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Communication in Synthetic Cells Regulates Population Expression Variability

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Synthetic cells (SCs) offer huge potential for functional compartment design. However, the key to realize controlled functionality are robust outcomes with low variability. This can be challenging in synthetic cells because increasing complexity often comes with increased variability. To address this, we used a bioinspired approach to harness communication from quorum sensing bacteria to reduce gene expression variability across populations of lipid vesicles that contain cell free gene expression. Our on-chip inverted emulsion platform enabled simultaneous production, manipulation and imaging of lipid vesicles to measure variability across populations of communication cells with quorum sensing Lux and Las gene circuits, thus providing the ability to measure gene expression variability across vesicle populations. Variability analysis revealed that higher plasmid concentrations reduced gene expression variability, as indicated by lower coefficient of variation. Our results show gene expression profiles are regulated by plasmid concentrations as well as communication that can impact resource availability. Overall, our findings demonstrate that quorum sensing-based communication can enhance the robustness of SC populations, where resource availability play a key role in dictating the expression variability.