Gene Regulation through the Control of Ribosome Movement

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While the importance of transcriptional control is universally acknowledged, there is now a deepening and widening appreciation of the diverse roles of translation in controlling gene expression. For example, it is now apparent that upstream open reading frames (uORFs), once thought of as rarities, are present in more than 25% of eukaryotic mRNAs, and that the translation of these uORFs can be critical for controlling gene expression levels. It is now apparent that initiation of translation of these uORFs - as well as initiation of translation of the major predicted gene products of mRNAs – can occur at codons other than AUG codons, and these non-AUG initiation events have functional significance. The rate of translation elongation can also be modulated at the level of specific mRNAs by codon-choice or by encoded nascent peptides that stall ribosomes by affecting the function of the ribosome's peptidyltransferase center. Initiation and elongation can both be modulated by controlling the activity of the translation machinery. Events associated with translation termination can have regulatory functions critical for controlling gene expression and also can have a major impact on mRNA stability through the mRNA quality control pathway known as nonsense-mediated mRNA decay (NMD). Here we discuss these processes of translational control and our studies in the model fungi that have contributed to our general understanding of how they impact gene expression.