

The promotor factor Lola regulates gene activation during embryogenesis by making promoters accessible over time

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ABSTRACT

Spatial and temporal changes in gene expression during development are frequently associated with changes in accessibility at cis-regulatory regions, while changes in accessibility at promoters are more limited. Promoters are frequently nucleosome-depleted and remain accessible to RNA polymerase II across tissues. Therefore, promoters are often assumed to be a passive integrator of activation signals from cis-regulatory sequences. However, we have observed that many promoters are regulated during *Drosophila* embryogenesis. Specifically, our global analyses show that many promoters display increase in accessibility and Pol II recruitment over time. Here we show that Lola, a DNA-binding factor with a BTB domain, plays a global role in “opening” these promoters during late embryogenesis. The regulated promoters are highly enriched for Lola’s consensus binding motif and are occupied by Lola in ChIP-seq experiments. In *lola* mutant embryos, Lola target promoters show decreased accessibility, lower RNA polymerase II recruitment and reduced expression in the late embryo. At the same time, the Lola promoters remain occupied by nucleosomes in the late embryo, similar to the early embryo. This suggests that Lola is responsible for the “opening” of promoters over developmental time, making them accessible to RNA polymerase II recruitment and tissue-specific gene activation. We conclude that changes in promoter accessibility over time is a mechanism to regulate gene expression during development.