

Thesis Portfolio

Profiling in vitro Neurogenesis Trajectories Resolved at the Single-cell Level to Compare Retinoic Acid Titrations with a novel Nearest Neighbor URD Trajectory Tool (NNUTT)
(Technical Report)

Investigation of the Political Consequences and Technological Determinism Characteristics of Content Filtering by TikTok's Algorithm
(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Thesis Prospectus

Sociotechnical Synthesis

Neurological diseases had been diagnosed in almost 100 million Americans as of 2011 (Gooch et al., 2017). Several diseases are linked to retinoic acid (RA), which plays an integral role in neural development (Rhinn & Dollé, 2012). This independent technical project defines how varying concentrations of RA affects the timing of the development of cell populations over a 14-day time course as well as develops tools to compare cell trajectories. This project relies on clustering algorithms to group cells together based on marker expression similarity in order to define distinct cell populations. Social media platforms such as TikTok also use clustering algorithms, however they use them to improve user experience rather than to advance biological research. With over 689 million active TikTok users and over half of them between the impressionable ages of 10 and 29, it is important to uncover the effects that the TikTok algorithm has on society.

In my STS research I specifically examined the political tendencies and technological deterministic characteristics of the TikTok algorithm. Using documentary analysis and discourse analysis, I discovered that the TikTok algorithm creates a power imbalance between creators which allows us to categorize the technology as political. When creators become popular, their content is viewed by many clusters of viewers resulting in a positive feedback loop where the creator becomes more popular and accrues more views (Ton, 2019). This takes away views from new or less popular creators creating the power imbalance. The clusters that the algorithm creates result in the users being exposed to only one mindset, and this has an effect of societal thought such as alignment of political ideologies with those of the user's cluster (Herrman, 2020). This indicates the TikTok algorithm is also an example of technological determinism. The technical portion of

my capstone produced an optimized mass cytometry cell marker antibody panel, three neural differentiations, a detailed overview of the cell populations that arise during neurogenesis as well as a tool to compare cell trajectories over time. Most significantly, the three neural differentiations were completed with 0 M RA, 1 nM RA, and 1 uM RA and comparisons between the cell populations (clusters) at Day 6 revealed that the neural progenitors are observed only in the 1 nM RA and 1 uM RA culture conditions. Cluster analysis at Day 14 revealed a unique mesoderm population in the 0 M RA culture, but most of the culture consisted of early neurons. The 1 nM RA and 1 uM RA cultures showed similar percentages of mature neurons. A tool to compare the trajectories of cell types from different differentiations was developed. The tool builds a dendrogram of the cell trajectories of one data set, finds the most similar cells in the second dataset based on the smallest Euclidean distance, and plots those similar cells on the dendrogram. Analysis of the pseudotimes of the cell trajectories showed unexpected similarities between the titrations and further directions for the tool are suggested.

Throughout my technical project, I learned technical wet lab and experimental design skills in order to complete the differentiations. I learned advanced R programming skills to develop the URD-mapping trajectory comparison tool. Most importantly, I am now able to approach data in a way to answer the relevant biological questions as well as recognize when to complete extraneous analysis to verify methods and findings in order to present the data ethically. With regards to my STS project, I learned about the balance between engineering impressive algorithms and considering the effects of the artifacts of the algorithms on society. It's important to do social research about how placing people in clusters and filtering their available content will alter their frame of mind and consider those implications.

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