Preface

There has been a long-standing debate on whether gender differences in our "behaviors" are learned or innate in principle. Even though this "nature-versus-nurture issue" in behavioral gender differences will remain a controversial subject for many years to come, everyone seems to agree that there exist behavioral gender differences indeed. That is, phenotypic differences between sexes are evident at the behavioral level. This observation was sufficient to prompt geneticists to initiate genetic analysis of and neuroscientists to commence their search for the neural basis of behavioral gender differences.

As a result of enormous efforts to elucidate the sex differences in brain anatomy and physiology in several model organisms, the neural correlates to behavioral sexual dimorphism are now emerging. In studies using animals amenable to genetic analysis, candidate genes responsible for neural sexual differences underlying behavioral sexual dimorphism have been identified.

Comparative studies of neural sex differentiation revealed a marked divergence in underlying molecular mechanisms. However, scientists found clues to evolutionary conservation in such apparently diverged sex differentiation. The best example of this is the discovery of a protein family with the DM domain in many different animals including insects and vertebrates, which represent the two "extreme" phylogenetic groups that had been considered to share nothing in common in their sex determination mechanisms.

Vertebrates and insects have been regarded to situate at opposite poles in terms of the logic in sex determination, as the former relies on a non-cell autonomous mechanism mediated by circulating hormones, whereas the latter utilizes an autonomous mechanism based exclusively on the genetic code. Even this dogma has been challenged by the observations that gynandromorphic birds have brains in which the female part and the male part are closely situated but separated by a distinct border. How are such insect-like gynandromorphic brains formed in birds if one postulates hormonal signaling as the sole mechanism operating in brain sex determination?

Yet another breakthrough was provided by the findings that genetic systems are typically controlled by epigenetic mechanisms that induce long-lasting chromatin alteration as triggered by environmental stimuli provided at a critical developmental stage. This type of genomic change may explain why certain key stimuli "predispose" organisms to particular behavioral patterns often for lifetime. Imprinted behaviors and developmental plasticity of brain functions may all be ascribed to this epigenetic regulation of the genome.

Thus, the conventional framework for understanding animal behavior as a patchwork of a bit of "innate" and a bit of "learned" is now to be replaced by a more dynamic view that genes and the environment interact, resulting in specific genomic conditions under which individual organisms develop behavioral patterns most appropriate for a particular situation they encounter.

In this volume, cutting-edge research on the genetic and epigenetic mechanisms that shape the brain gender are reviewed and discussed, with the aim of developing a new paradigm for understanding the nature-versus-nurture issue in animal and human behavior.

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