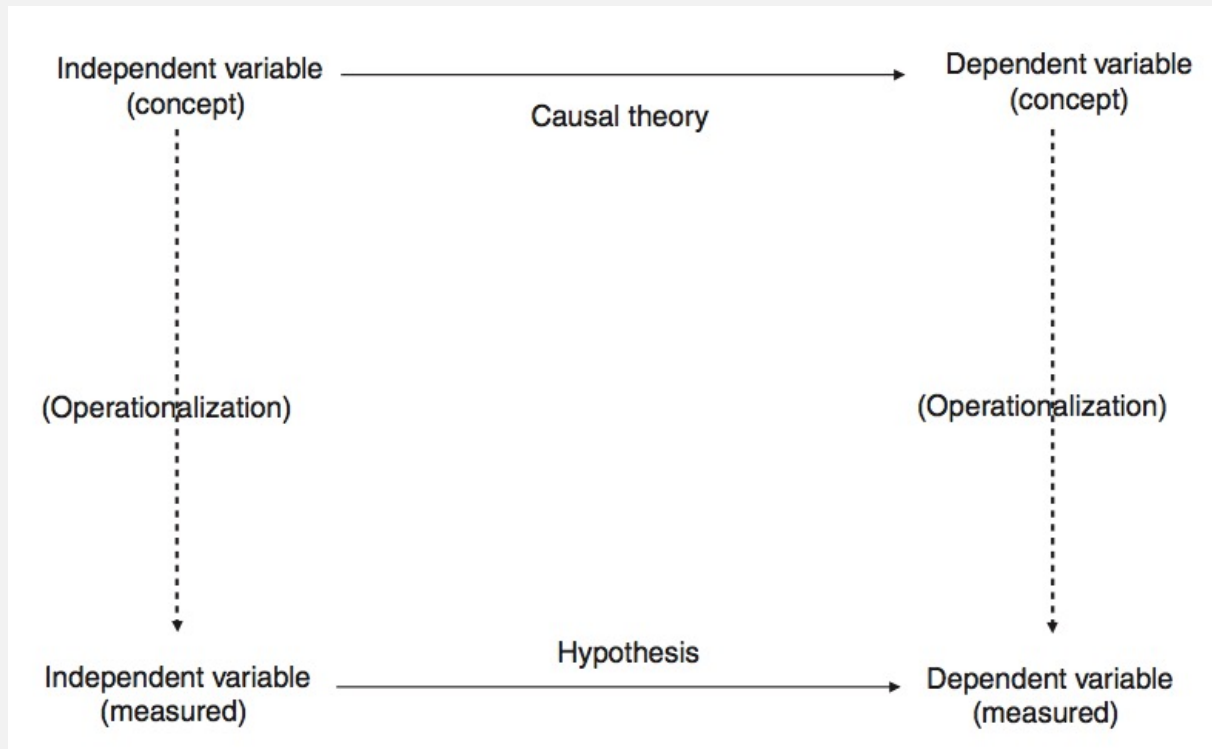# SCALING (AND MEASUREMENT)

SICSS - Edinburgh

27 May 2025
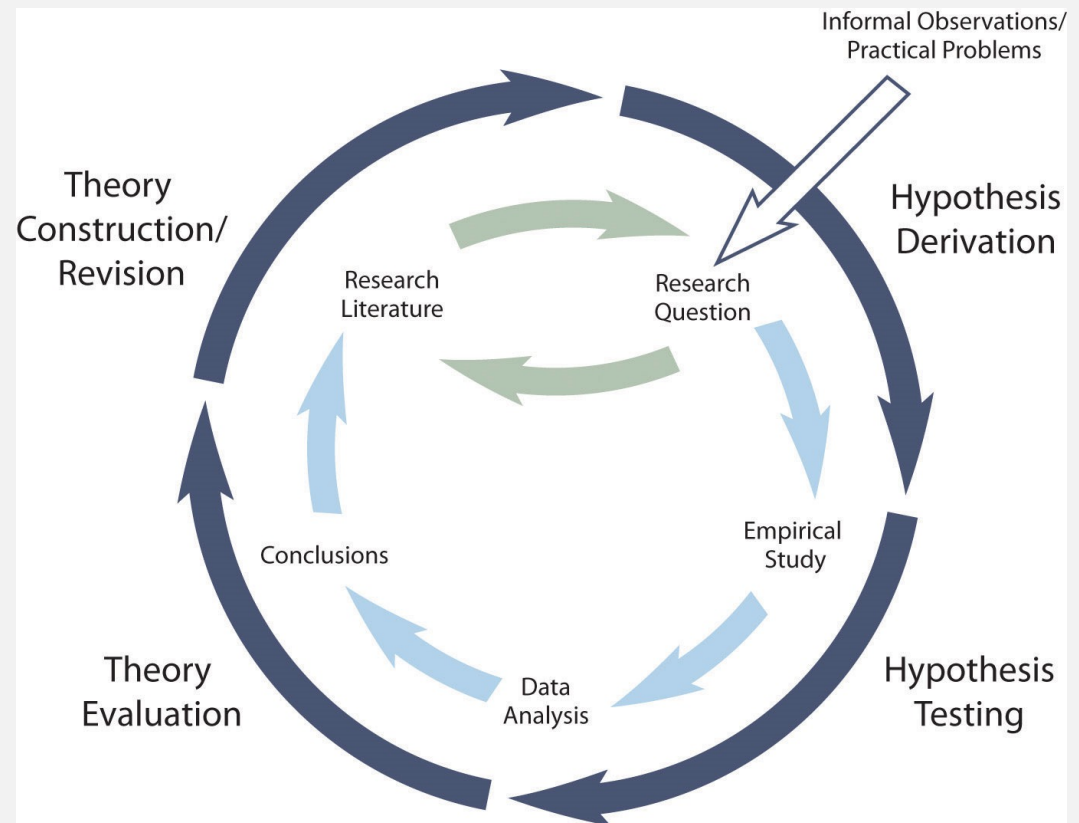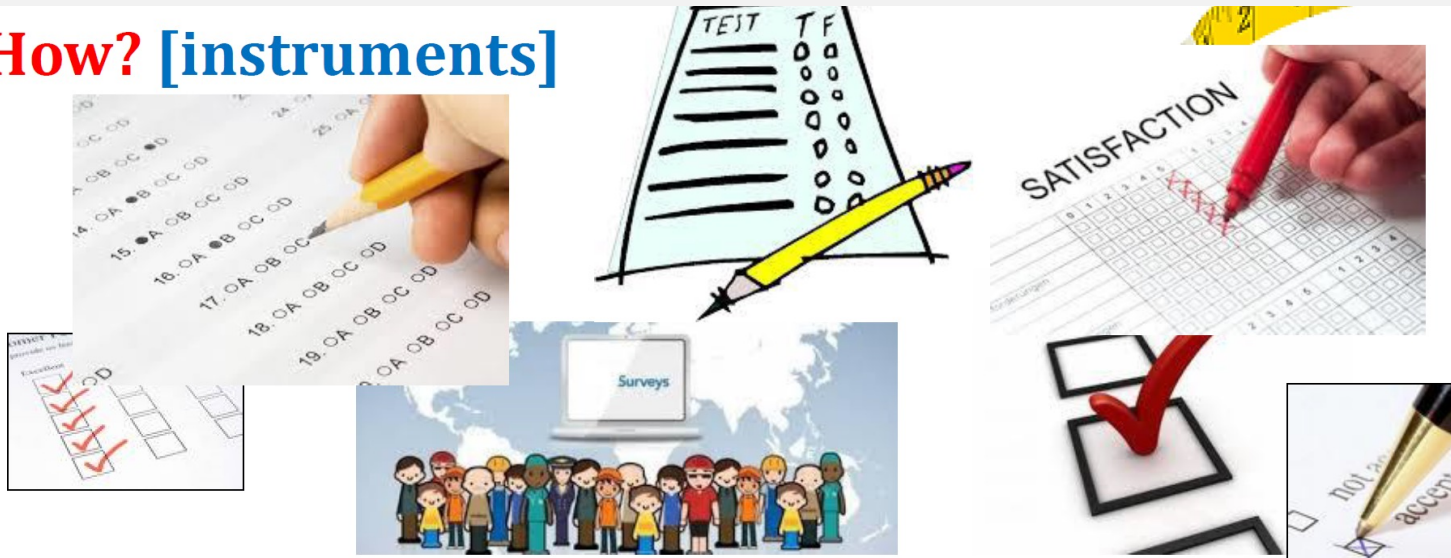
Dr. Ugur Ozdemir

FROM THEORY TO HYPOTHESIS

RESEARCH STAGES

- Deductive stages
  - Read existing theory
  - Formulate research question
  - Conceptualisation
  - Formulate hypotheses
  - Operationalisation
  - Data collection
  - Test hypotheses
  - Reflect back on theory
  - Publish results
  - Repeat!

MEASUREMENT IN SOCIAL SCIENCES

How? [instruments]

Surveys

What?

Grades

Emotions

Practices Attitudes ...

Social Class Behaviour

Happiness Scale

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
ready to jump off bridge really loving life

HAIR AND ELECTORAL CHANCES

- Does baldness affect electoral success?

  - Lee Sigelman et al (1990) "Hair Loss and Electability: The Bald Truth" *Journal of Nonverbal Behavior* 14(4): NO

  - Susan Banducci et al (2003) "Candidate Appearance Cues in Low-Information Elections" *APSA Conference Paper*: YES

	Operationalising baldness	Operationalising electoral success
General	Are they bald? Yes-No Assess the following: total bald, partially bald, full head of hair	Did they win? Yes – No If they lost, did they win back their deposit? Yes-No
Specific	% of total head area covered by hair	What % votes did they receive?
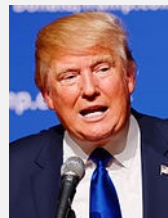
RISK AND SUPPORT FOR INDEPENDENCE

- Do risk attitudes affect support for independence?

  - Blais et al YES

  - Clarke et al NO

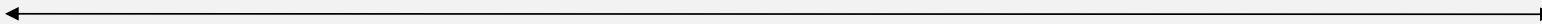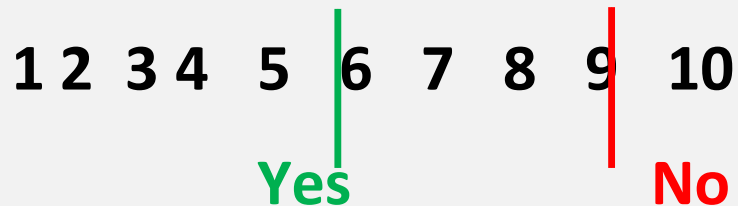|	Operationalising risk	Operationalising support for independence
General	Do you like taking risks? Yes-No	Do you support independence>? Yes-No
Specific	How much do you agree with the following statement: I like taking risks? Agree strongly, agree, neither agree nor disagree, disagree, disagree strongly	

OR …

KEY: AGGREGATION

- Many interesting social scientific measures involve some kind of aggregation and or scaling.
  - How to measure democracy?
  - Can you measure authoritarian values from multiple Likert scale research questions?
  - Can you deduce locations from pairwise distances?
  - How can we estimate ideologies of MPs from their voting histories?
- Other conventional methods? PCA? Factor analysis?

LAND OF THE FREE

Brasil

USA
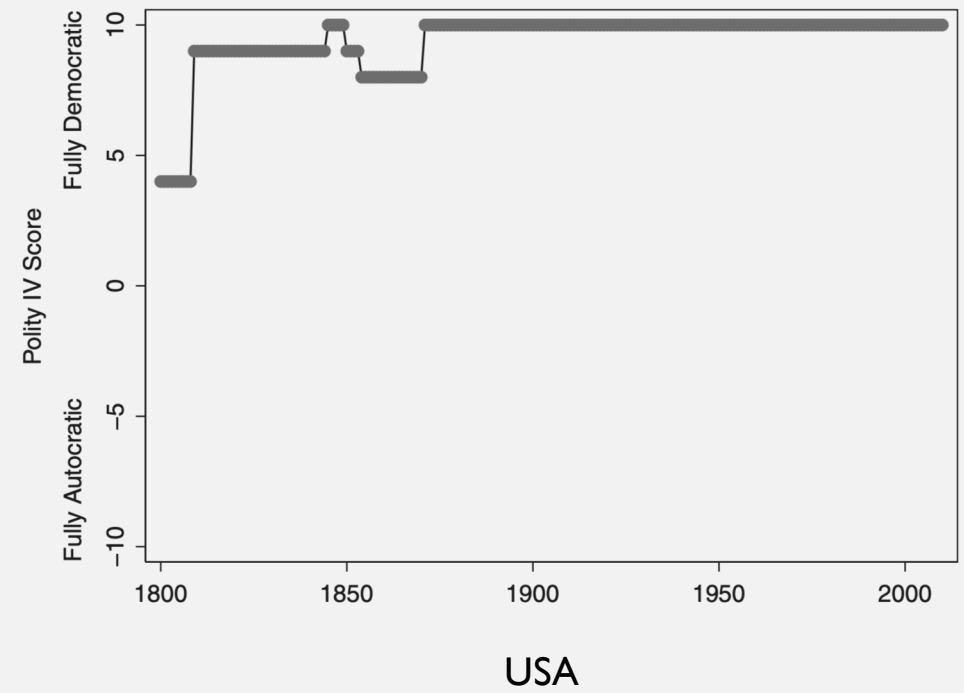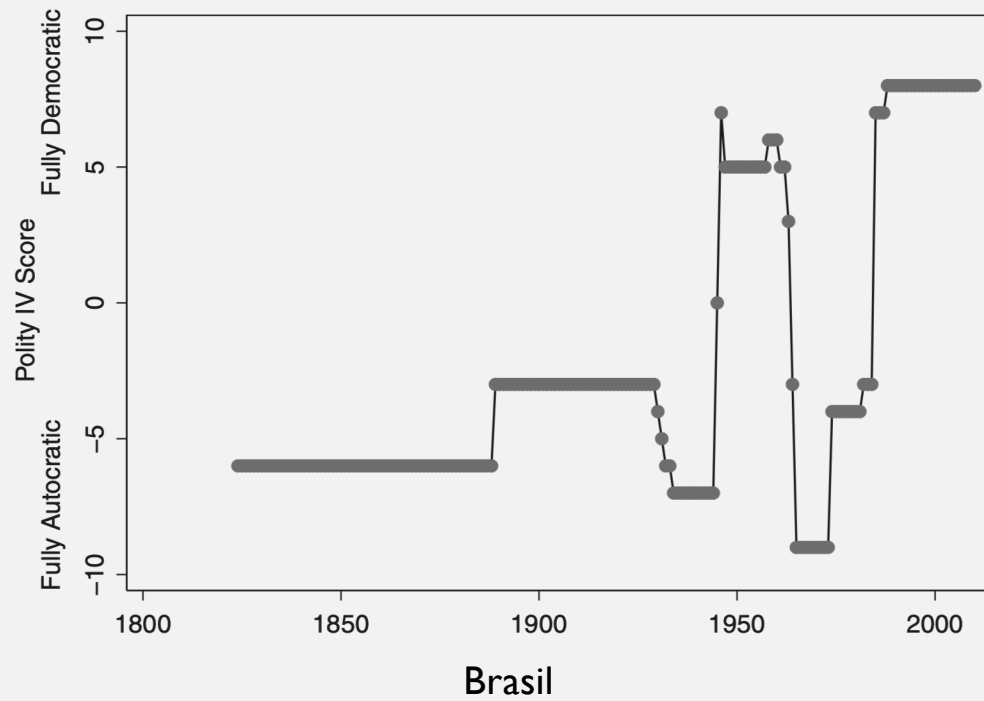
METHODS WE WILL DISCUSS

1. BayesianAldrich-McKelvey Scaling
2. Graded Item Response Model
3. Multidimensional Scaling: SMACOF
4. Unfolding of Binary Data: Optimal Classification

A-M SCALING

JOHN H. ALDRICH
Michigan State University

RICHARD D. MCKELVEY
Carnegie-Mellon University

Aldrich and McKelvey's (1977) pathbreaking solution to the problem of DIF is to treat raw placements as linear distortions of the "true" positions of the stimuli (e.g., political parties and candidates). By estimating

In brief, differential item functioning (DIF) occurs when groups (such as defined by gender, ethnicity, age, or education) have different probabilities of endorsing a given item on a multi-item scale after controlling for overall scale scores.

Using Bayesian Aldrich-McKelvey Scaling to Study Citizens' Ideological Preferences and Perceptions

Christopher Hare   University of Georgia
David A. Armstrong II   University of Wisconsin-Milwaukee
Ryan Bakker   University of Georgia
Royce Carroll   Rice University
Keith T. Poole   University of Georgia

A-M SCALING

	Self-Placement	Stimuli 1	Stimuli 2	.	.	Stimuli K
Ind 1	2	3	6	.	.	4
Ind 2	5	7	2	.	.	6
Ind 3	6	4	5	.	.	3
.	.	.	.	.	.	.
.	.	.	.	.	.	.
Ind N	7	6	3	.	.	2

A-M Scaling

	Scaled Ideals
Ind 1	0.7
Ind 2	0.5
Ind 3	2.4
.	.
.	.
Ind N	1.5

A-M SCALING

Raw Self-Placements
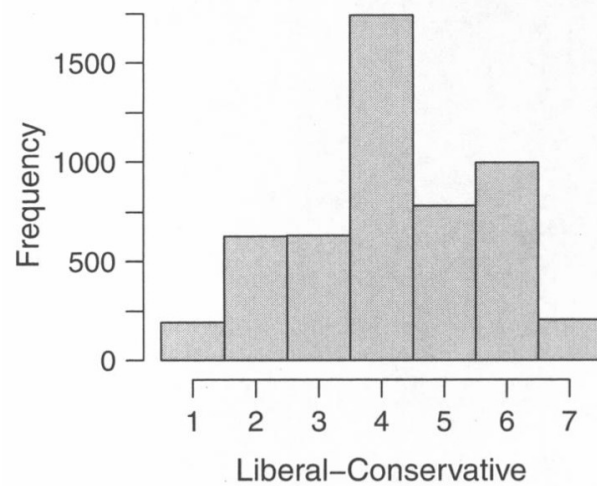
BAM Ideal Point Estimates

A-M SCALING

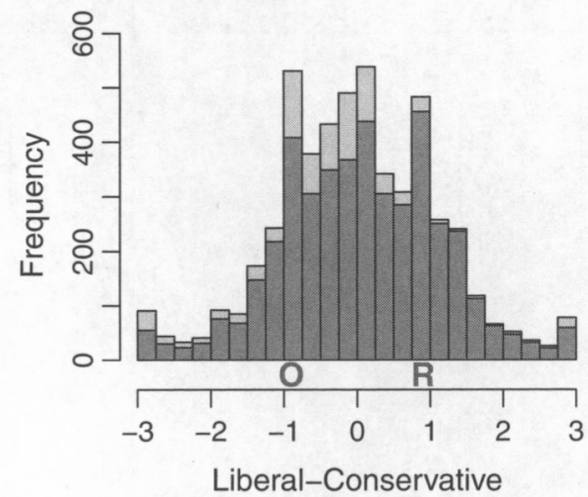The `aldmck()` function requires five arguments: the matrix to be analyzed (`franceEES2009`), the column number for respondent self-placements (1), the column number for a stimuli to be placed on the left side of the dimension (2 for the Extreme Left party), a vector of missing value codes, and a logical argument (`TRUE/FALSE`) that specifies whether verbose output is desired as the function is executed. The left stimulus requirement is a function of the recovered space being defined only up to a rotation. By convention, `aldmck()` places left-leaning stimuli on the left end of the scale by assigning them negative scores.

MULTIDIMENSIONAL SCALING

	Brazil	Congo	Cuba	Egypt	France	India	Israel	Japan	China	USSR	USA	Yugoslavia
Brazil	9.00	4.83	5.28	3.44	4.72	4.50	3.83	3.50	2.39	3.06	5.39	3.17
Congo	4.83	9.00	4.56	5.00	4.00	4.83	3.33	3.39	4.00	3.39	2.39	3.50
Cuba	5.28	4.56	9.00	5.17	4.11	4.00	3.61	2.94	5.50	5.44	3.17	5.11
Egypt	3.44	5.00	5.17	9.00	4.78	5.83	4.67	3.83	4.39	4.39	3.33	4.28
France	4.72	4.00	4.11	4.78	9.00	3.44	4.00	4.22	3.67	5.06	5.94	4.72
India	4.50	4.83	4.00	5.83	3.44	9.00	4.11	4.50	4.11	4.50	4.28	4.00
Israel	3.83	3.33	3.61	4.67	4.00	4.11	9.00	4.83	3.00	4.17	5.94	4.44
Japan	3.50	3.39	2.94	3.83	4.22	4.50	4.83	9.00	4.17	4.61	6.06	4.28
China	2.39	4.00	5.50	4.39	3.67	4.11	3.00	4.17	9.00	5.72	2.56	5.06
USSR	3.06	3.39	5.44	4.39	5.06	4.50	4.17	4.61	5.72	9.00	5.00	6.67
USA	5.39	2.39	3.17	3.33	5.94	4.28	5.94	6.06	2.56	5.00	9.00	3.56
Yugoslavia	3.17	3.50	5.11	4.28	4.72	4.00	4.44	4.28	5.06	6.67	3.56	9.00

MDS
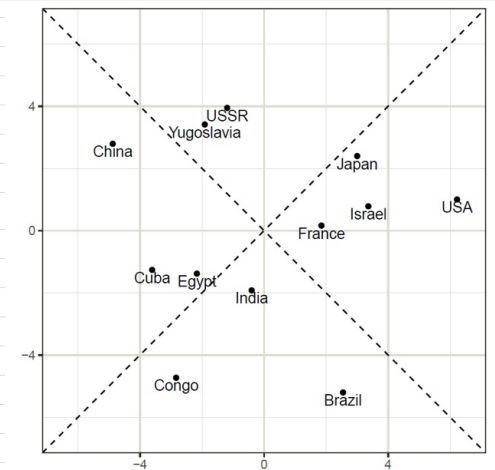
MULTIDIMENSIONAL SCALING

- Visualizes complex data by positioning items in a reduced dimensional space based on similarity or dissimilarity.
- SMACOF (Scaling by Majorizing a Complicated Function) is an iterative algorithm for MDS that minimizes stress to improve visualization accuracy.

Process:

1. Calculate initial distances between items.
2. Use SMACOF to iteratively adjust positions to minimize stress, improving the fit between high-dimensional and lower-dimensional distances.
3. Resulting plot shows item clusters and spatial relationships based on similarity.

Application: Common in consumer research, perceptual mapping, and network analysis, where visualizing relationships among items is key.

GRADED ITEM RESPONSE MODELS

- Analyzes ordinal response data, modeling both item characteristic and respondent trait.
- Useful for survey data with graded responses (e.g., agree-disagree scales).
- It estimates the likelihood of choosing a particular response category, based on a respondent's latent trait.

Model Components:
  - **Threshold Parameters**: Represent the boundaries between response categories.
  - **Ability Parameter**: Represents respondent ability or preference level.

Applications: Frequently used in education and psychology for attitude and ability assessment, as well as in survey data analysis.
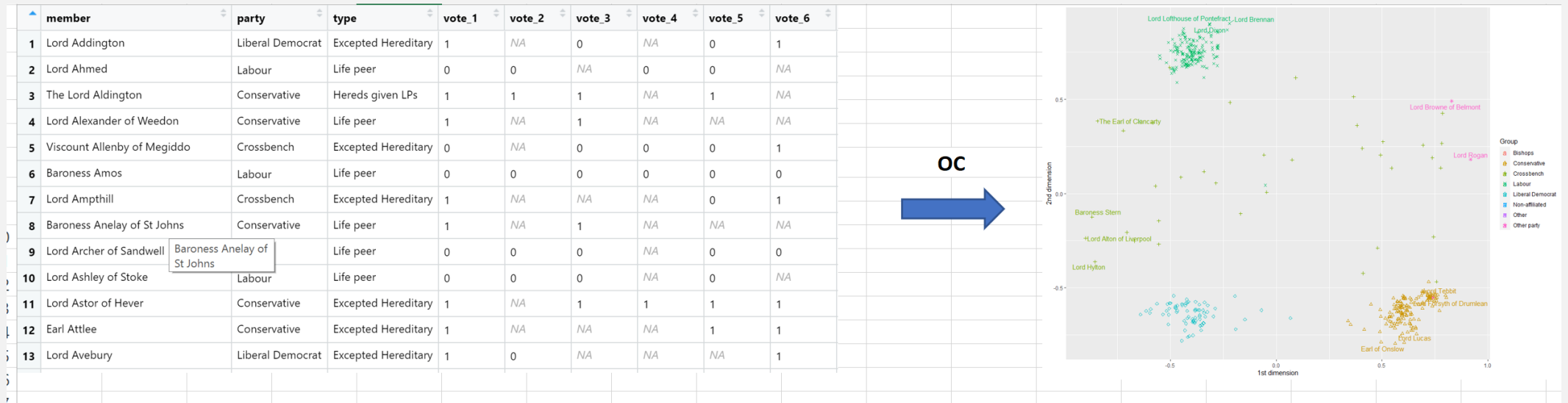
OC

- Places binary responses (e.g., yes/no) on a spatial map to reveal underlying structures and preferences.
- Suitable for dichotomous (binary) data, Optimal Classification can be used to understand preference structures.
- Positions items and individuals in a low-dimensional space, aiming to best fit observed response patterns.
- **Application:** Commonly used in political science for voting and preference analysis, particularly in situations where data is binary.

WHY USE MORE SOPHISTICATED METHODS?

- Produces scales at the interval level of measurement.

- Assesses the dimensionality of scales.

- Measures the error associated with each case.

- Measures the consistency of the pattern of responses for each case.

- Enables persons to be measured using different sets of items.

- Handles cases with missing data.