

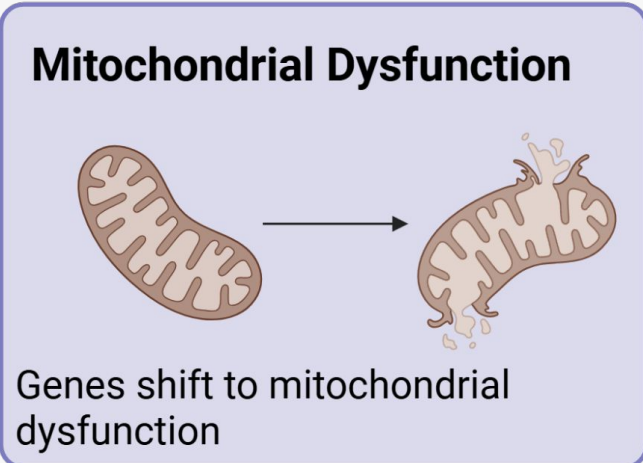
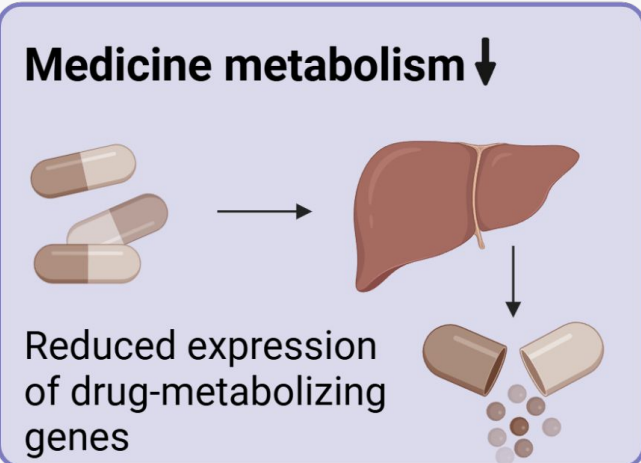
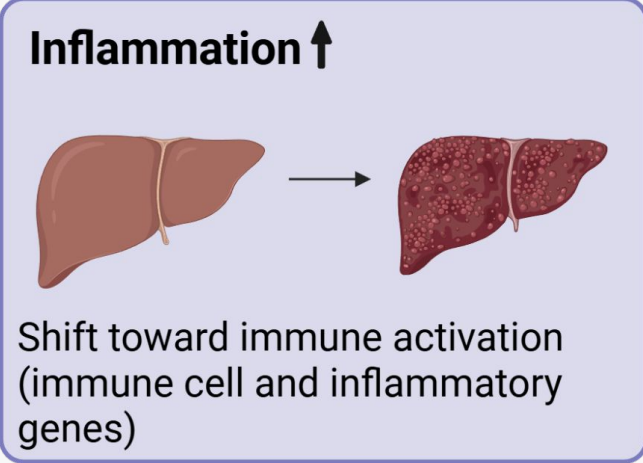
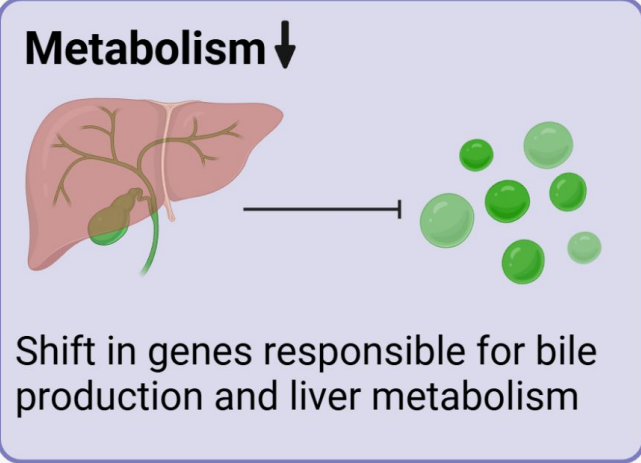
Gene expression in rat liver as a representative model for human aging

Data Science in Biomedicine – 10 October 2025 – Group 1

Introduction

To study drug metabolism, model organisms are needed representing the human liver. With aging, gene expression in the liver changes over time (Thomas et al., 2002). Liver aging is partly explained by changes in the genome and epigenome, responsible for cellular senescence and low-grade inflammation. This causes multiple phenotypic changes in all liver cells (Hunt et al., 2019). To investigate if the liver of rats represents the human liver during aging, this case study aims to compare the change in gene expression over time.

Hypothesis:



Research question

How does gene expression during aging in the rat liver represent aging of the human liver?

Methods

- Gene expression data of rat liver by Yu et al. (2014) and human liver GTEx
- Data of rats (21w and 104w)
- Data of 86 humans (20–29y and 60–69y)
- Analysis using R and R studio

Conclusion + Implication

Significantly differentiated genes for human and rat liver show to be different. Our results show that the gene expression in the liver of rats does not represent the expression in the human liver.

When comparing the results of humans with the rats: the heat map shows similar patterns of changes in gene expression. However, the similarities are not significant and in different type of genes. This could be due to the dataset or the analysis itself.

Rat models are often used to gain insights into aging when looking at the liver. Yet, species-specific differences make it crucial to carefully contextualize before applying rat data to human liver aging as shown in our results.

However, more data would be needed to confirm these findings, since the used data did not correlate with the hypothesis.

Results

Figure 1 and 2: Up- and downregulated genes in the liver during aging in rats

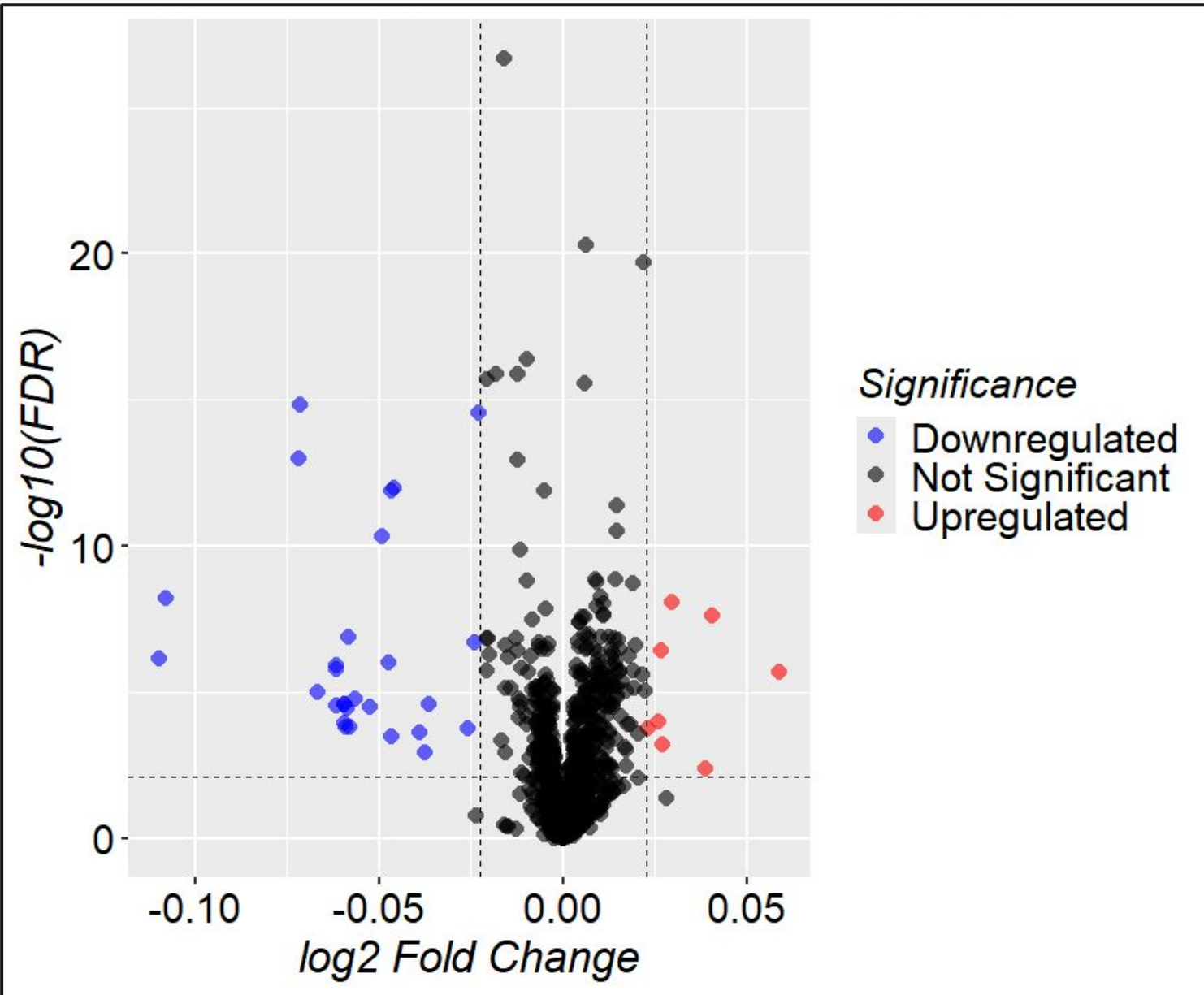


Fig. 1. Mostly downregulation of genes with increased age in rats.
In aging rats:
Genes related to immune activation and inflammation processes are upregulated. Genes related to (drug/fat) metabolism are downregulated

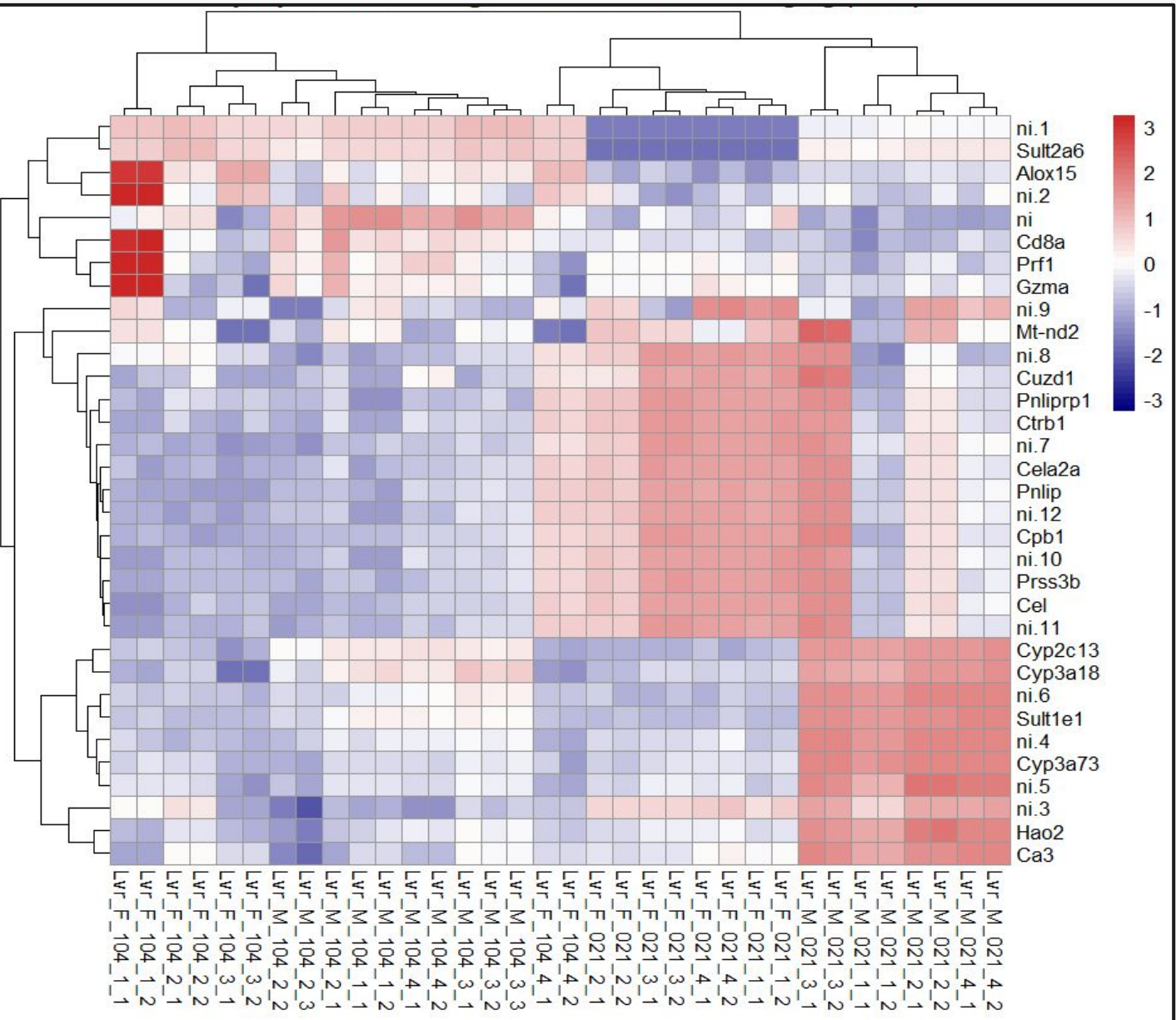


Fig. 2. Clear switch in gene expression when comparing young (right) to old (left) rats.
The majority of all genes switches from red to blue or vice versa, indicating changed expression during aging.

Figure 3 and 4: Up- and downregulated genes in the liver during aging in humans

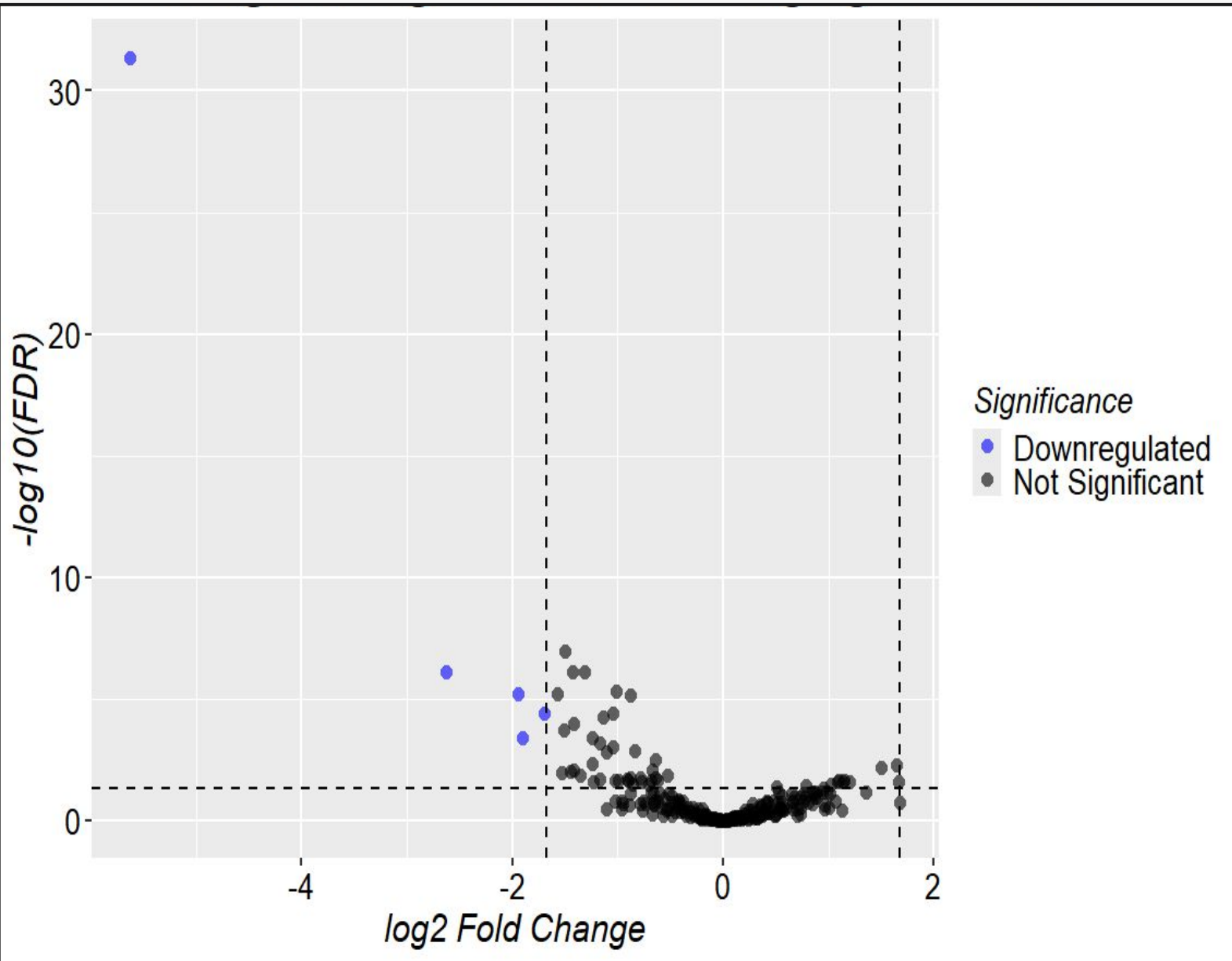


Fig. 3. Only downregulation of significant genes with increased age in humans
For humans, there is downregulation visible for a gene related to a heat shock protein, involved in ATP hydrolysis. It is activated in cellular responses against heat (NCBI, 2025). There are no significant upregulated genes for humans

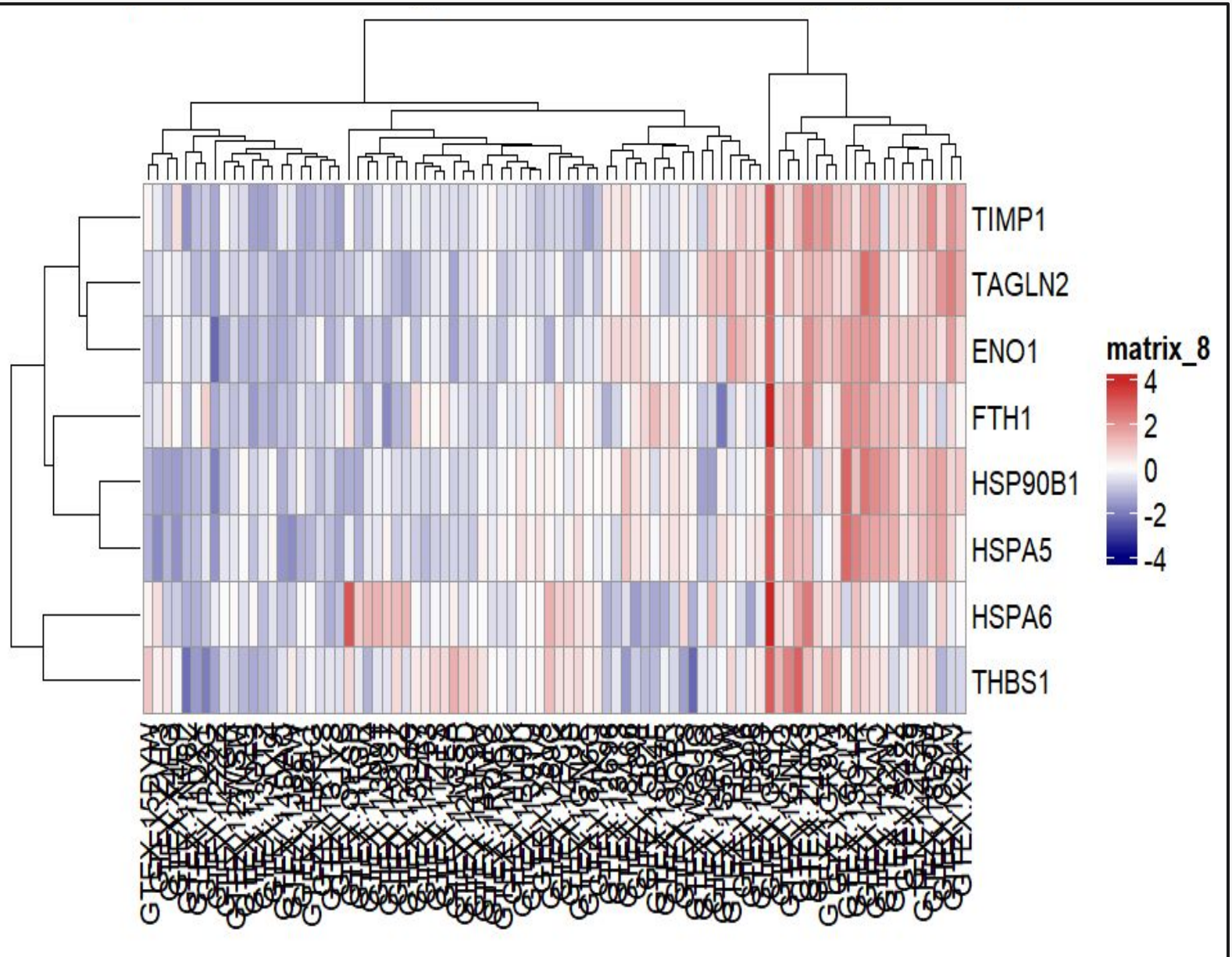


Fig. 4. Switch in gene expression when comparing young (right) to old (left) humans.
When comparing older with younger individuals, gene expression has been generally decreased. This indicates a change in gene expression during aging.