**Text S5: Asymmetry produced by an imprinted genetic variant.**

We make the simplifying assumption that only the maternally-inherited copy is expressed, and denote the relative risk for a maternally inherited copy as *I*. Again we consider the grandmother’s relative risk $\frac{P\_{MM|D\_{c}}W\_{G}}{P\_{FM|D\_{c}}W\_{G}}$ except that now $W\_{G}=\left[R\_{0G},\frac{R\_{0G}\left(I+1\right)}{2},R\_{0G}I\right]^{T}$ for the parent-of-origin model. As with maternal effects, one calculates $P\_{MM|D\_{c}}$, the genotype distribution among maternal grandmothers of an affected child, by post-multiplying $P\_{M|D\_{c}}$, the genotype distribution among mothers of an affected child, by the matrix $V$, thus $P\_{MM|D\_{c}}=P\_{M|D\_{c}}V$. For $Q=1-p+Ip$, $P\_{M|D\_{c}}=$

$\left[(1-p)^{2}Q^{-1}, p\left(1-p\right)(I+1)Q^{-1}, p^{2}IQ^{-1}\right]$ (Table S3). A similar calculation, $P\_{FM|D\_{c}}=P\_{F|D\_{c}}V$, applies to paternal grandmothers; however, $P\_{F|D\_{c}}$is the HWE distribution, $P\_{HWE}$ (Table S3). Under the assumption that *I* is the same in both sexes, the grandfather’s relative risk, $\frac{P\_{MF|D\_{c}}W\_{B}}{P\_{FF|D\_{c}}W\_{B}}$ will be the same as the grandmother’s relative risk.