



TITLE: Spatially Aware Plate Layouts (SAPL): A Web-Based Tool Integrating Experimental Constraints into Randomization for Optimal Plate Designs

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ABSTRACT: Multi-well plates underpin high-throughput experimentation across biochemistry, pharmacology, and molecular biology, yet spatial artefacts—such as edge effects and local clustering—can introduce systematic biases that compromise reproducibility and statistical power. Traditional layout strategies, whether manually designed or based on naive randomization, often fail to address these spatial dependencies effectively.

We introduce SAPL (Spatially Aware Plate Layouts), a controlled randomization framework that merges rigorous experimental design principles with the spatial structure of common plate formats. In contrast to full randomization, which may inadvertently concentrate critical conditions or controls, SAPL actively enforces spatial balance by managing factors such as control dispersion, edge-related susceptibility, and row/column structure. This approach enhances the reliability of normalization procedures and strengthens downstream statistical analyses.

By coupling spatial awareness with methodological rigor, SAPL helps improve the reproducibility, robustness, and translational value of preclinical data. To facilitate widespread use, SAPL is available as an open-access, user-friendly web tool requiring no programming expertise. It reduces the time of generating a 384 well plate from 1 day to 15min. The framework has been rigorously evaluated in collaboration with scientists at AstraZeneca and the Functional Genomics Lab across diverse experimental settings.

BRIEF SPEAKER BIO: Beate is a Mathematical Innovation Research Fellow at the Institute for Mathematical Innovation (IMI) at the University of Bath. Her research focuses on statistical modelling and machine learning for interdisciplinary projects across academia, industry, and the third sector. Her work spans statistical testing, Bayesian methods, neural networks, network modelling, optimal experimental design, and causal inference, and she has experience with pharmaceutical, insurance, and social science data.

Before joining IMI, Beate was a Senior Research Statistician at AstraZeneca, where she designed and analysed complex in vitro and in vivo experiments, including organs on chips, cell based assays, mass spectrometry, RNA Seq, and neurobehavioral studies.