RNA structure modulates emergent material properties of model neuronal granules

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The translocation and processing of mRNA play a key role in neuronal development. RNA binding proteins are found abundantly in membranelles protein assemblies known as neuronal granules, which aid in mRNA trafficking within the neuron. These assemblies are enriched with Fragile X mental retardation protein (FMRP), the absence of which results in the development of Fragile X Syndrome, the most common genetic cause of autism and intellectual disabilities. FMRP is linked to translational repression and localization of mRNA. However, the binding specificity between the protein and its RNA targets is not well understood. Previous studies suggest that the low complexity region (LCR) of FMRP has a preferential binding affinity towards G-quadruplex containing mRNA. Here, we combine microrheology and fluorescence correlation spectroscopy (FCS) to examine the effect of RNA identity on the material properties of phase separated FMRP-LCR condensates. We find that distinct RNA identities can modulate the physical properties of FMRP-LCR liquid droplets as a function of secondary structure and binding affinity. The role of FMRP methylation, a common post-translational modification of the protein *in-vivo*, is further interrogated. Our findings lend insight into the mechanisms by which targeted RNA molecules modulate the material properties of neuronal granules.