

Extended Data Figure 6: Y–Y gene conversion within multi-copy gene families.

Consensus phylogenies reconstructed by DNAML with 100 bootstrap replicates; scale bars represent the expected number of nucleotide substitutions per site along each branch. Phylogenies for ancestral X–Y pair genes from the X-conserved region, shared between placental and marsupial mammals are shown. Adjacent to each tree, light blue bars highlight the positions of Y-linked genes with high within-species identity and across-species divergence, indicating that gene conversion is more frequent than mutation. **a–g**, *TSPY*, *RBMV*, *SRY*, *HSFY*, *DDX3Y*, *UBE1Y* and *EIF1AY* show signs of Y–Y gene conversion; in the species where they are present in multiple copies, they are clustered in arrays of genes. **h, i**, *RPS4Y* and *ZFY* do not show signs of recent Y–Y gene conversion; in the species where they are present in two copies, they are dispersed on the Y chromosome. **a**, *TSPY* is present as a multi-copy gene family on the human, chimpanzee, rhesus, marmoset and bull Y chromosomes. Note that 2 distinct families of *TSPY* emerged in bull. **b**, *RBMV* is present as a multi-copy gene family on the human, chimpanzee, marmoset, mouse and bull Y chromosomes. **c**, *SRY* is present as a multi-copy gene family on the rat Y chromosome. **d**, *HSFY* is present as a multi-copy gene family on the human, rhesus, and bull Y chromosomes. **e**, *DDX3Y* is present as a multi-copy gene family on the marmoset Y chromosome. **f**, *UBE1Y* is present as a multi-copy gene family on the rat Y chromosome. **g**, *EIF1AY* is present as a multi-copy gene family on the marmoset Y chromosome. **h**, *RPS4Y* is present as a multi-copy gene family on the human, chimpanzee and rhesus Y chromosomes. *RPS4Y* genes appear to have split into two distinct families before the divergence of primate species, which have not engaged in subsequent gene conversion within each species. **i**, *ZFY* is present as a multi-copy gene family on the mouse Y chromosome. Although *ZFY* participated in multiple independent X–Y gene conversion events after the divergence of placental mammals, there is no evidence of recent Y–Y gene conversion in mouse. Mouse *Zfy1* and *Zfy2* genes are more divergent than human and chimpanzee *ZFY*. Species abbreviations: HSA, human; PTR, chimpanzee; MAQ, rhesus; CJA, marmoset; MUS, mouse; RNO, rat; BTA, bull; MDO, opossum; GGA, chicken; MFA, *Macaca fascicularis*; and XTR, *Xenopus tropicalis*.