# Do Social Network Categories Affect Cognitive Functioning of the Elderly?
## Assessing Heterogenities in SHARE.

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Thesis Defence
MSc in Economic and Social Sciences
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April 05, 2025

## Summary

- **Question**: What is the association of Social Network Categories with Cognitive Function? What are the interesting regional heterogenities?
- **Method**: Hierarchical Clustering of Social Networks, OLS Regressions using SHARE
- **Findings**:
  - Network size +vely associated with Cognitive Function:
  - Measuring **quality** of Social Networks is important:
    - All clusters have a higher magnitude of +ve association with Cognitive Function
    - Holding network size constant, clusters with better Geographical and Emotional Proximity; Contact frequency perform better
  - Regions perform differently despite being characterized by the same network category
    - Family-led v/s Institution-led elderly care
    - Historical regime changes- stable v/s rapid

Introduction
○●○

Data
○○

Methodology
○○○

Findings
○○○○

Conclusion
○

References
○○○○

## Background

- Healthy ageing in Europe- focus on degenerative diseases
- Mitigating social isolation a promising way to reduce cognitive decline (Livingston et al., 2017)
- Socioemotional selectivity theory (SST): when perceived future time is limited, people pursue emotionally meaningful goals
    - e.g. seeking smaller but higher quality social networks
- Social networks of older adults see a transformation for many reasons (Cudjoe et al., 2018):
    - migration of children, family, and friends
    - death of network members
    - declining health hindering social engagement
- Compared to the young, older people are more dependent on their social network to meet their emotional and physical needs (Bahramnezhad et al., 2017)
    - e.g. children helping with daily activities and care when ill

## Literature Review

- Social isolation is just as bad for mortality risk as smoking/ pollution exposure/ sedentary living (Holt-Lunstad et al., 2015; Nguyen et al., 2024)
- Network Size is +vely associated with Cognitive Function (Cunha et al., 2024; Kuiper et al., 2016)
- Mixed effects of gender on cognition (Lee et al., 2020; Wolfova et al., 2024)

Lack of literature that examines the quality of social networks, and its association with cognitive function

Examine regional heterogenities

Introduction
000

Data
●0

Methodology
000

Findings
0000

Conclusion
0

References
0000

## About SHARE

- Survey of Health, Ageing and Retirement in Europe (SHARE)
- Bi-annual survey from 2004-05; Cross-section from 2021-2022 (Wave 9) with $N \sim 70000$ used
- Covers 28 countries in Europe and West Asia
- Target population has Age $\geq$ 50 yrs (Born $\leq$ 1971)

Table: Variables in 3 modules of SHARE:

| SN | CF | GV |
|---|---|---|
| network members | verbal fluency | age |
| relation | memory | yrs of edu |
| emotional proximity | | gender |
| geographical proximity | | |
| contact frequency | | |

Introduction
ooo

Data
o●

Methodology
ooo

Findings
oooo

Conclusion
o

References
oooo

## Cognitive Function (CF) Module

**Verbal Fluency**

- Objective measure; Score from 0-100 based on a timed animal naming task
- Simple task but standard in the literature
    - Respondents cannot repeat animal names- requires monitoring and controlling thoughts- key to cognition (Sutin et al., 2019)

**Memory**

- Subjective measure; self-reported score from 1-5 where one is poor and five is excellent
- Evidence of self-reported memory complaints as a strong predictor of cognitive impairment (Verdelho et al., 2011)
- Limitation: region-specific under/over-estimation of own memory

Introduction
○○○

Data
○○

**Methodology**
●○○

Findings
○○○○

Conclusion
○

References
○○○○

# Social Network Clustering
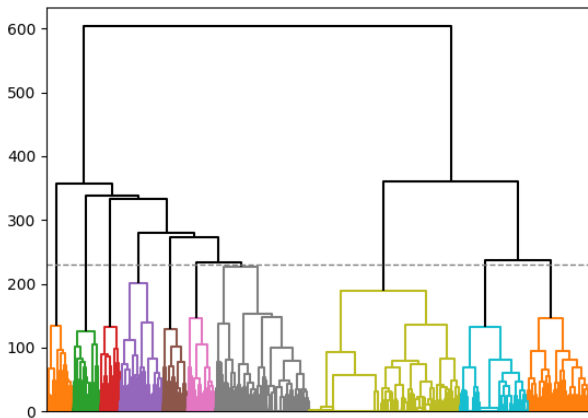


Agglomerative Clustering

- minimize dissimilarity between observations within cluster
- maximize distances between clusters

**Ward's method** (minimum variance criterion)- ensures within cluster similarity
Joining higher up in the dendogram- more different

Introduction
000

Data
00

Methodology
0●0

Findings
0000

Conclusion
0

References
0000

## Cluster Interpretation

|                 | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| n_size          | 4.0 | 4.2 | 4.2 | 4.0 | 3.5 | 3.3 | 4.1 | 1.7 | 0.9 | 2.6 |
| n_kin           | 3.3 | 3.7 | 2.6 | 2.3 | 2.6 | 2.6 | 3.3 | 1.6 | 0.7 | 1.7 |
| n_nonkin        | 0.8 | 0.5 | 1.6 | 1.7 | 0.8 | 0.7 | 0.8 | 0.1 | 0.2 | 0.9 |
| n_child         | 0.9 | 1.4 | 1.1 | 1.0 | 1.4 | 1.5 | 1.9 | 0.5 | 0.5 | 1.2 |
| n_parent        | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| n_inlaw         | 0.1 | 1.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| n_partner       | 0.7 | 0.5 | 0.5 | 0.6 | 0.5 | 0.5 | 0.9 | 1.0 | 0.0 | 0.0 |
| n_male          | 1.1 | 1.1 | 1.2 | 1.3 | 0.8 | 0.7 | 1.0 | 0.5 | 0.1 | 0.3 |
| n_female        | 2.0 | 1.7 | 1.9 | 1.8 | 1.3 | 1.2 | 1.3 | 0.7 | 0.2 | 1.0 |
| n_close_very    | 3.6 | 3.7 | 2.9 | 2.5 | 3.0 | 3.0 | 3.9 | 1.5 | 0.8 | 2.2 |
| n_close_avg     | 0.5 | 0.5 | 1.3 | 1.5 | 0.5 | 0.3 | 0.2 | 0.2 | 0.1 | 0.4 |
| n_daily         | 0.5 | 1.0 | 0.3 | 0.4 | 0.6 | 0.6 | 0.9 | 0.2 | 0.3 | 0.8 |
| n_weeks         | 1.4 | 2.1 | 1.6 | 2.1 | 2.0 | 2.0 | 2.2 | 0.3 | 0.3 | 1.7 |
| n_monthly       | 0.1 | 0.1 | 0.5 | 0.8 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| n_rarely        | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| n_prx_location  | 0.9 | 1.2 | 0.7 | 0.7 | 0.7 | 0.7 | 1.0 | 1.2 | 0.3 | 0.2 |
| n_prx_city      | 0.7 | 1.2 | 1.0 | 1.2 | 0.6 | 0.5 | 1.0 | 0.2 | 0.3 | 1.2 |
| n_prx_district  | 0.8 | 1.1 | 1.5 | 1.4 | 0.7 | 0.6 | 1.0 | 0.2 | 0.2 | 1.0 |
| n_prx_region    | 0.2 | 0.2 | 0.5 | 0.3 | 0.2 | 1.5 | 0.1 | 0.0 | 0.0 | 0.0 |
| n_prx_far       | 0.1 | 0.1 | 0.2 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Introduction
○○○

Data
○○

**Methodology**
○○●

Findings
○○○○

Conclusion
○

References
○○○○

# Cluster Interpretation

- C1: Kin dominated SN including parent (parent, child, partner, friend)
- C2: Kin-dominated SN including in-laws
- C3: Large SN of family and friends, including not close people who are rarely contacted
- C4: Equal friends and family (2 each) within the district; includes not close people contacted in weeks/month
- C5: A child/spouse at home and two others (kin + friend) over 500 km away
- C6: A child/spouse at home and two others (kin + friend) 100-500 km away
- C7: Spouse/partner, two children and a friend living within the district
- C8: Only Spouse/cohabiting partner (very close, kin is partner, live in the same house)
- C9: Isolated respondents (smallest SN size of 0.9)
- C10: Children and a friend from same city/district

Introduction
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Data
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Methodology
000

Findings
●000

Conclusion
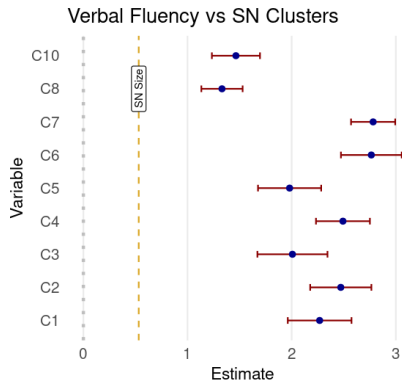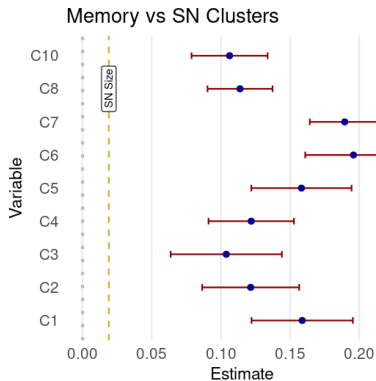0

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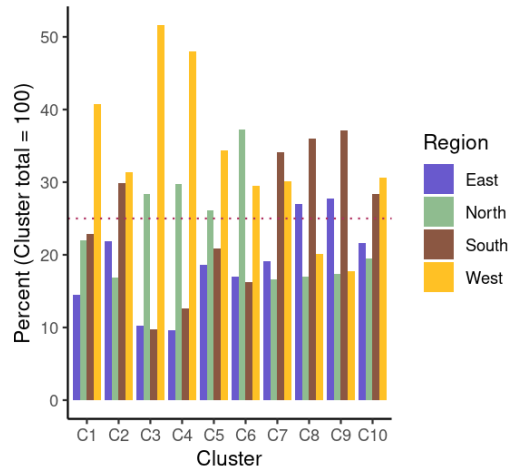
## Does CF improve with larger SN size?

$$CF_i = \beta_0 + \beta_1 SN\_size_i + \gamma_1 Age_i + \gamma_2 Education_i + \gamma_3 Female_i + u_i$$

| Dependent Variables: | Memory | | Verbal Fluency | |
|---|---|---|---|---|
| Model: | (1) | (2) | (3) | (4) |
| *Variables* | | | | |
| Constant | 4.316*** | | 28.87*** | |
| | (0.0290) | | (0.2468) | |
| SN Size | 0.0285*** | 0.0190*** | 0.7333*** | 0.5316*** |
| | (0.0020) | (0.0042) | (0.0173) | (0.0478) |
| Age | -0.0245*** | -0.0252*** | -0.2229*** | -0.2371*** |
| | (0.0004) | (0.0012) | (0.0030) | (0.0099) |
| Yrs of Edu | 0.0278*** | 0.0307*** | 0.4691*** | 0.3625*** |
| | (0.0008) | (0.0035) | (0.0071) | (0.0291) |
| Female | -0.0080 | 0.0080 | -0.1108* | -0.1413 |
| | (0.0068) | (0.0120) | (0.0580) | (0.1189) |
| *Fixed-effects* | | | | |
| Country | | Yes | | Yes |
| *Fit statistics* | | | | |
| Observations | 68,145 | 68,145 | 67,323 | 67,323 |
| $R^2$ | 0.10132 | 0.16032 | 0.18566 | 0.26932 |
| Within $R^2$ | | 0.10889 | | 0.16384 |

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Introduction
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Data
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Methodology
000

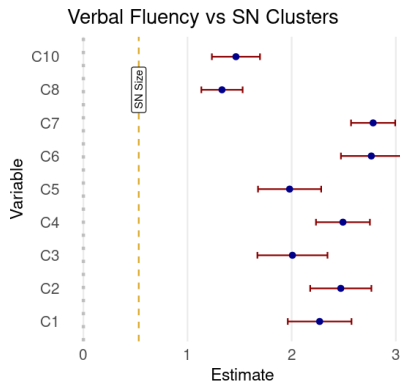Findings
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Conclusion
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References
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## Do SN categories affect CF?

$$CF_i = \beta_0 + \beta_1 Cluster_i + \gamma_1 Age_i + \gamma_2 Education_i + \gamma_3 Female_i + \gamma_4 Region + u_i$$
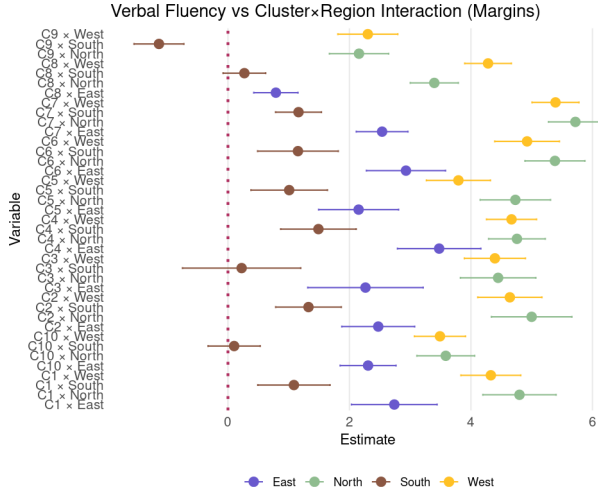


Memory vs SN Clusters

Verbal Fluency vs SN Clusters

Introduction
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Data
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Methodology
000

Findings
0000

Conclusion
0

References
0000

## Quality of SN matters more for Cognition

$$CF_i = \beta_0 + \beta_1 Cluster_i + \gamma_1 Age_i + \gamma_2 Education_i + \gamma_3 Female_i + \gamma_4 Region + u_i$$

- SN Categories are more strongly associated with CF: 5x for Memory, 3x for Verbal Fluency
- Clusters with large network sizes, mix of family and friends perform better on cognition
- Holding network size constant, having network members who are rarely contacted/ less emotionally close is disadvantageous (C3 v/s C4)
- Having members who live further is disadvantageous (C5 v/s C6)



Verbal Fluency vs SN Clusters

Introduction
ooo

Data
oo

Methodology
ooo

Findings
ooo●

Conclusion
o

References
oooo

## Within-cluster Regional Heterogeniety



Verbal Fluency vs Cluster×Region Interaction (Margins)

- Clear pattern: Within each cluster West/North > East > South
- Consider C9, most isolated cluster.
  South: family-led care; worse
  North: institution-led care even when isolated
- Historical regime changes- stable v/s rapid

## Conclusion and Discussion

Future Research

- Examine more objective measures of CF
- Examine cognitive decline- do social networks remain relevant after accounting for baseline cognition?

Contribution

- Quality of social network matters
- Regional heterogenieties teach us that institution-led elderly care is important for the most socially isolated.

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Introduction
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Data
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Methodology
000

Findings
0000

Conclusion
0

References
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Introduction
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Data
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Methodology
ooo

Findings
oooo

Conclusion
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References
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Introduction
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Data
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Methodology
ooo

Findings
oooo

Conclusion
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References
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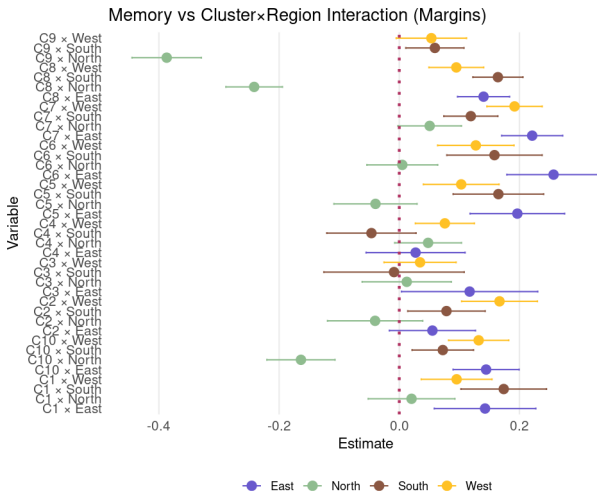https://doi.org/10.3233/JAD-2011-110494

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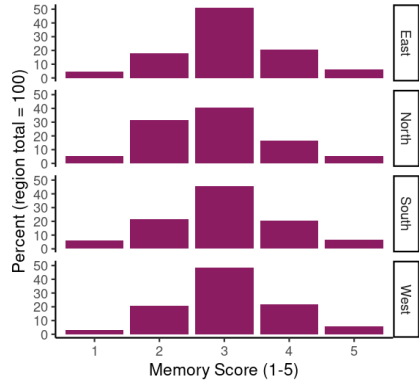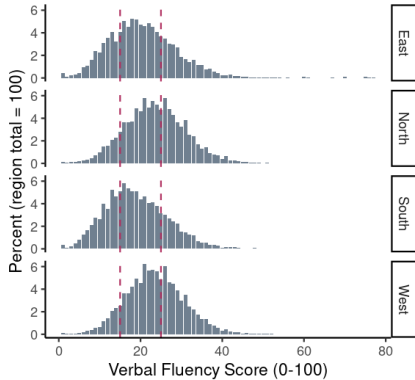
# Appendix: Within-cluster Regional Heterogeniety



Memory vs Cluster×Region Interaction (Margins)

- Differences in CF despite being characterized by the same SN
- No monotonic regional pattern though
- Self-reporting: **region-specific benchmarks** of memory may lead participants to under- or over-report their memory