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RIKEN Brain Science Institute
Laboratory for Developmental Gene Regulation
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Mechanisms for Brain Asymmetry

Researchers at RIKEN Brain Science Institute's Laboratory for Developmental Gene Regulation (head: Hitoshi Okamoto) have discovered one more piece of the brain development puzzle, at least in the zebrafish. Hidenori Aizawa ete al. found a molecular mechanism that facilitates asymmetric lateralisation in the brain. This discovery may help explain why hemispheric differences exist in brain function and how developmental processes ensure appropriate structural formation of the brain.

Okamoto's team identified difference in neural circuitry development patterns between the left and right habernular projections into the interpeduncler nucleus (IPN) using both normal and transgenic zebrafish. They further found that the asymmetric difference in the sizes of lateral vs. medial subnuclei of the left and right habernulae is responsible for the different neuronal projection patterns along the habenulo-IPN pathway. Point of origin mediated axonal destination. Habenular development in the embryo with a mutation that affects lateralization had reversed orientation, however asymmetry remained intact. Indicating that asymmetric sizing of the subnuclei is regulated through one process, and laterality specification would occurs through another, namely Nodal signaling.

That medial and lateral sub-nuclei expansion or contraction appears to mediate lateralized development and that the extent of nodal signaling regulates lateralization provides a more simple model for developmental variation in the degrees of laterality across species. Different neural circuits process information from the left and right hemispheres, and the extent of the asymmetry appears be consistent within species. If so, then Okamoto's team speculates that coordination of lateralization among individuals within the same species might be important in determining consistency in their social behaviour, and thereby giving the group a survival advantage. Other reports say that the social behaviour of fish varies depending the extent of consistency in laterality of the species.

To further understand how lateralization emerges and affects behaviour, the lab will now investigate the roles of the individual circuits within each side of the brain for behaviour. This might further elucidate the anatomical basis for the behavioral asymmetry, and set the stage for lateralization studies across species to explain how lateralization influences behaviours.

The article, "Laterotopic Representation of Left-Right Information onto the Dorso-Ventral Axis of a Zebrafish Midbrain Target Nucleus" can be found in the February 8 issue of Current Biology.

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