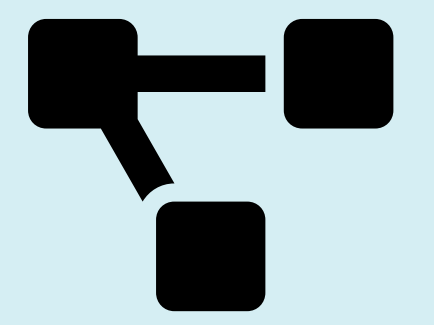


Mapping the Complete Network of Sweden



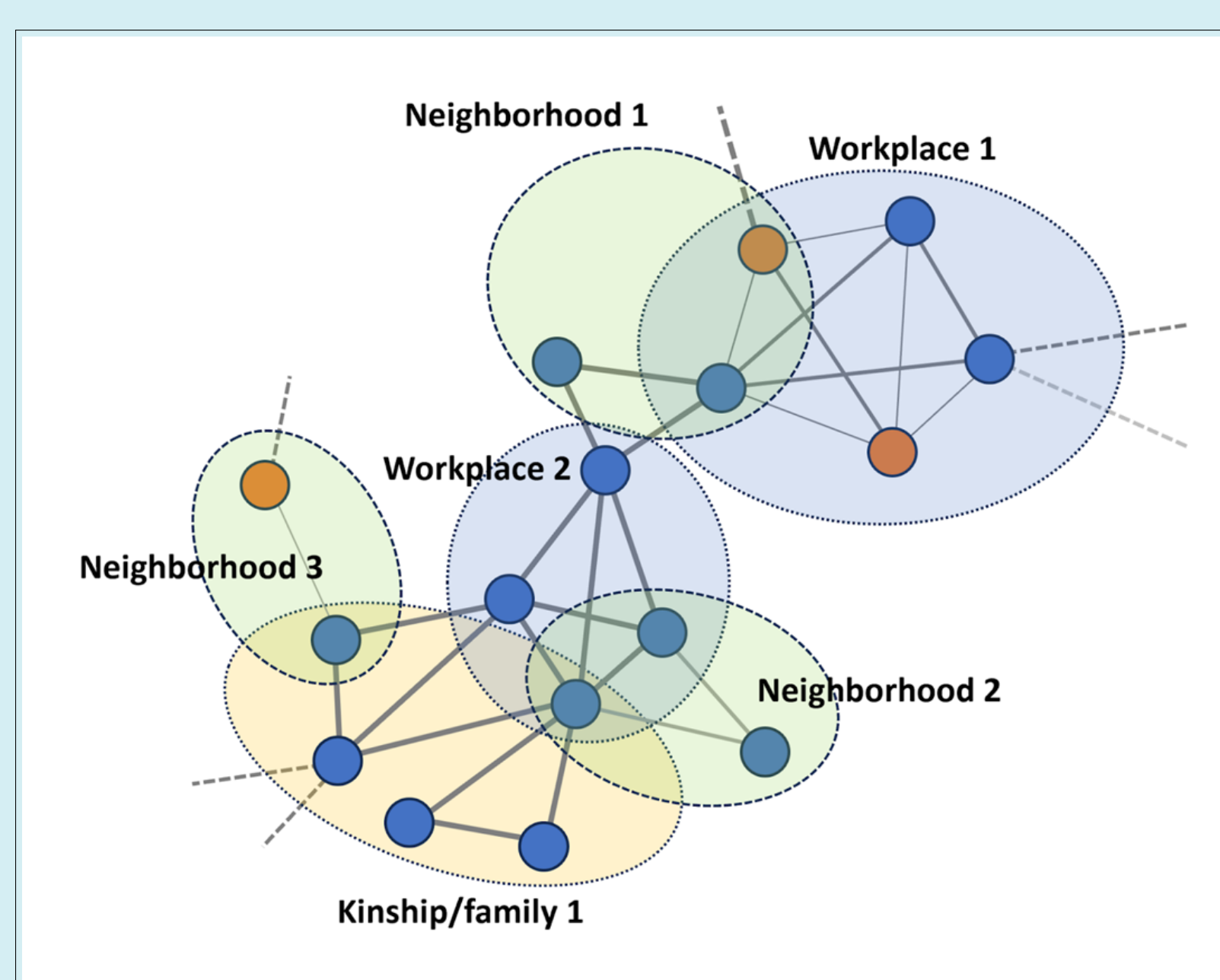
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Introduction

Social life is inherently **multiplex**: people are simultaneously embedded in families, workplaces, neighborhoods, schools, and other social domains.

Research analyzes life domains in **isolation**, leaving us with a partial view of how society is intertwined.

Interactions across domains are **not just additive**—they generate emergent dynamics that cannot be predicted by studying each layer alone.



Project¹

Recent studies exploring full-population networks with administrative data^{2,3,4} demonstrate the potential of this approach.

Our project uses Swedish register data to map the multiplex structure of society and its consequences with **three objectives**:

1. Build a longitudinal, multi-domain full-population network.
2. Map its properties.
3. Track life-course network dynamics and their consequences on life outcomes.

Data

In the first stage of the project, we use full-population Swedish register data to construct a multiplex network for three time-points—2001, 2011, and 2021. The pilot analysis is based on two key domains:

Family: Includes parents, siblings, extended family, partners, and children.

Workplace: In workplaces with ≤ 50 employees, all colleagues are connected. In larger ones, each person links to up to 50 colleagues—by occupation first, then randomly.

Pilot Study: Social Integration Measured by Network Distance

Rather than traditional segregation indices, we propose to measure social integration based on the **average between- and within-group network distances**.

How many ties, on average, separate a person from group X from someone from group Y?

This pilot study constructs a multiplex network and provides a first exploration of intergroup distances in a full-population context, offering a novel view of segregation as a property of connectivity, not just co-location.

Network Analysis

We calculated **average shortest paths (ASP)** and the **proportion of node pairs have defined shortest paths** (henceforth, reach) in two settings: family ties, and family + workplace ties, for a random sample of 1,000 “from” and 1,000 “to” nodes per year.

We regressed distances on ethnicity and gender to examine how intergroup distances vary and change over time.

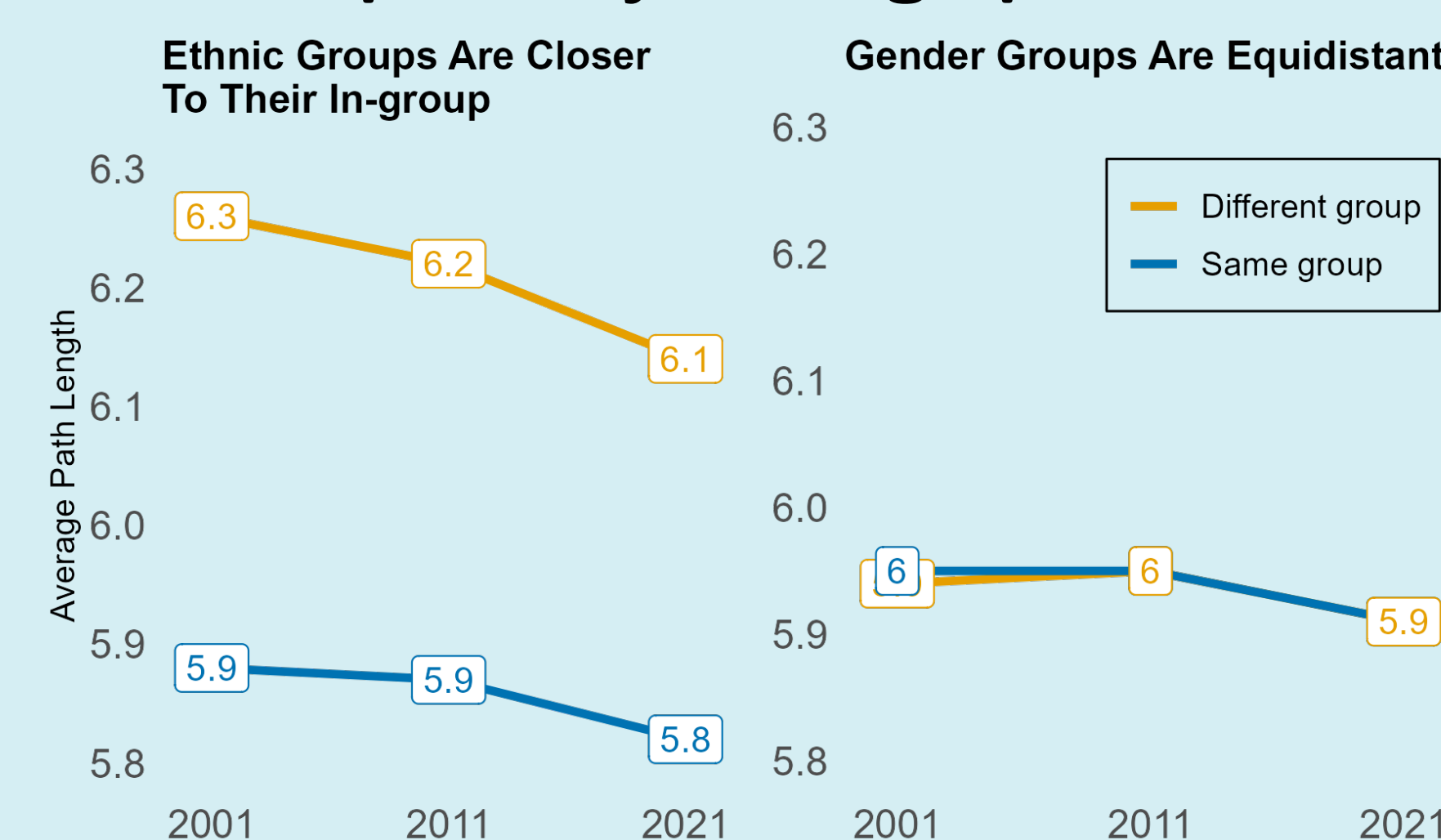
Results

Shortest paths

Ties	ASP	Reach
Family	13.0	80%
Family + work	6.0	97%

- **With only family ties**, the average shortest path (ASP) is **13 steps** and 80% of person-pairs are connected via family ties.
- **Adding workplace ties** reduces the path to **6 steps** and connects 97%, reshaping social connectivity.

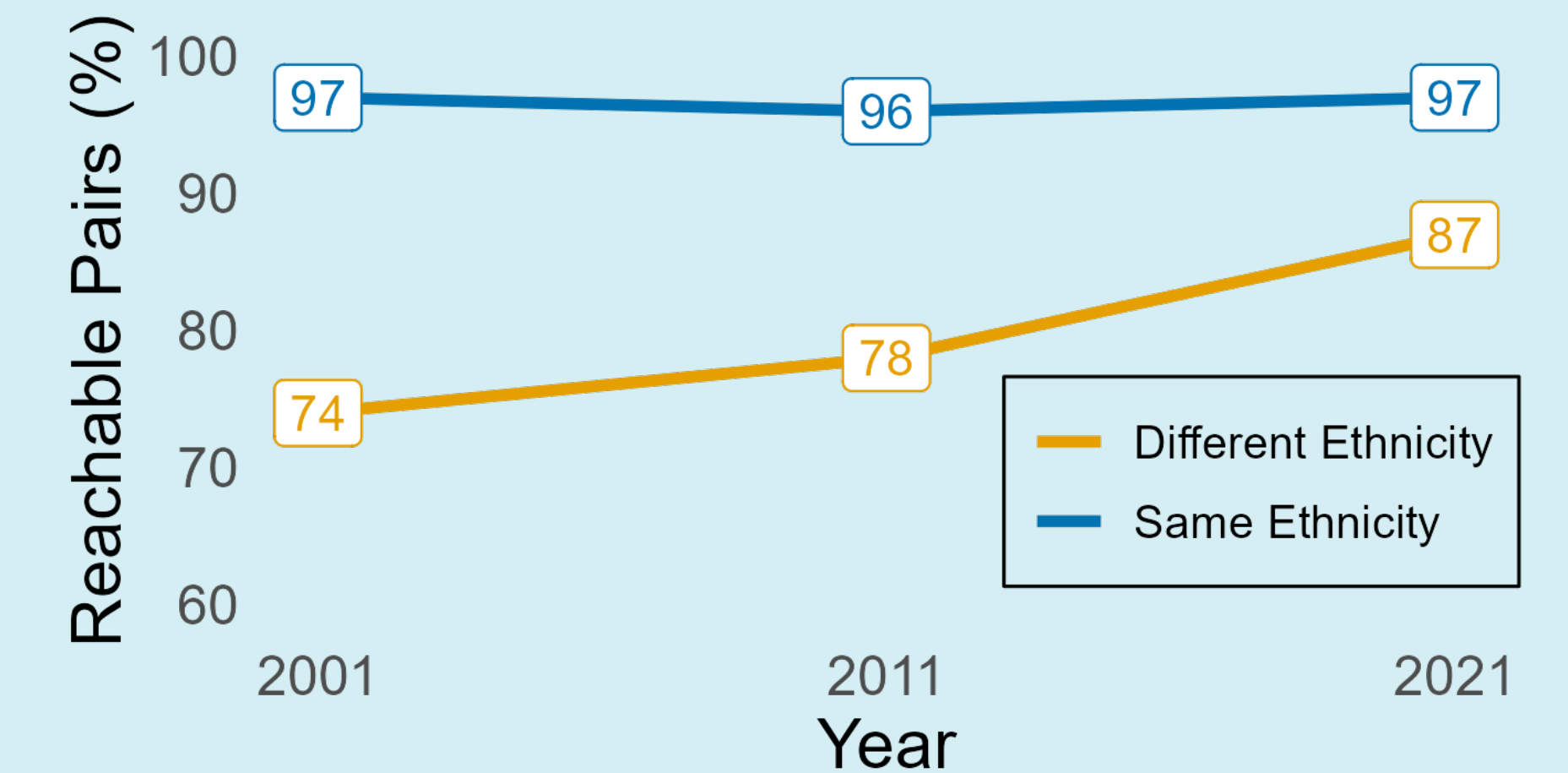
Shortest paths by demographics



- We find **no significant gender differences** in average shortest paths.
- Individuals of different ethnic backgrounds are farther apart, though this gap narrows over time (−20% over 20 years).

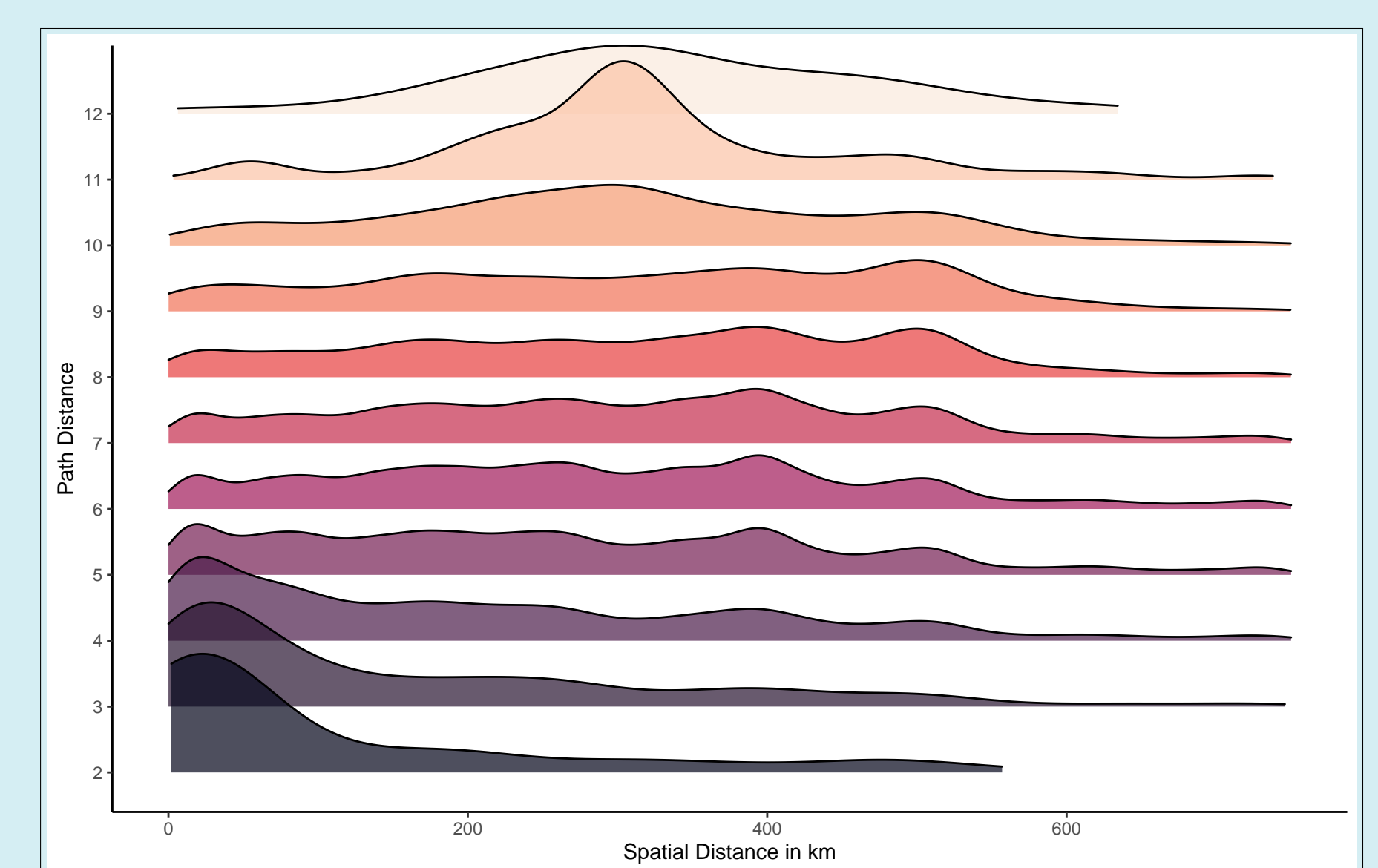
Reach by demographics

Ethnic Groups Are Dramatically Less Isolated Now



We find a significant **increase in reach for individuals from different ethnic groups**. No difference by gender (not shown).

Spatial distance and network distance



- **Close social ties are mostly local**: People connected by short paths tend to live near each other.
- **Longer network paths span greater distances**: Contacts are more geographically dispersed as path distance increases.

Discussion and next steps

- We illustrate the use of multiplex exposure networks at the population scale for the study of integration.
- Our pilot study shows that in Sweden ethnic groups are dramatically less isolated now compared to 20 years ago.
- New measures are needed because population-scale network data is unprecedented.
- We use network distances to assess group exposures and social integration.
- Further possibilities: complex contagion opportunities, cross-cutting social circles.

Notes

1. This project has been funded by the Swedish Research Council (VR) grant 2024-01861.
2. Panayiotou, G., Wohler, I. K., Bask, M., Bask, M., Magnani, M., Mäkinen, I.H. (2025). Anatomy of a Swedish population-scale network.
3. Van der Laan, J., de Jonge, E., Das, M., Te Riele, S., Emery, T. (2023). A whole population network and its application for the social sciences. *European Sociological Review*, 39(1), 145-160.
4. Bokányi, E., Heemskerk, E.M., Takes, F.W. (2023). The anatomy of a population-scale social network. *Scientific Reports*, 13(1), 9209