**Highlights**

* Mean-independent noise control allows noise attenuation without affecting the mean.
* Intermediate states enable such control through proportional coupling.
* This controls spatial gene expression noise without shifting boundary locations.
* Specific noise levels are required for successful downstream boundary sharpening.

**eTOC**

The general principle of mean-independent noise control allows gene regulatory networks to regulate signaling noise without changing the mean, and an example where this is required is the sharpening of segmental boundaries in the zebrafish hindbrain.