiquity. Aristotle, designated the moment at which the male fetus receives its soul at the 40th day of gestation, whereas the female fetus was supposed to become antimated only six weeks later, around the 80th day of pregnancy. In the course of 19th century, the interest in the sexual dimorphism of the human brain grew rapidly. The first studies reported that the male brains were larger and more asymmetrical than the female brains and that men had relatively more brain substance in front of the central sulcus than behind. The existence of these comparatively minor nad seemingly random morphological sex differences in the human brain were often used in support of the biological view of that era, that men were intellectually superior to women nad that white upperclass people were superior to the other races and lower classes.

Keywords: sex hormones; behavior; human brain; X-chromosome

Introduction

Sex differences in behavior are the result of natural and sexual selection. The dimorphic classes of behavior described here, courtship, copulatory, and parental behaviors, reflect both kinds of evolutionary selective pressures. The term dimorphism refers to the existence of two distinct forms within a single species. The term sexually dimorphic behavior, by extension, implies two different forms of behavior exhibited by the male and the female. To describe these behavioral differences between the sexes as sexual dimorphisms does not violate common usage of the term by the morphological sciences. Among mammalian forms, both sexes have a pelvis. The difference between the sexes is not in the presence or absence of a pelvis or pelvic outlet, but in its size, girth, or other quantitative measure. Countless examples exist in morphology of sexual dimorphisms based only on quantitative differences, differences in intensity, or in response of a specific structure to hormonal stimulation. Current concepts of morphogenesis hold that the genetic sex of all vertebrates determines whether the embryonic genital ridge develops into a testis or an ovary. The means of action by which chromosomes direct the differentiation of the embryonic gonad are unknown; but it is known that the type of gonad differentiated determines by its secretory products whether male or female secondary reproductive organs develop. According to the organizational hypothesis (Phoenix et al., 1959), not only the reproductive organs but also the neural processes mediating sexual behavior in mammals have the intrinsic tendency to develop according to a female pattern of body structure and behavior. Sex steroids can be regarded as master regulators of sex- specific behaviors (Morris et al., 2004; Baum, 2003). The devel- opmental influence (organizational role) of sex hormones can lead to enduring effects on brain and behavior. By contrast, in adults sex steroids elicit reversible changes (activational role) in neural circuits and behavior. Gonadal hormones bind to distinct nuclear hormone receptors that are essential for sex- typical displays (Scordalakes and Rissman, 2003; Raskin et al., 2009; Kudwa and Rissman, 2003; Wersinger et al., 1997; Juntti et al., 2010; Ogawa et al., 2000; Lydon et al., 1995). These receptors directly regulate gene expression by binding DNA (Mangels- dorf et al., 1995), and they can initiate nontranscriptional signaling via mechanisms such as interactions with intracellular kinases and transmembrane receptors (Foradori et al., 2008; Lishko et al., 2011; Micevych and Dominguez, 2009; Revankar et al., 2005; Vasudevan and Pfaff, 2008; McDevitt et al., 2008). Sex hormones or their metabolites can also bind to neurotrans- mitter receptors to gate their activity (Henderson, 2007). Such nontranscriptional signaling can control neural function at time scales that allow real time modulation of behavior. Prior work has identified genes downstream of sex hormones that regulate sexually dimorphic behaviors (Kayasuga et al., 2007; Wersinger et al., 2002; Nelson et al., 1995; Winslow and Insel, 2002). The relative paucity of such genes is in contrast to the diversity of these behaviors, and suggests that the underlying neural circuits may be regulated largely by nontranscriptional hormone signaling [1-24].

Results and Discussion

Sexually dimorphic influences on human cognition and behaviour may affect the phenotypic expression of ‘disorders’ and ‘traits. ‘Disorders’ are sporadic/heritable abnormalities due to non-functional or otherwise mutated genes. ‘Traits’ represent normal variation in sexually dimorphic characteristics. X-linked disorders, such as fragile X syndrome or Rett syndrome, are sexually dimorphic in their expression but they represent extreme cases – dysfunction of a critical gene, even though expression of that gene might be neither dominant nor recessive in the conventional Mendelian sense. X-linked behavioural traits, quantitative variants, include male aggression and parental behaviour. Sexually dimorphic cognitive traits include spatial orientation; in rodents, male spatial learning advantages observed in the radial or water maze are caused by male–female differences

in strategy selection. Females (rats and humans) navigate preferentially using landmarks, but males rely on a broader set of spatial representations. These traits are probably influenced by a Y-linked locus, although an X-linked locus may play a contributory role. During evolution, could X-linked genes for specific cognitive abilities, and a female preference for males who demonstrate those traits, have become closely linked, and hence jointly inherited? Owing to the obligatory expression of all X-linked genes in males, any X-linked trait that is advantageous to males (or to females) would spread rapidly in the population. If higher cognitive abilities were a critical step in our own evolution, it makes sense that you might find those functions on the X-chromosome.

Conclusion

Studies on human facial sexual dimorphism have yielded intriguing insights into perceptions of other characteristics, such as attractiveness or trustworthiness, based on facial masculinity or femininity. Specifically, by manipulating the degree of sexually dimorphic facial traits in computerized faces, scientists have been able to study what judgmental differences arise as a result of physical alterations. What is significant about these findings is their evolutionary implications, in particular the facial cues that trigger innate judgments in reaction to a masculine or feminine face. Multiple studies have confirmed the correlations between sexually dimorphic faces and ratings of attractiveness, and many psychologists theorize that such judgments are evolutionarily based. Sexual selection in humans is largely based upon facial cues and their reflection of an individual's reproductive quality. In a study of Little et al. (2008) found that symmetry and sexual dimorphism in faces are both judged as more attractive to the opposite sex, leading the researchers to conclude that both qualities are reflective of biological quality, and that such judgments are likely to be the result of sexual selective pressures and mate choice preferences. Much research has been conducted on external judgments of personality as they relate to facial asymmetry and neuroticism, facial symmetry and personality, facial attractiveness and narcissism and judgment accuracy differences between the sexes.

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DOI:10.31579/2693-4779/235