HistoBankVis: Investigating Language Change via Visual Analytics

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Motivation

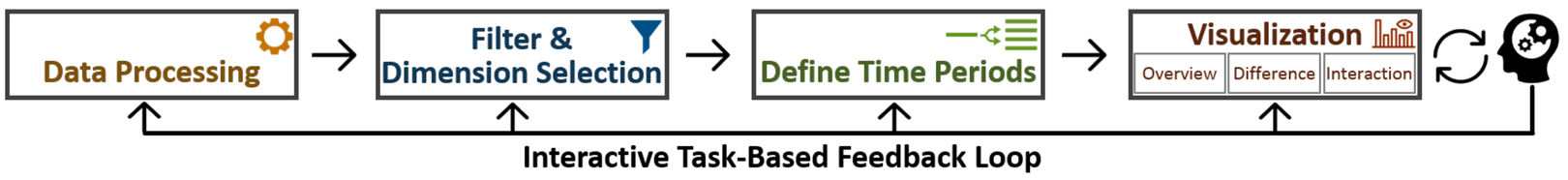
- Historical language change typically results from complex interactions between different structural language features.
- **Challenges/Problems:**
  - Highly complex interactions between various linguistic and extra-linguistic features have to be understood, while factoring in a temporal dimension.
  - The factors underlying a change are often unknown or at least highly debated among researchers.
  - Data sparsity is an inherent problem of historical corpus-based research.

→ Multiple complicated analyses including different features may have to be conducted in order to formulate clear hypotheses.

→ **Solution:**
Visual Analytics for Linguistics (LingVis)

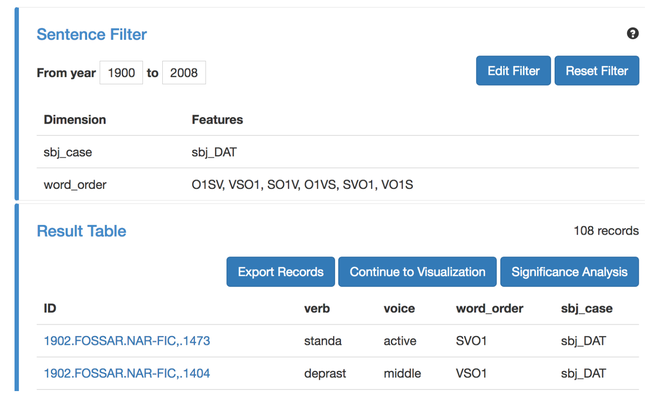
HistoBankVis: A Multilayer Visualization System

- On-line browser app: `http://histobankvis.dbvis.de`.
- Generically applicable system for historical linguistic research.
- Flexible and interactive investigation of a potentially high number of interacting linguistic features stored in a SQL database.

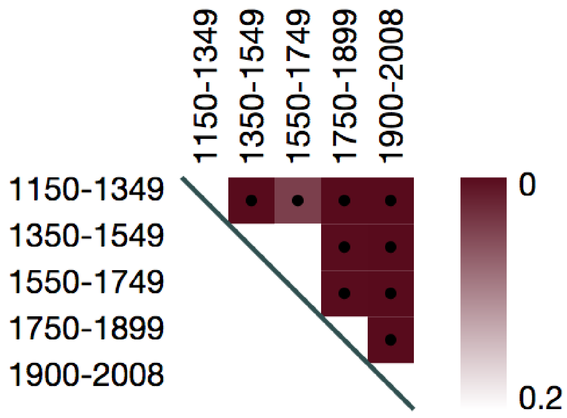


- Multiple layers of data representation at different levels of detail are combined with a structured statistical analysis process.
  - Filtering component
  - Compact Matrix Visualization
  - Difference Histograms Visualization
  - Dimension Interaction Visualization

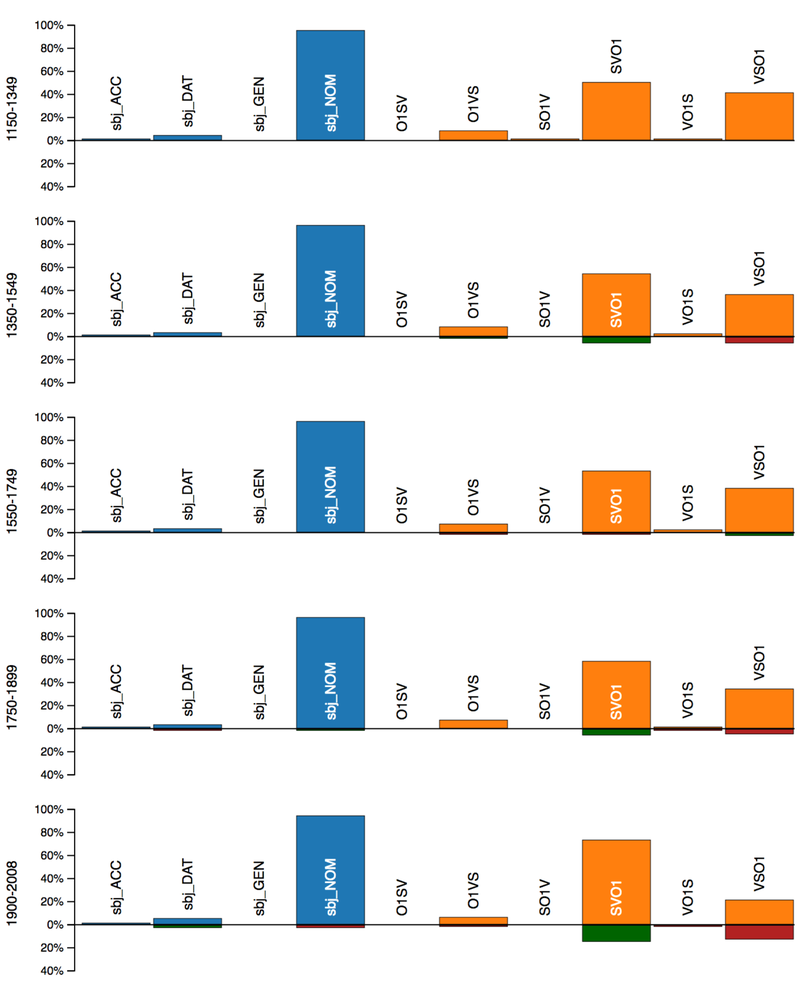
→ Iterative process of hypothesis generation and testing.



Compact Matrix

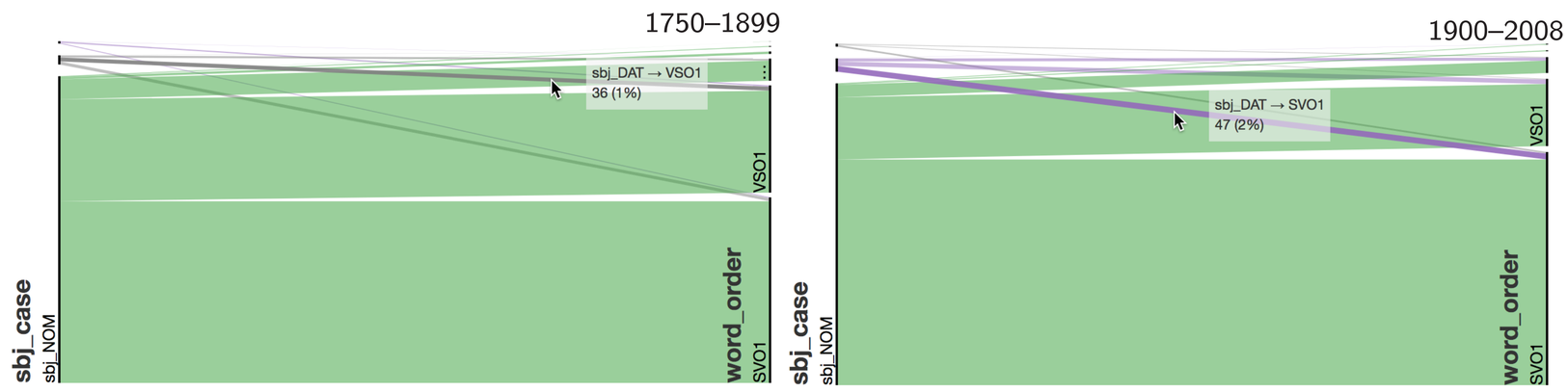


Difference Histograms



Dimension Interaction Visualization

- Visualizes dimension interactions as **Parallel Sets** (Bendix et al. 2005, Kosara et al. 2006).
  - Each feature is visualized as a proportion of an equally spaced vertical line.
  - The vertical lines represent the data dimensions.
- Flexible investigation of interactions between features from different data dimensions.
  → Particularly suitable for the analysis of historical linguistic data.



Case Study

- Investigation of the interaction between subject case and word order in the Icelandic Parsed Historical Corpus (IcePaHC, Wallenberg et al., 2011).
- **Compact Matrix:** Significant changes between the last two time periods.
- **Difference Histograms:**
  - SVO1 is the preferred word order overall (S=subject, V=verb, O1=primary object).
  - Frequency of SVO1 increases over time.
  - The use of dative subjects increases in the period post-1900.
- **Dimension Interactions:**
  - Dative subjects lag behind other subjects in being realized in a particular position.
  - Only as of 1900, dative subjects also occur preferably with SVO1.

→ Identification of a previously unknown interrelation between word order changes and subject case marking in Icelandic via HistoBankVis.

→ Dimension interactions visualization represents an effective new means for historical linguistics.

References

Bendix, F., Kosara, R., Hauser, H.: Parallel sets: Visual analysis of categorical data. In: IEEE Symposium on Information Visualization. pp. 133–140. IEEE (2005)
Kosara, R., Bendix, F., Hauser, H.: Parallel Sets: interactive exploration and visual analysis of categorical data. IEEE Transactions on Visualization and Computer Graphics 12(4), 558–568 (2006)
Wallenberg, J.C., Ingason, A.K., Sigurðsson, E.F., Rögnvaldsson, E.: Icelandic Parsed Historical Corpus (IcePaHC) (2011), `http://www.linguist.is/icelandic_treebank`, version 0.9
Schätzle, C., Hund, M., Dennig, F., Butt, M., Keim, D.: HistoBankVis: Detecting Language Change via Data Visualization. NoDaLiDa Workshop on Processing Historical Language (2017)

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Project D02 "Evaluation Metrics for Visual Analytics in Linguistics"
Project A03 "Quantification of Visual Analytics Transformations and Mappings"