Information Visualization

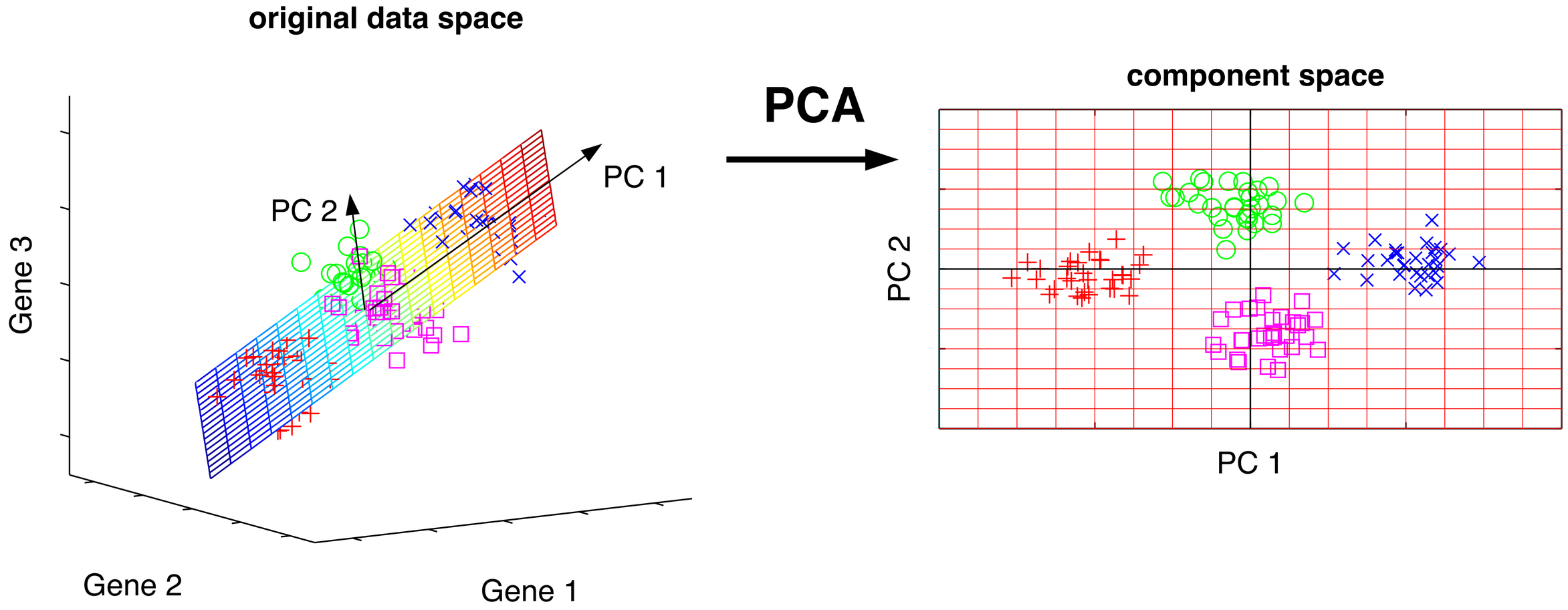
High-Dimensional Data

Dr. David Koop

High-Dimensional Data Visualization Techniques

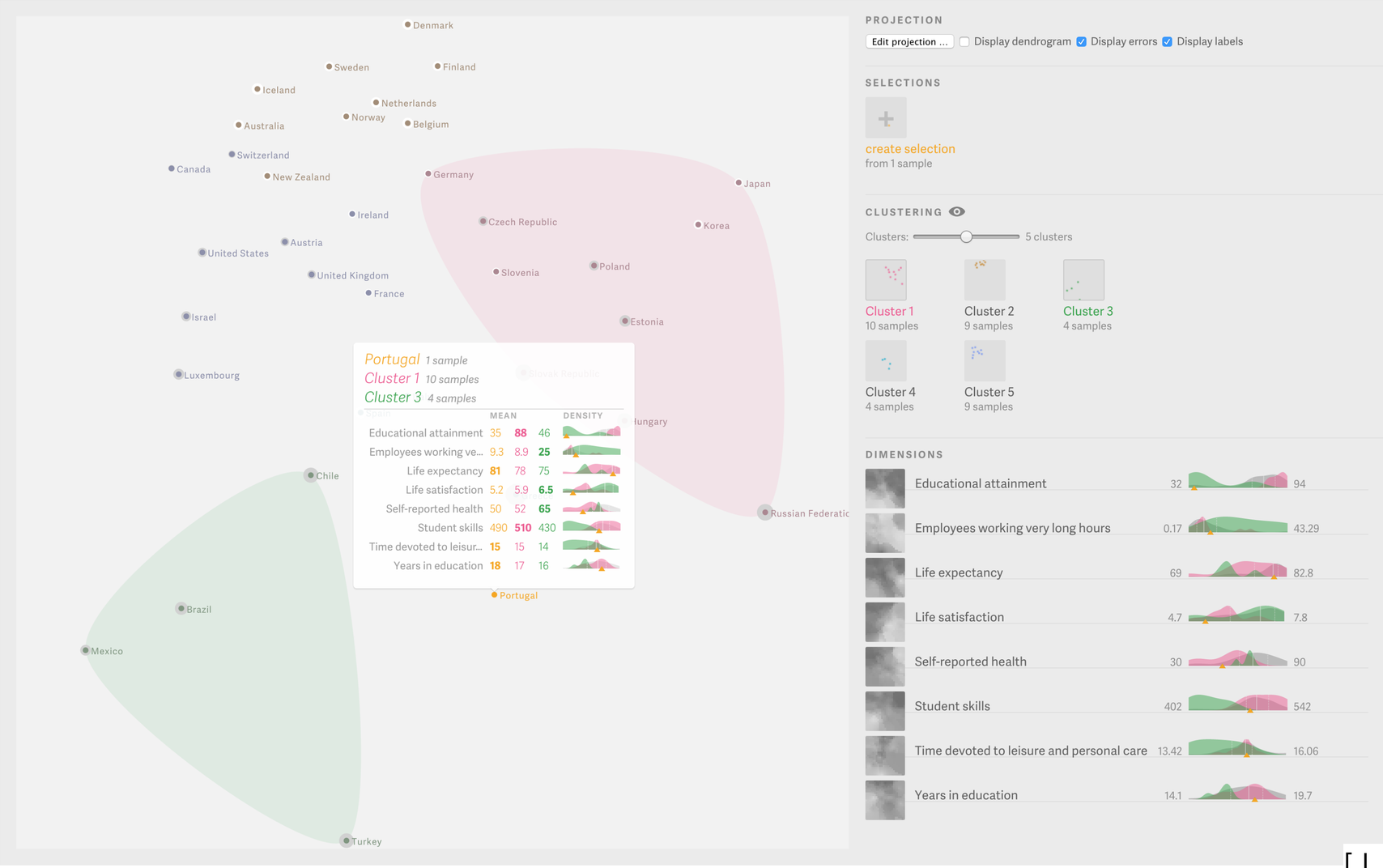
- Scatterplot Matrix (SPLOM)
- Parallel Coordinates Plot (PCP)
- Heatmap
- Interactive Elements:
  - Brushing (Linked Highlighting)
  - Tooltips
- Projection
- Tours

Principle Component Analysis (PCA)



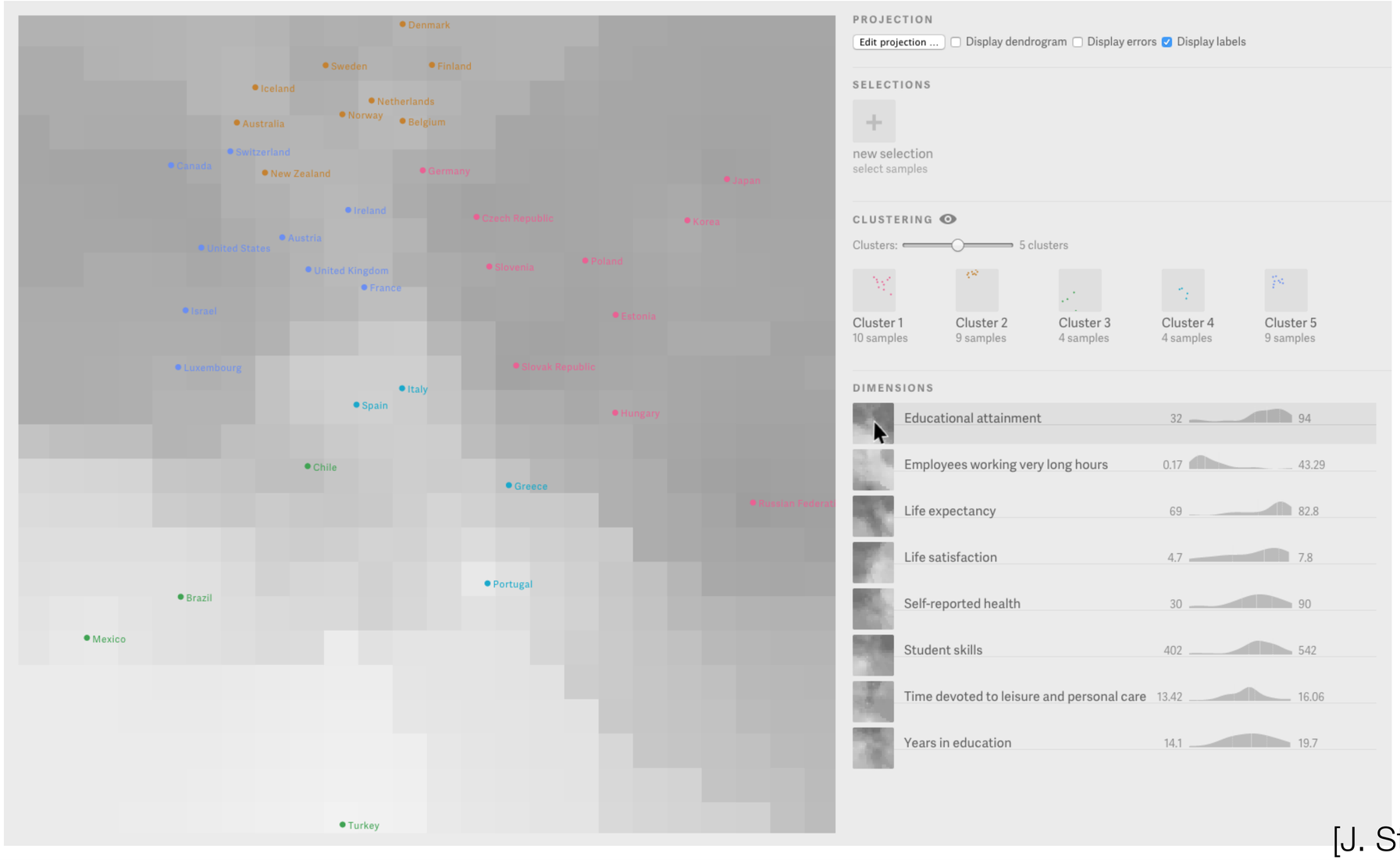
[M. Scholz, CC-BY-SA 2.0]

Probing Projections



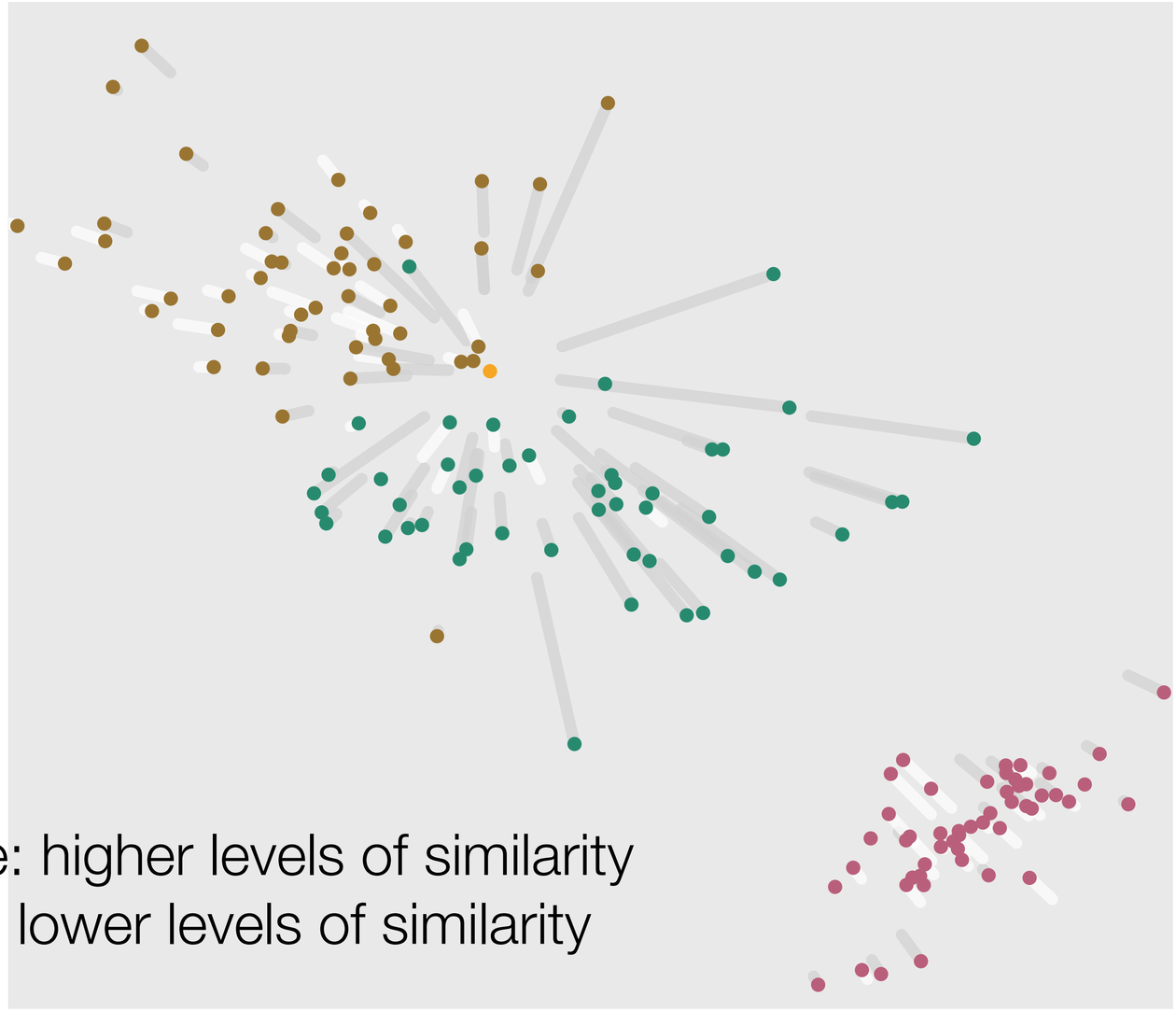
[J. Stahnke et al., 2015]

Heatmap from Dimension Hover



[J. Stahnke et al., 2015]

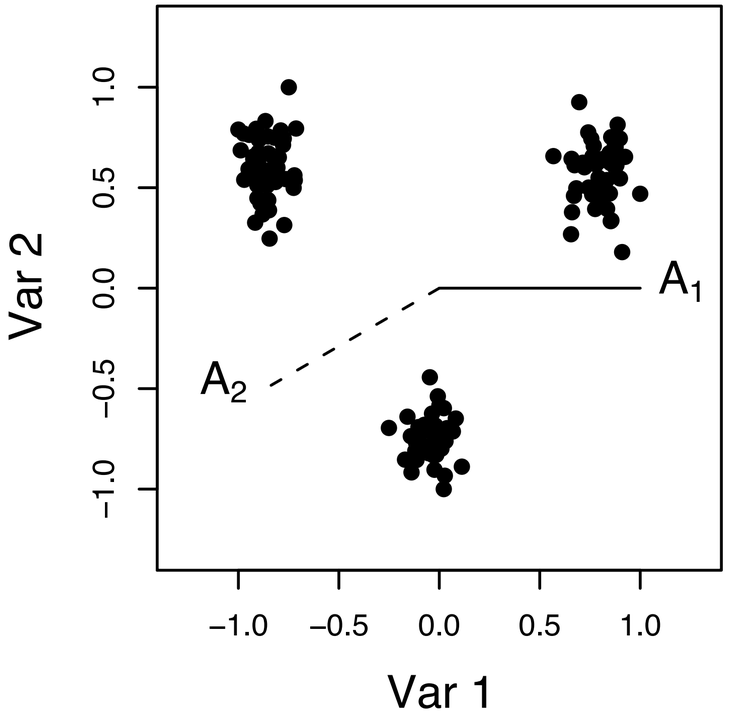
Showing Projection Errors

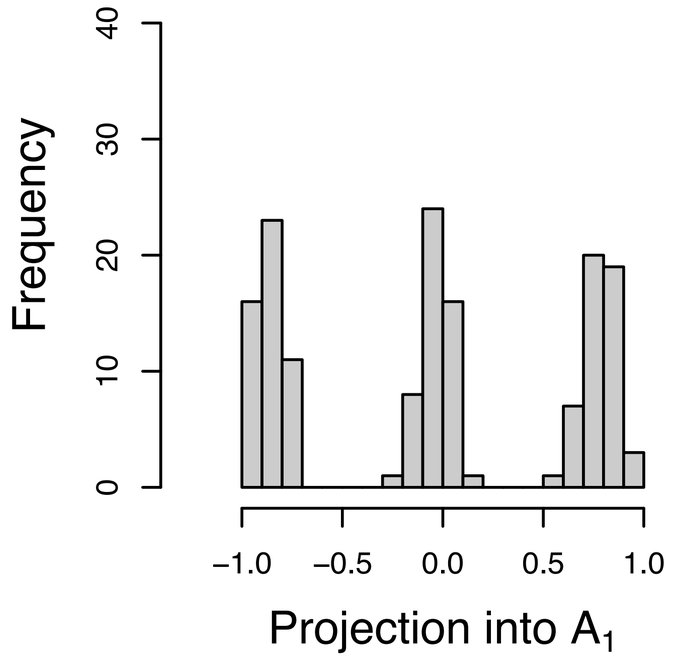


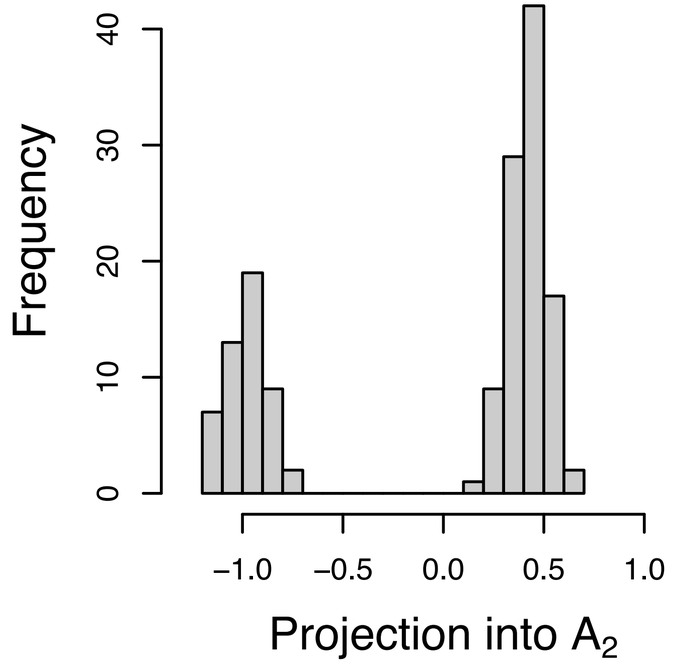
White: higher levels of similarity
Gray: lower levels of similarity

[J. Stahnke et al., 2015]

Different Projections Lead to Different Conclusions



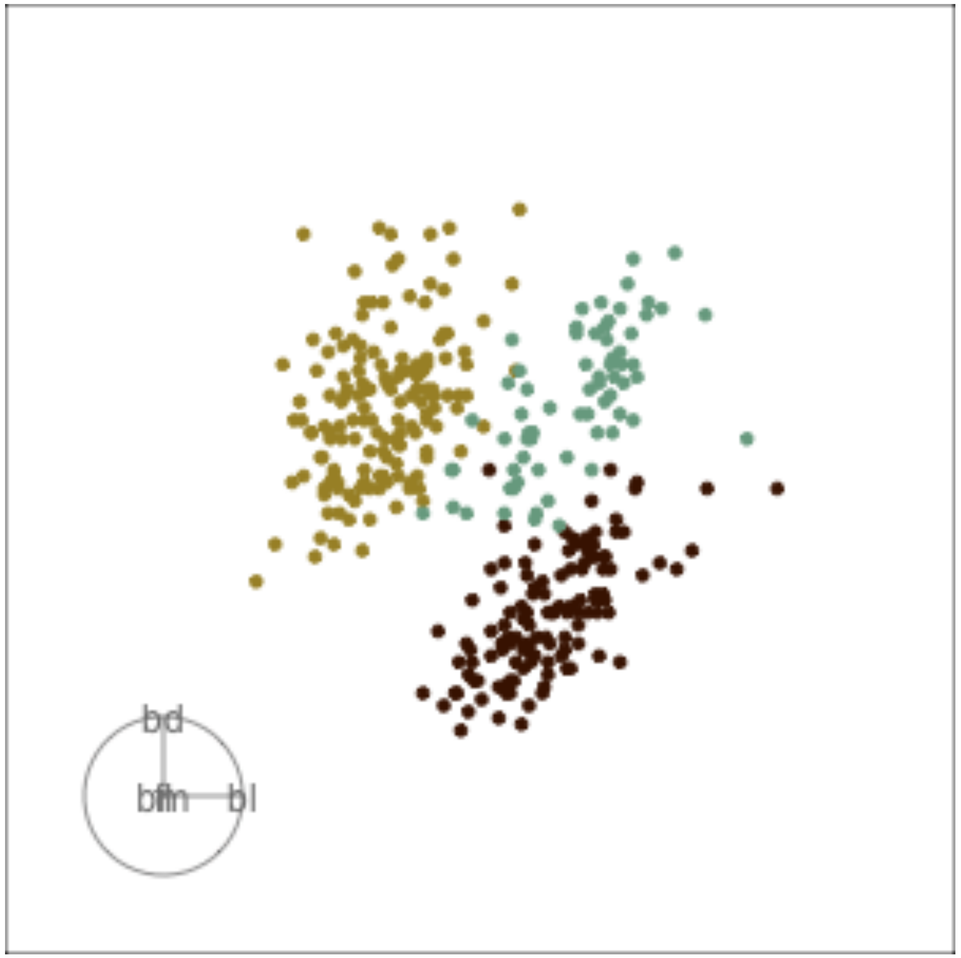




[D. Cook et al., 2008]

Grand Tour

- A **grand tour** is…
  - "A space-filling curve in the manifold of low-dimensional projections of high-dimensional data spaces"
  - "A movie of low-dimensional projections constructed in such a way that it comes arbitrarily close to showing all possible low-dimensional projections"
  - "A random walk through all possible planes"
  - Indexed by time



[D. Cook]

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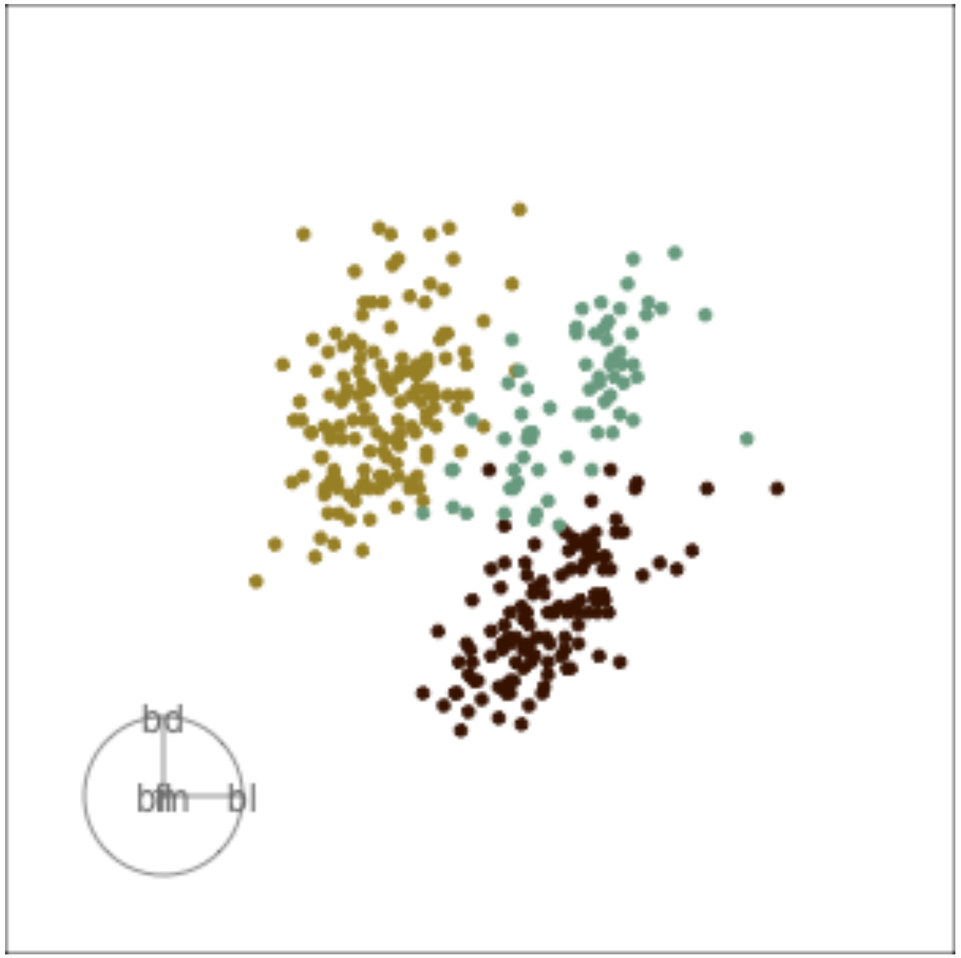
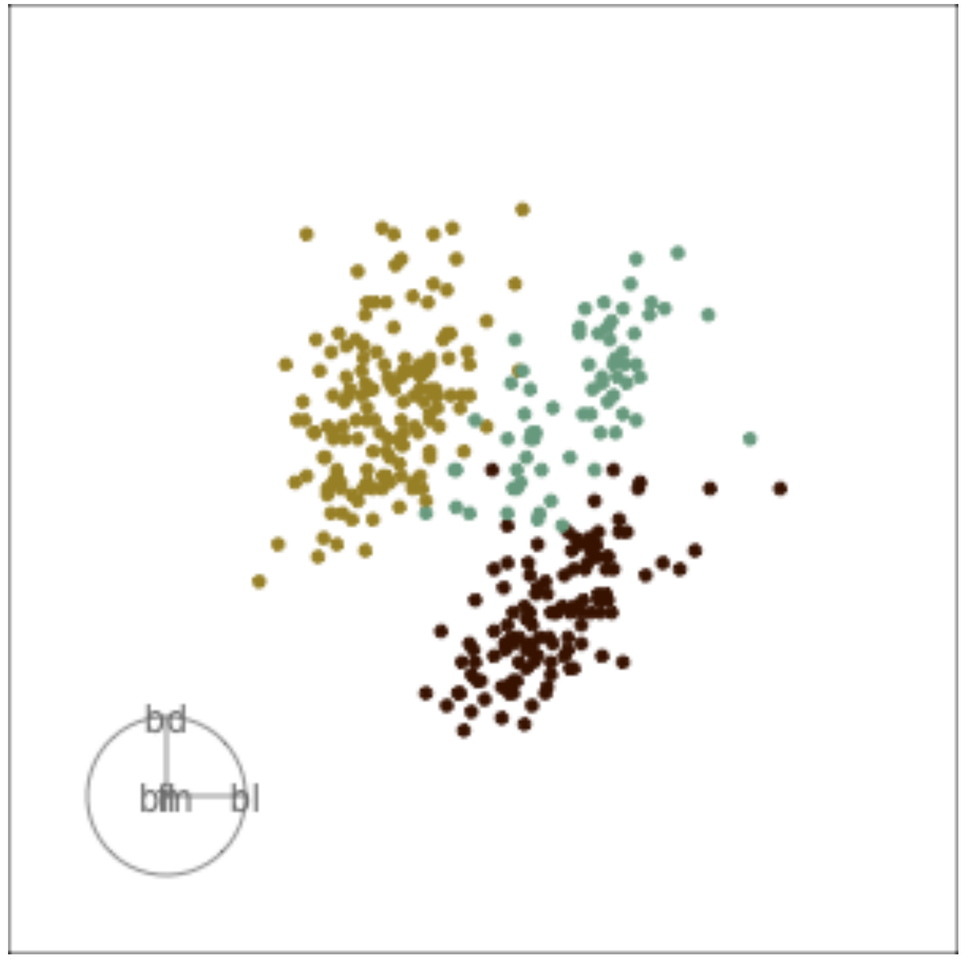


[D. Cook]

Grand Tour

- Helps to see
  - Clusters
  - Outliers
  - Linear Dependence
  - Elliptical Clusters (different shapes)
  - Separated Elliptical Clusters



[D. Cook]

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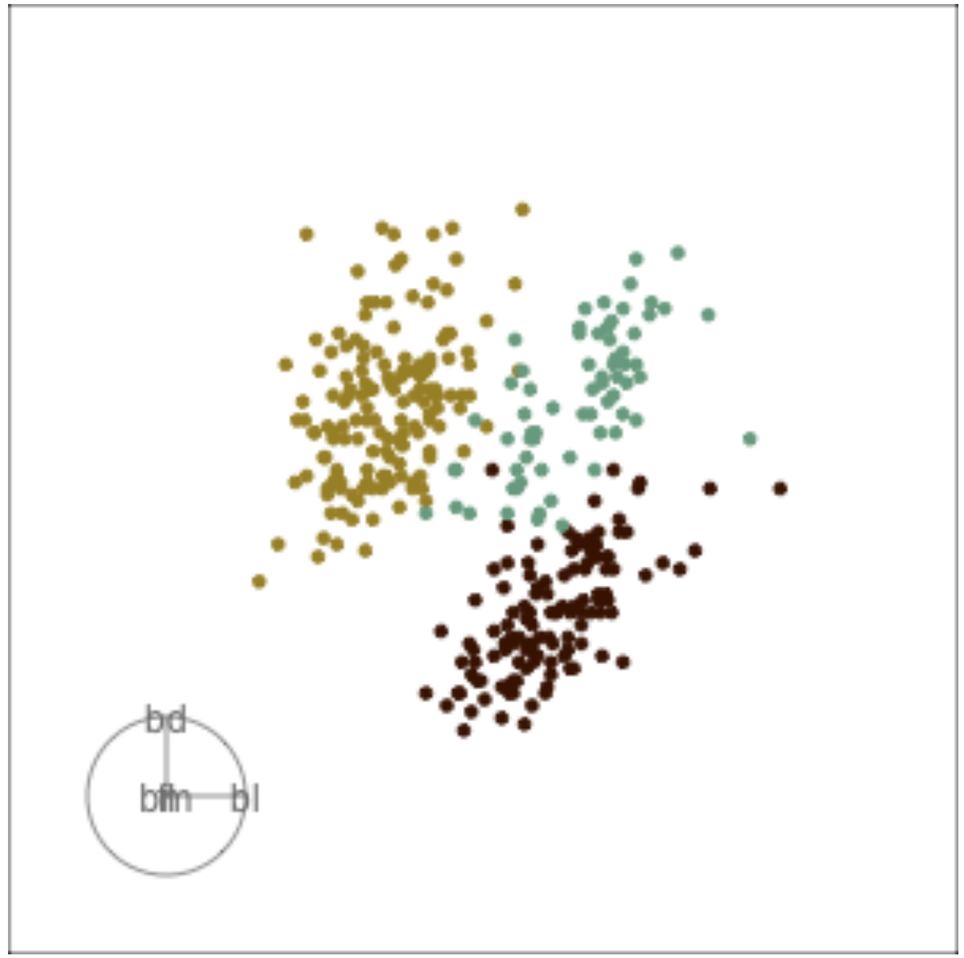
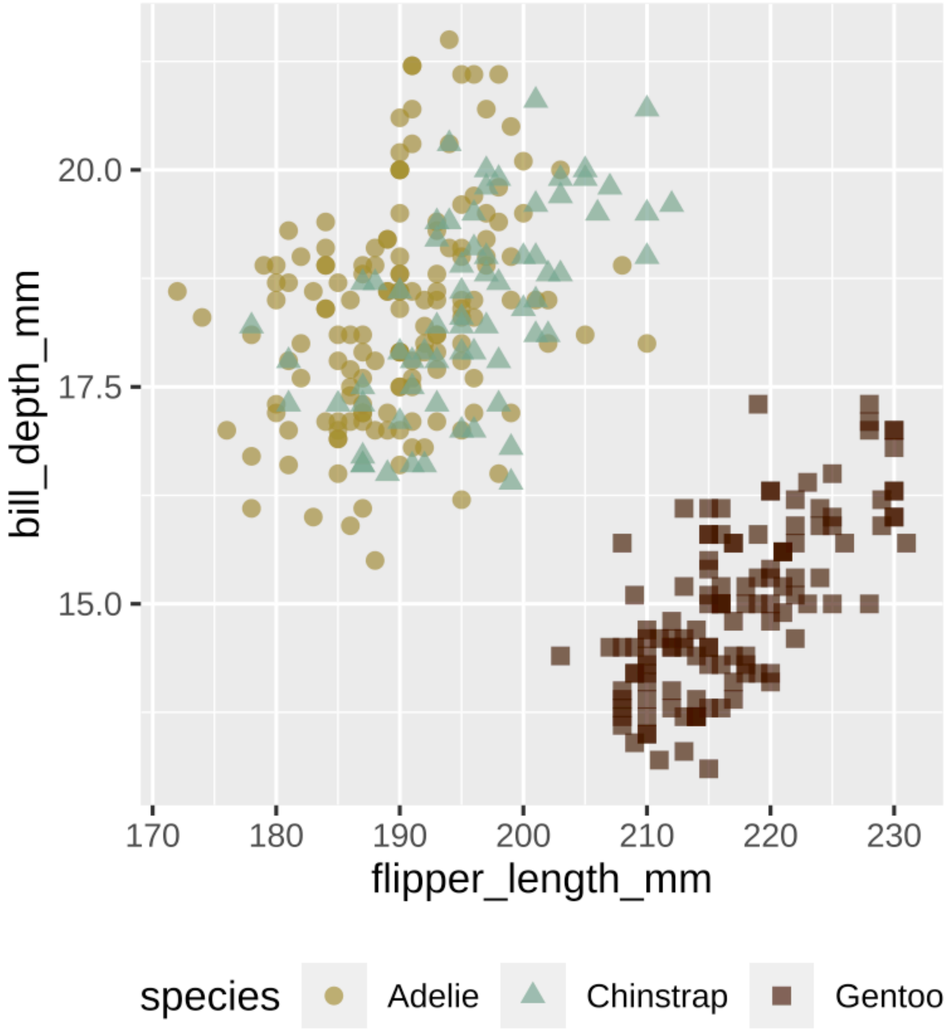
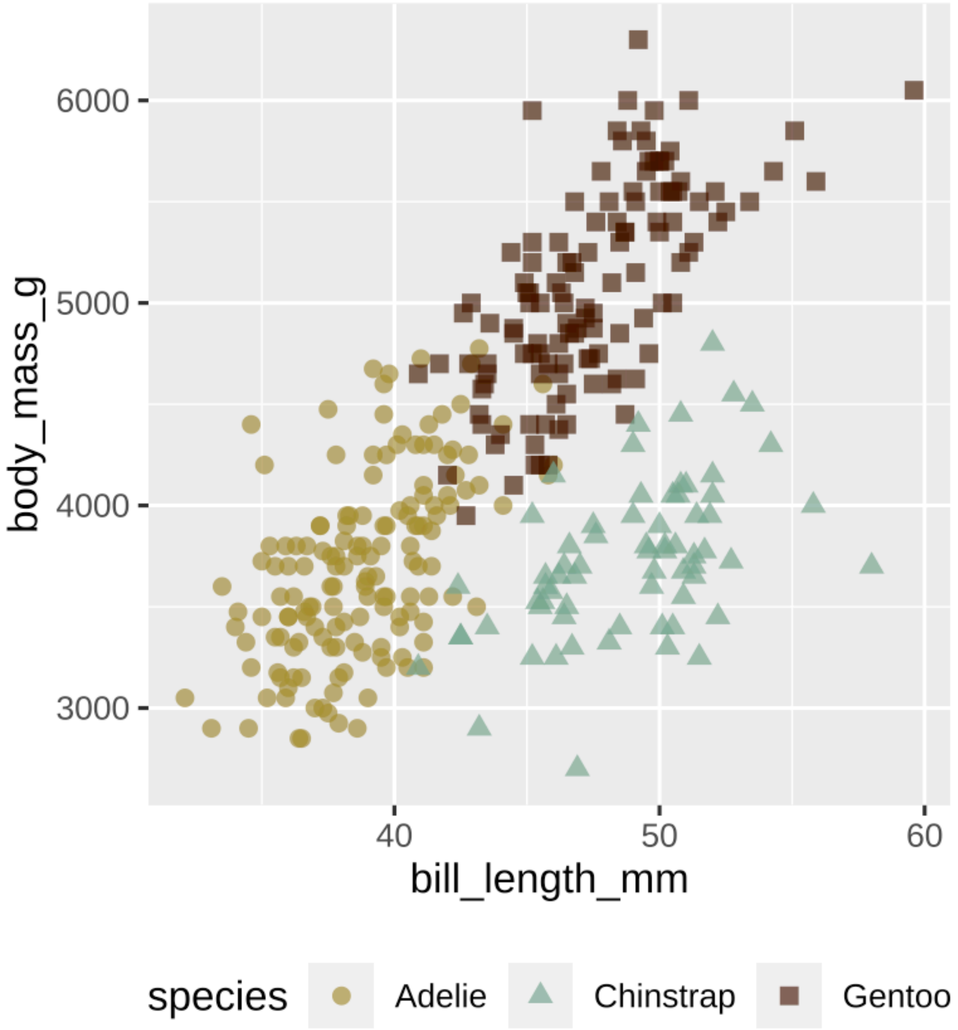


[D. Cook]

Different Views Help



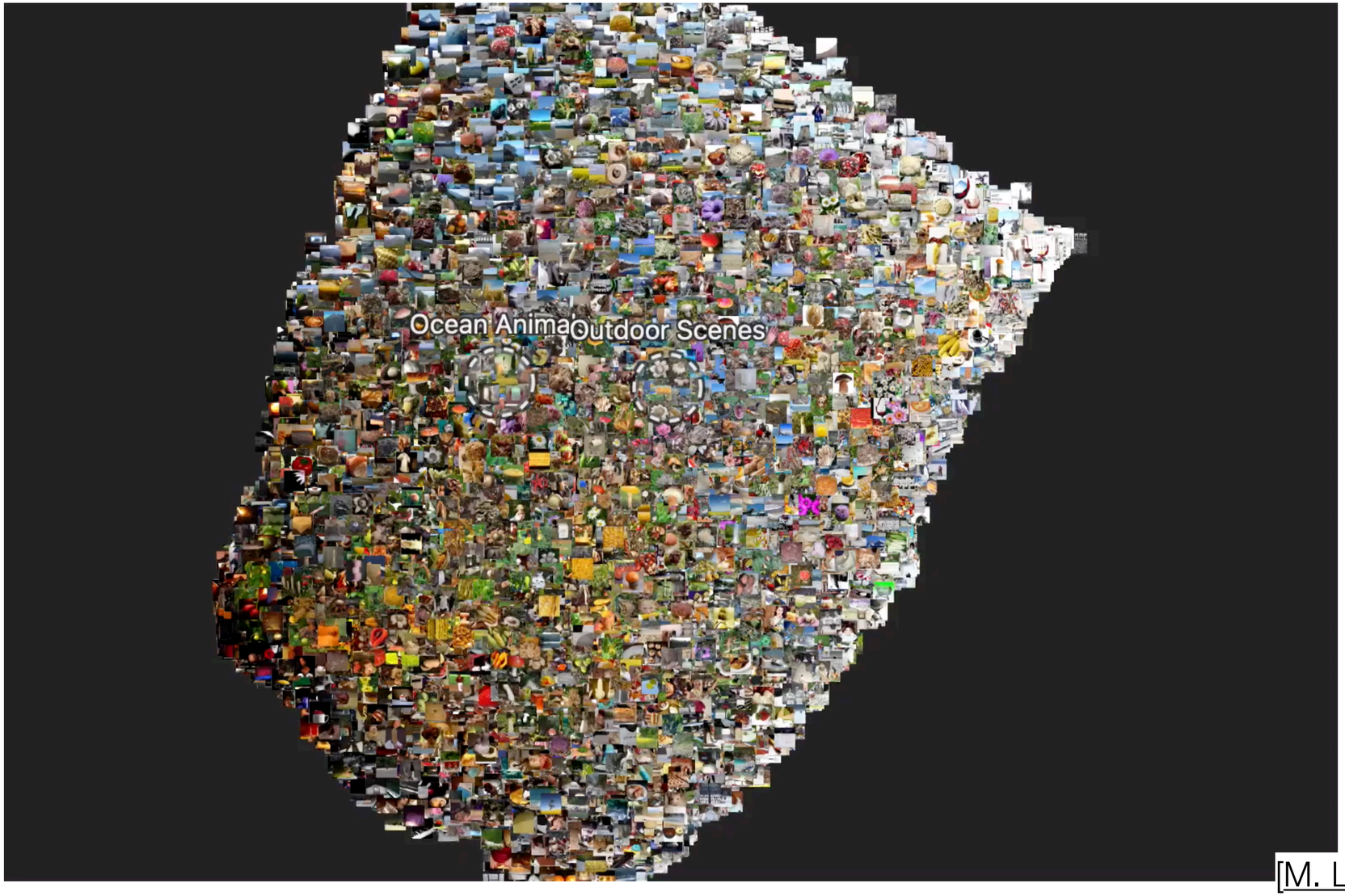


[D. Cook]

Other Tours

- Guided: follows the optimization path for a projection pursuit index
- Local: rocks back and forth from a given projection, shows all possible projections within a radius
- Manual: start from best projection, control coefficient of one variable

Grand Tour of Image Data using UMAP



[M. Li and C. Scheidegger]

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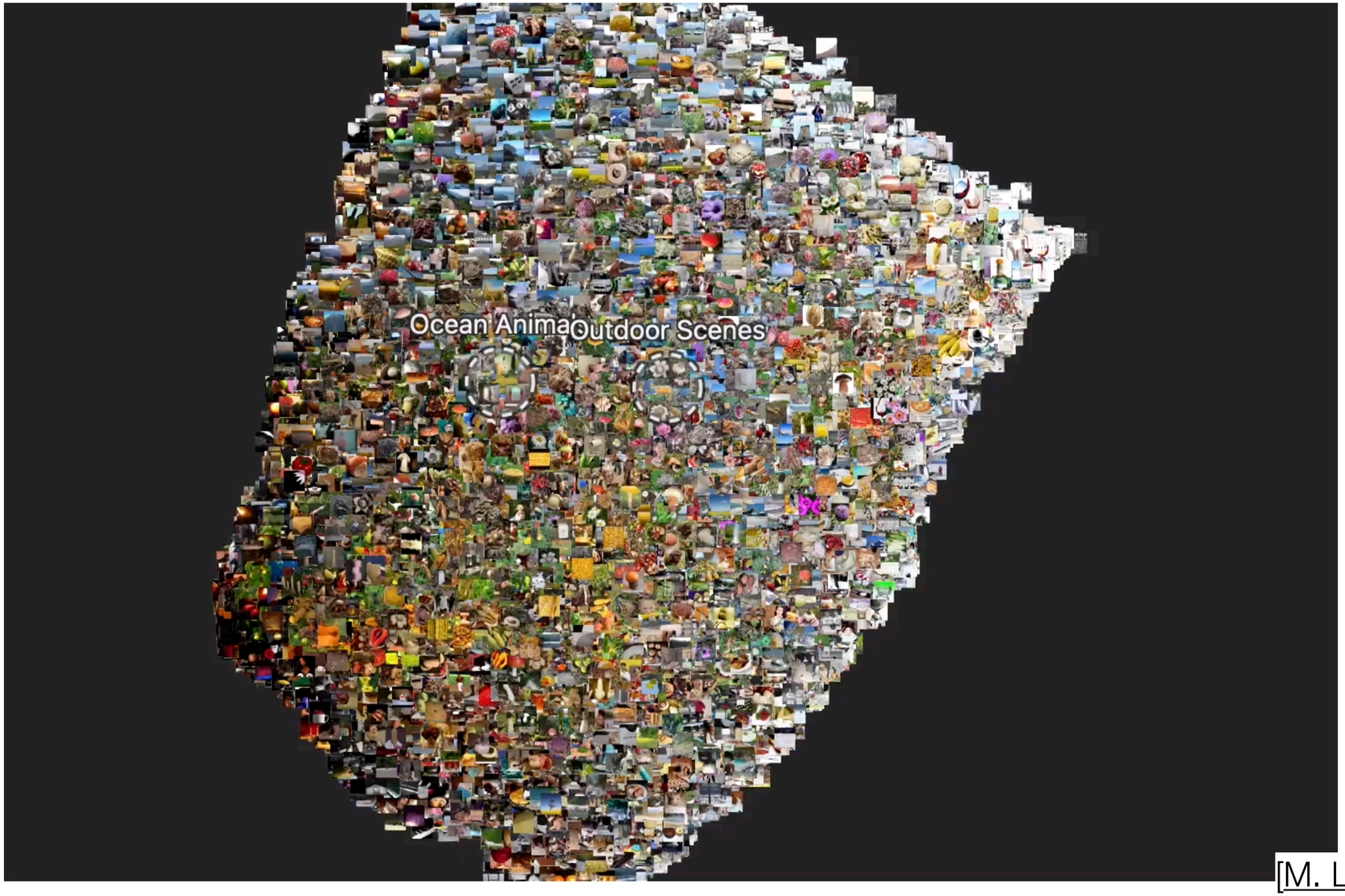


[M. Li and C. Scheidegger]

Reading Critique

- Turn in by tonight

Project Updates

- Thursday
- If you want feedback, please bring demos, web pages

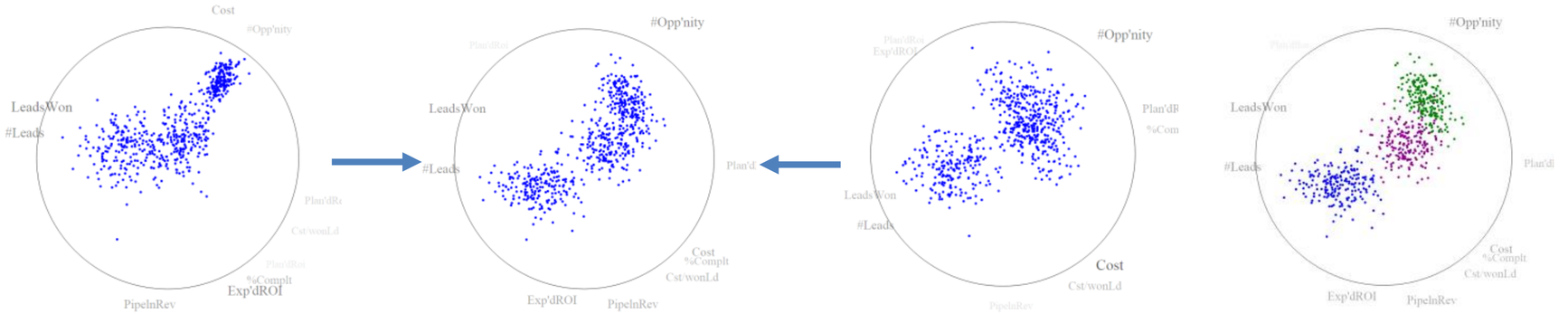
Reminder: IEEE VIS

- Lots of interesting work being presented
- Students have free admission
- Two more days: today and tomorrow
- https://ieeevis.org

Today's Paper

The Subspace Voyager: Exploring High-Dimensional Data along a Continuum of Salient 3D Subspace

Bing Wang and Klaus Mueller, *Senior Member, IEEE*



(a) (b) (c) (d)

Panel (a) and (c) are two projective views onto a 10-dimesional sales pipeline dataset with 900 points. The labels at the circle boundary indicate the data attributes and their axis directions in that view. The strength of the label fonts indicates how well the attributes are expressed in this view. Panel (b) shows a view generated by using our system's trackball interface to generate new projective views between view (a) and (c). The motion parallax clarified that there were not two but three clusters. Panel (d) shows the three clusters in different colors.