# Visualizing Geographic Sequences: A case study Intergenerational Migration

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Representing movement over time remains a challenge in geovisualization. Existing approaches, such as origin–destination flow maps, trajectory visualizations, and sankey diagrams, are designed to represent isolated movements or pairwise transitions. However, they are not designed to represent flows as sequential, multi-step processes unfolding over time, particularly when these sequences are structured across related entities rather than independent events. This creates a mismatch between the structure of sequential geographic data and the capabilities of current visualization techniques. This raises an important question: how can geographic flows be represented over sequences and time?

Intergenerational migration illustrates the problem clearly. Movement across generations is not a single transition but a chain of different states, where a grandparent's birthplace may influence a parent's location, which in turn influences where children are born and where descendants settle. These sequences are ordered and structured; properties that existing visualization methods are not designed to represent. The challenge is not simply one of scale or complexity, but of representation: existing methods assume movement as pairwise transitions, whereas intergenerational flow data encodes movement as sequences distributed across linked individuals connected through kinship.

We draw on two data sources to address this challenge. The primary source is a population-scale family tree dataset of 51 million individuals constructed from crowdsourced genealogical records, providing birthplace data at the state level across three generations: grandparents (G1), parents (G2), and grandchildren (G3). Four lineal paths: paternal-paternal, maternal-paternal, paternal-maternal, and maternal-maternal are used to examine variation across gendered lineages. A secondary source, the IPUMS Multigenerational Longitudinal Panel, provides census level data where we can generate sequences for comparison, allowing assessment of what each source reveals and where each fall short.

To represent these sequences, we introduce Seqvia, a geovisualization tool that employs a small multiples design, organizing the flow map as a grid of aligned panels in which each panel isolates a single state as the point of analysis. Each panel integrates a choropleth map and a corresponding alluvial diagram with consistent encodings across views. The choropleth encodes the Intergenerational Symmetry Index (ISI) at the state level, capturing patterns of kin retention and dispersion, while the alluvial diagram traces weighted flows across G1, G2, and G3 birthplaces. This preserves generational order, lineage structure, and the multi-step nature of movement. By representing flows as sequences and isolating them within comparable panels, this approach reduces visual clutter and enables clearer interpretation of geographic sequences.