

Uncovering Countries' Science Interest Structure Using a Psychometric Network Approach

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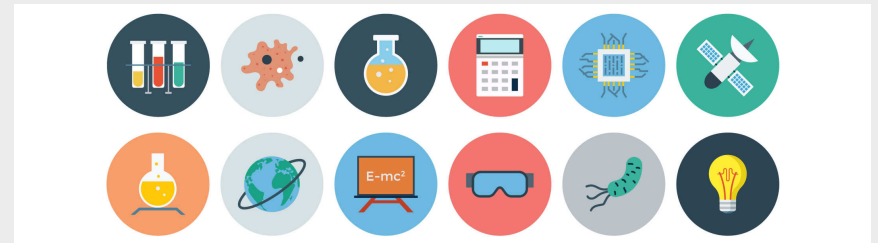


Lifelong learning

What is interest? (e.g., Renninger & Hidi, 2011)

■ Content-specific

(e.g., Holland, 1985/1997;
Krapp et al., 1992; Silvia, 2006)



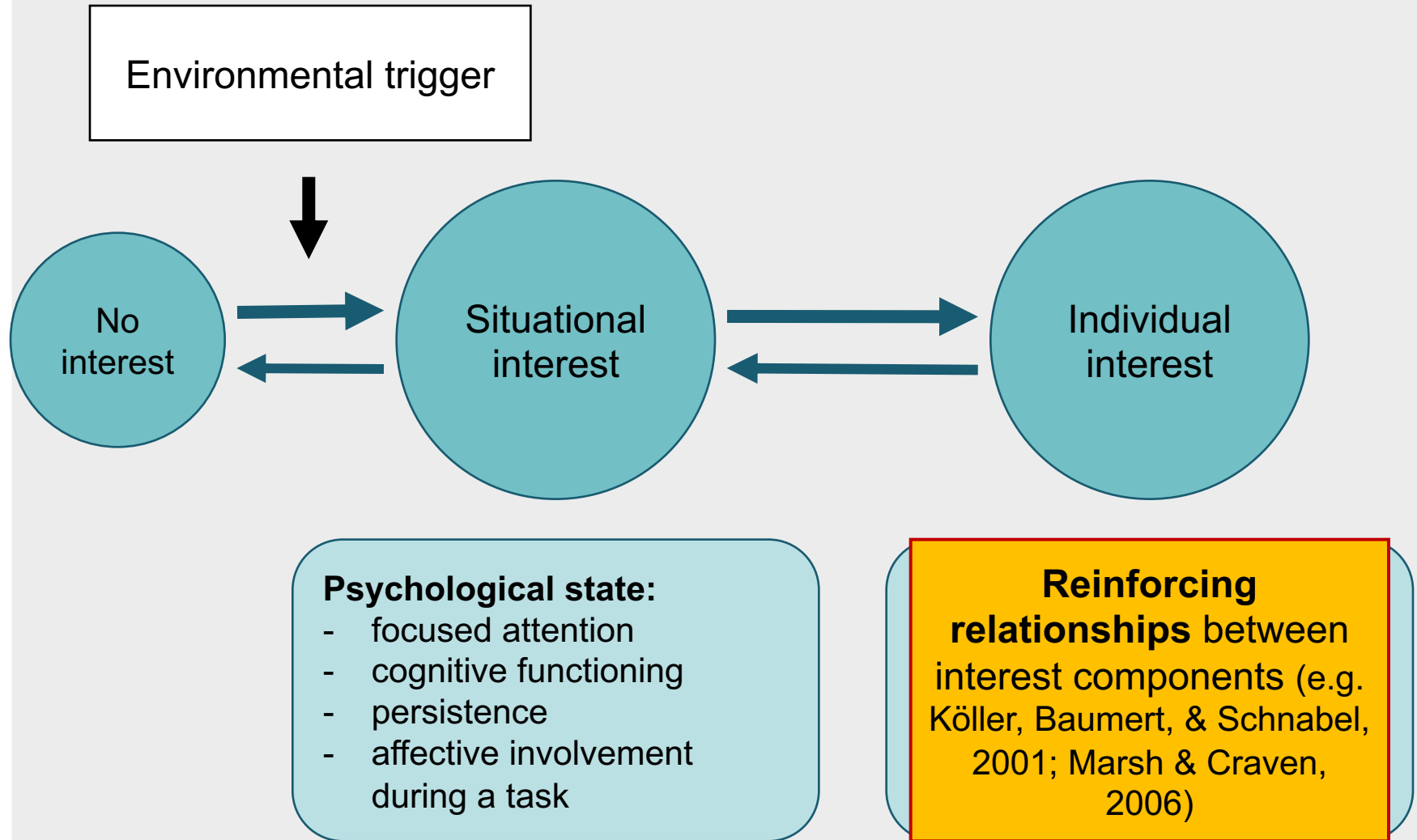
■ Emerging through *interaction* of individual with environment

(e.g., Barron, 2006; Sansone & Thoman, 2005;
Schiefele et al., 1983)



■ Affective & cognitive components

(e.g., Ainley, Hidi, & Berndorff, 2002; Harp & Mayer, 1997; Renninger & Wozniak, 1985)

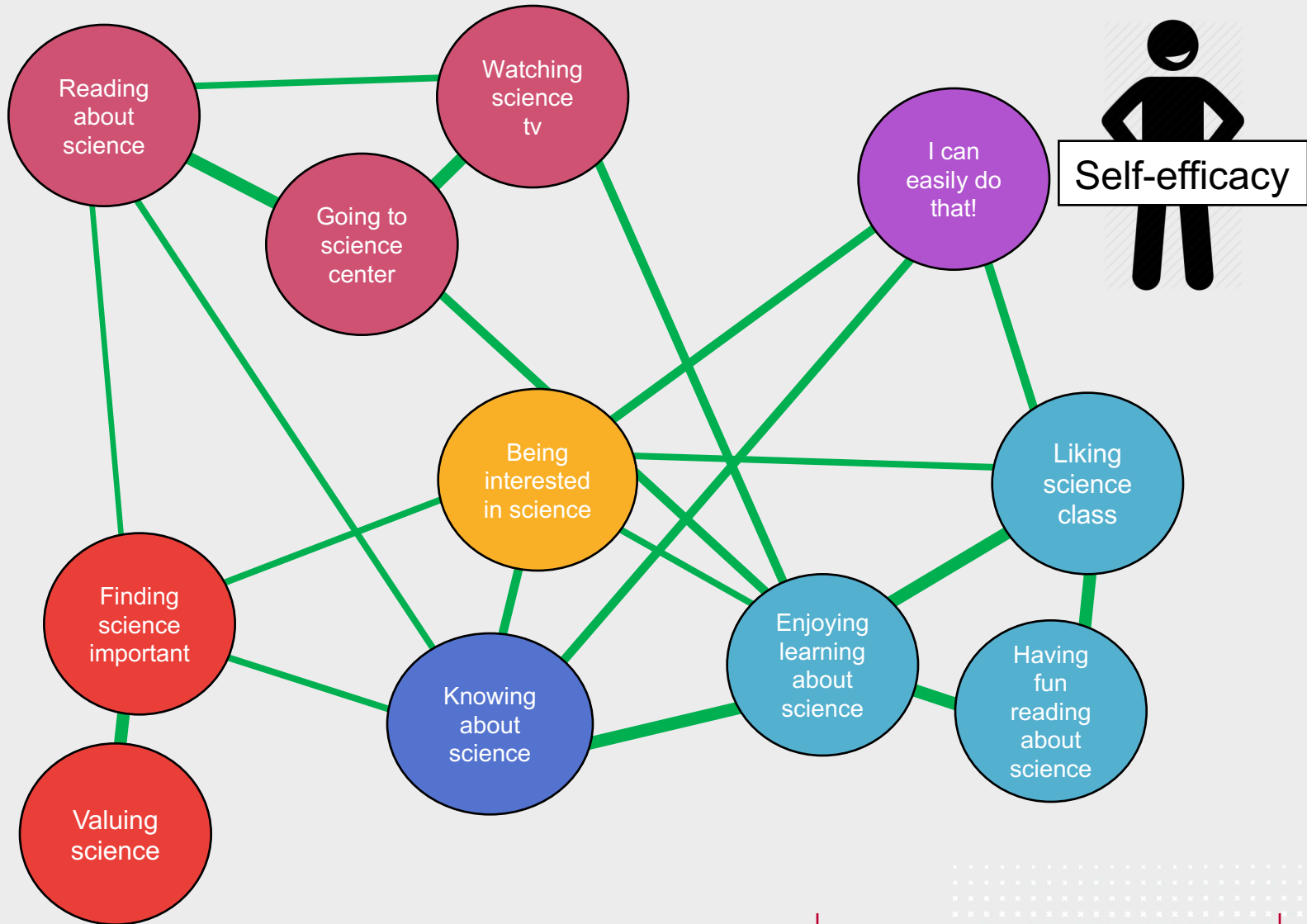


Interest as dynamic relational construct (Ainley, 2017)

- **Dynamic systems theory** (e.g., Lewis & Granic, 2000; Thelen & Smith, 2007): individual as a self-organizing system

- Past interactions & expectations of future interactions

➔ **Relative importance** of interest components
(Ainley, 2010; Ainley & Hidi, 2014)



Science interest as network

- **Interacting indicators** of interest components and closely related motivational components **constitute** science interest
 - Components: (positive) affect, engagement with the object of interest, value components and knowledge
 - Self-efficacy (belief one is able to do something)
 - Reciprocal relationship with interest (Nieswandt, 2007)

Goals

1. Uncovering structure of interactions between indicators across countries
2. Predicting which indicator(s) are of structural importance within each country

Country differences (Inglehart & Baker, 2000; Inglehart & Wenzel, 2005)

■ Low vs. high income countries:

- Role of **knowledge**: interest & knowledge positively related only in higher income countries (Ainley & Ainley, 2011; Tucker-Drop, Cheung & Briley, 2014)
- Difference in **opportunities to engage** with sciences / topic of interest

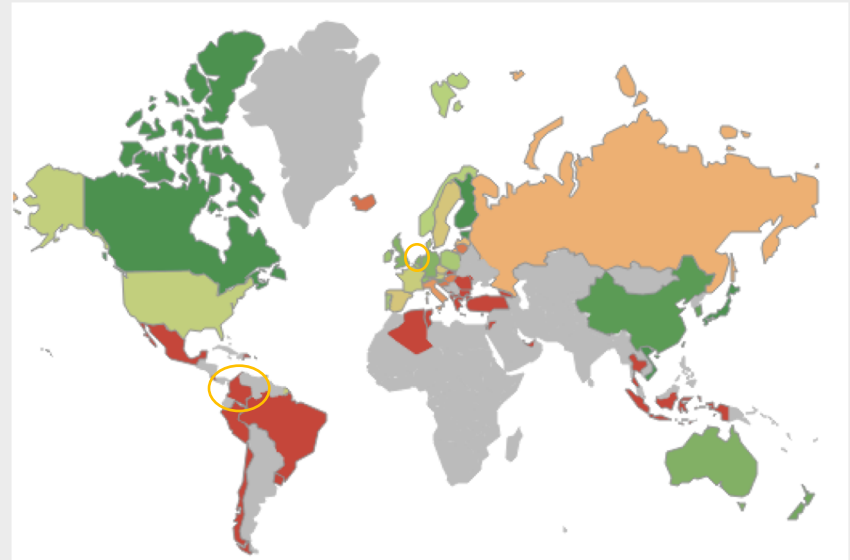
Hypotheses

1. Science interest structure different depending on country
 - Role of knowledge
2. Different indicators of importance

Data: PISA 2015

■ Programme for International Student Assessment (PISA)

- International survey testing the skills and knowledge of 15-year-old students
- Focus 2015: Scientific literacy – including measures of science interest



Scientific literacy of participating nations

Data: PISA 2015

■ Participants

□ Dutch:

HAVO/VWO students: 2129 (1149 girls, 980 boys) students in total, with a mean age of 15.73 years ($SD = 0.29$).

□ Colombian:

Upper secondary school students: 5557 (3151 girls, 2406 boys) in total, with a mean age of 15.88 years ($SD = 0.28$).



Data: PISA 2015

■ Science interest measures

● Enjoyment

I am happy working on broad science topics

● Interest

I am interested in... The Universe and its history

● Value (instrumental)

Many things I learn in my school science subject(s) will help me to get a job

● Behavior

I (often) ... Watch TV programmes about broad science

● Self-efficacy

I could (easily) ... Describe the role of antibiotics in the treatment of disease

● Knowledge

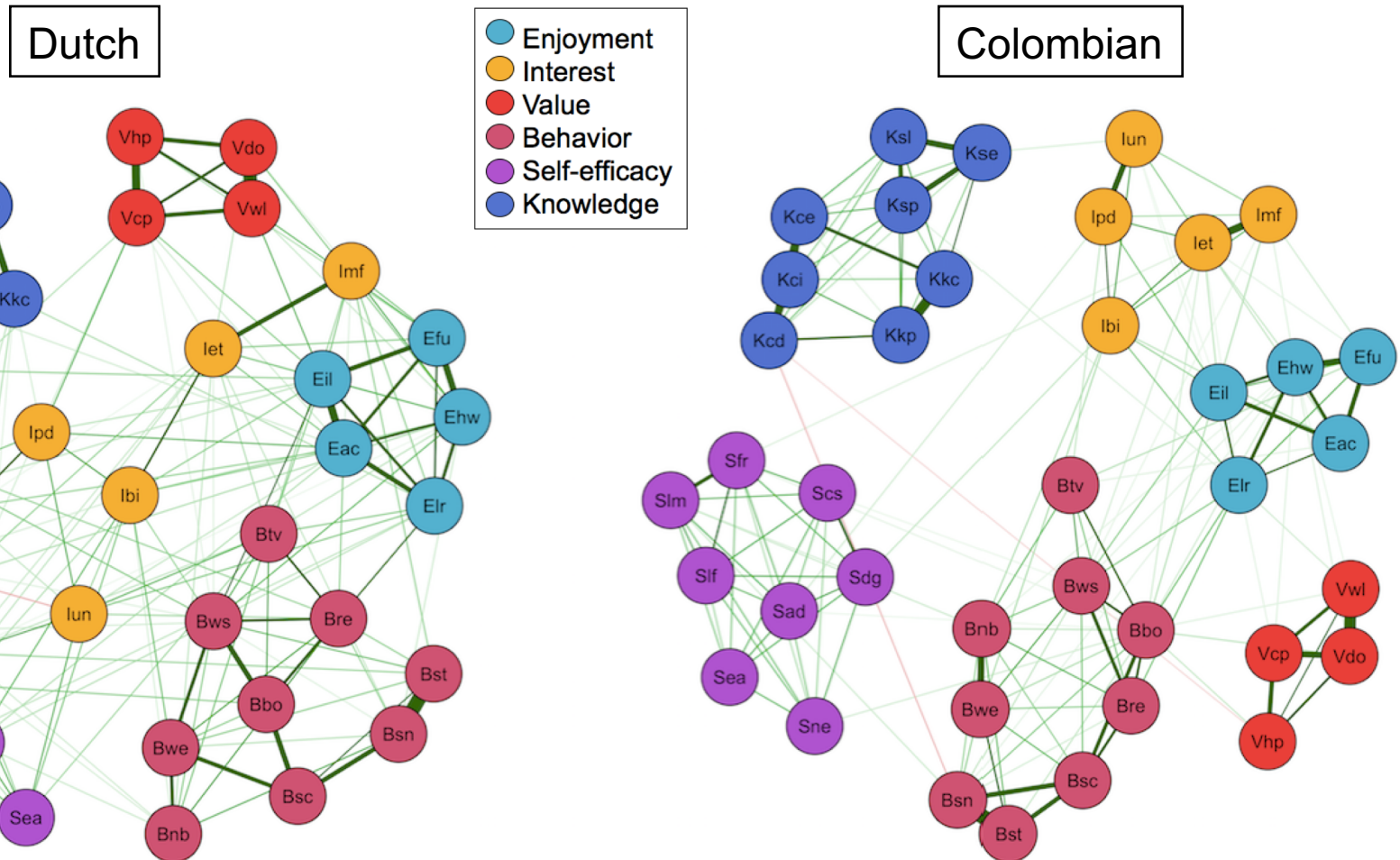
Knowledge Subscale of Science - Content

Methods

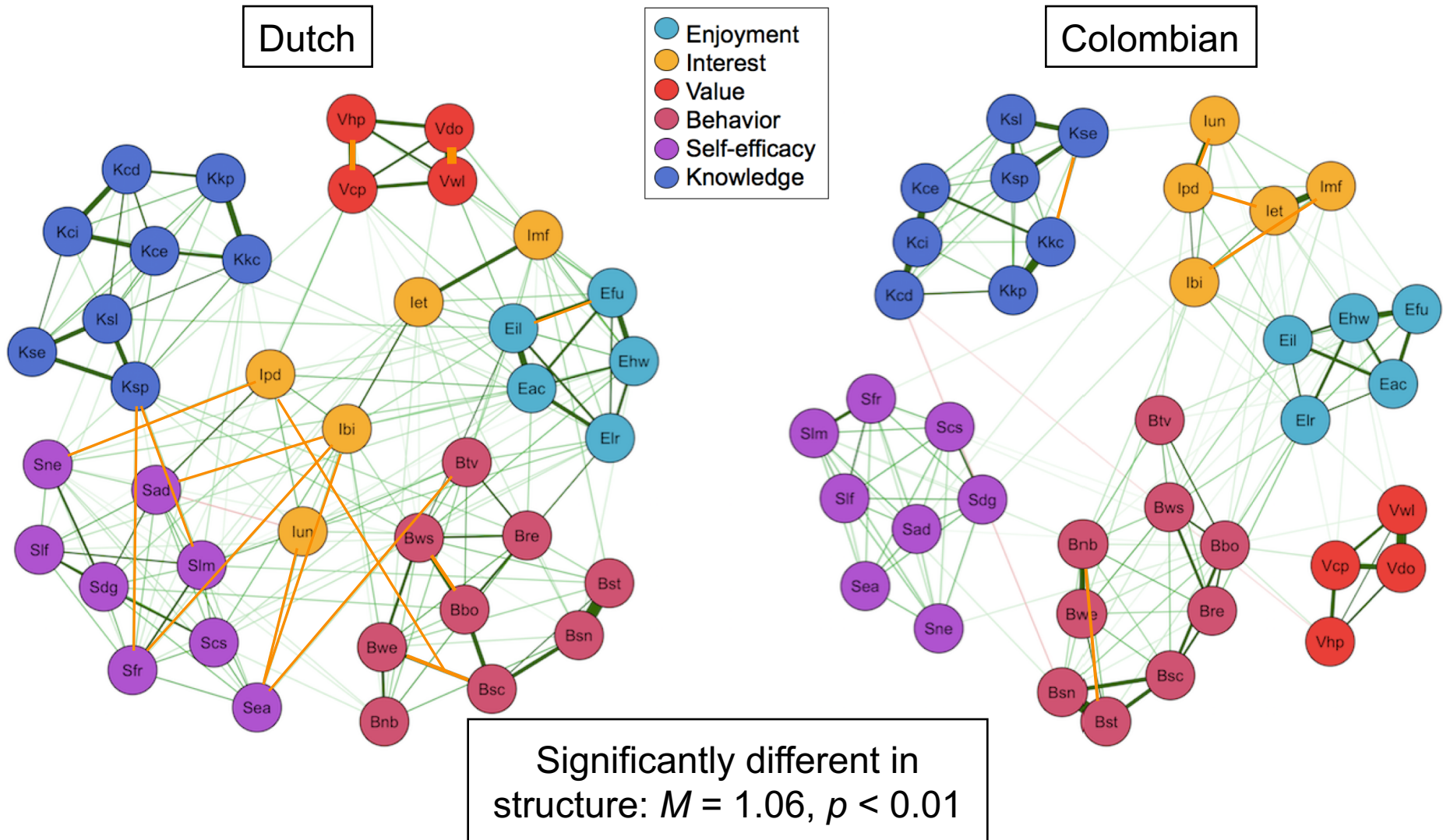
■ Network analysis:

- Network comparison (van Borkulo et al., 2016)
- Cluster detection (Pons & Latapy, 2005)
- Structural importance – strength (Barrat et al., 2004; Freeman, 1978; Opsahl et al., 2010)

Network estimation

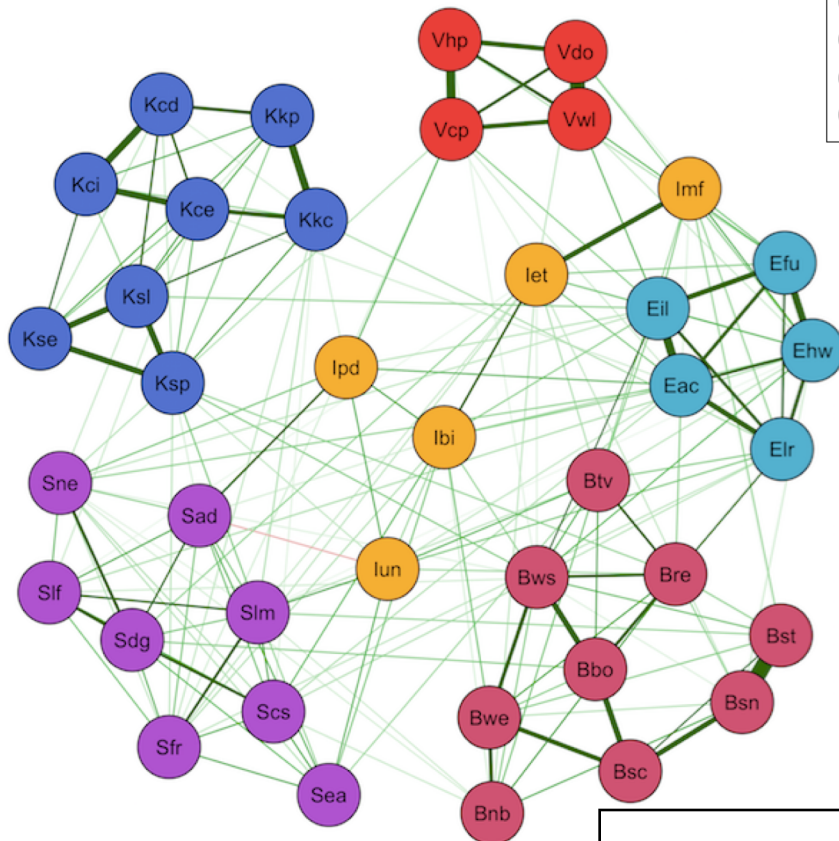


Network comparison: Structure

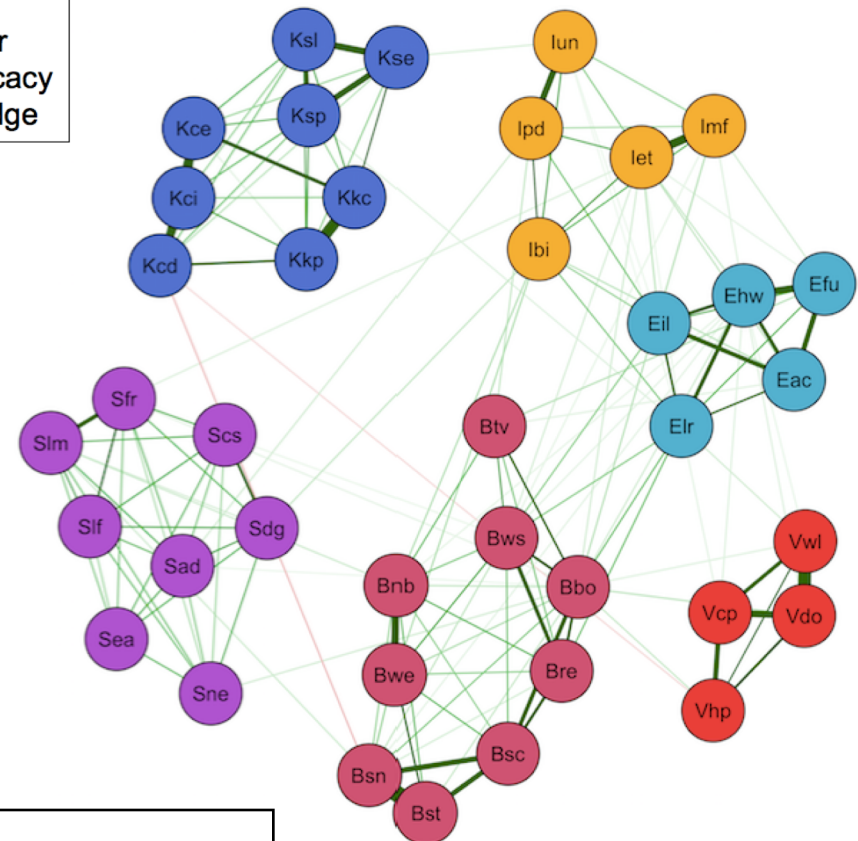


Network comparison: Global strength

Dutch



Colombian

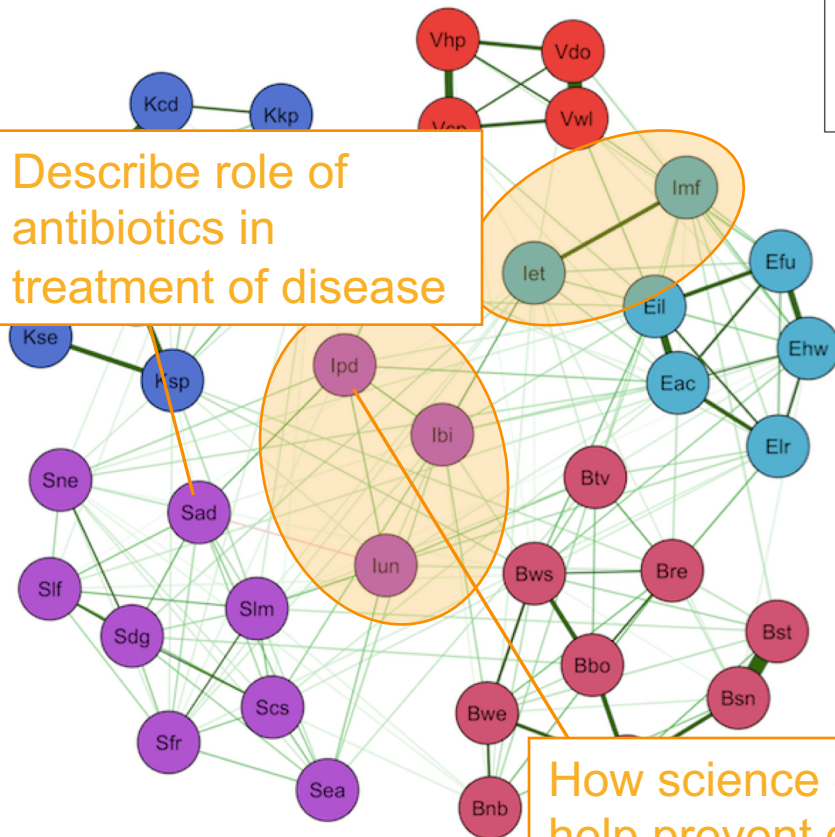


Significantly different in strength: $S = 9.37$, $p < 0.01$

Cluster detection

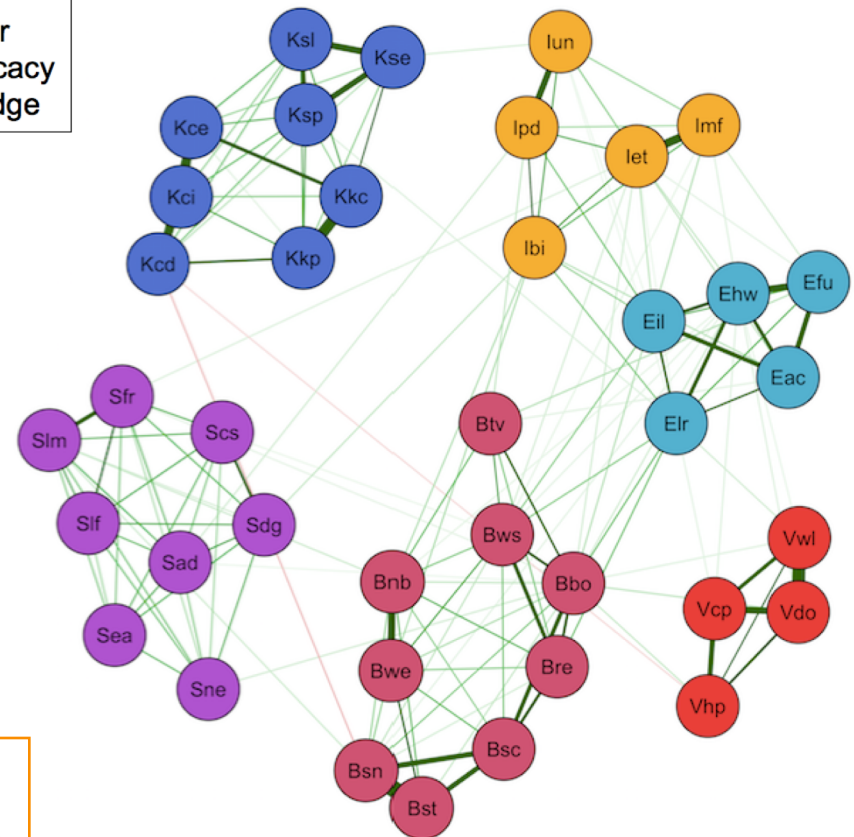
Dutch

Describe role of antibiotics in treatment of disease



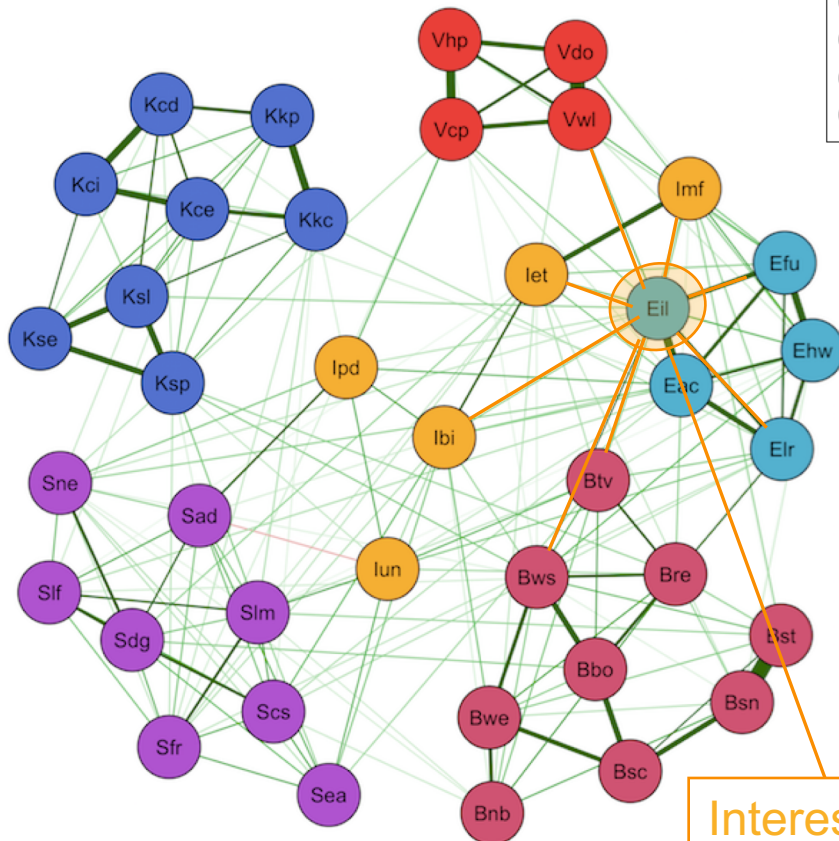
How science can help prevent disease

Colombian



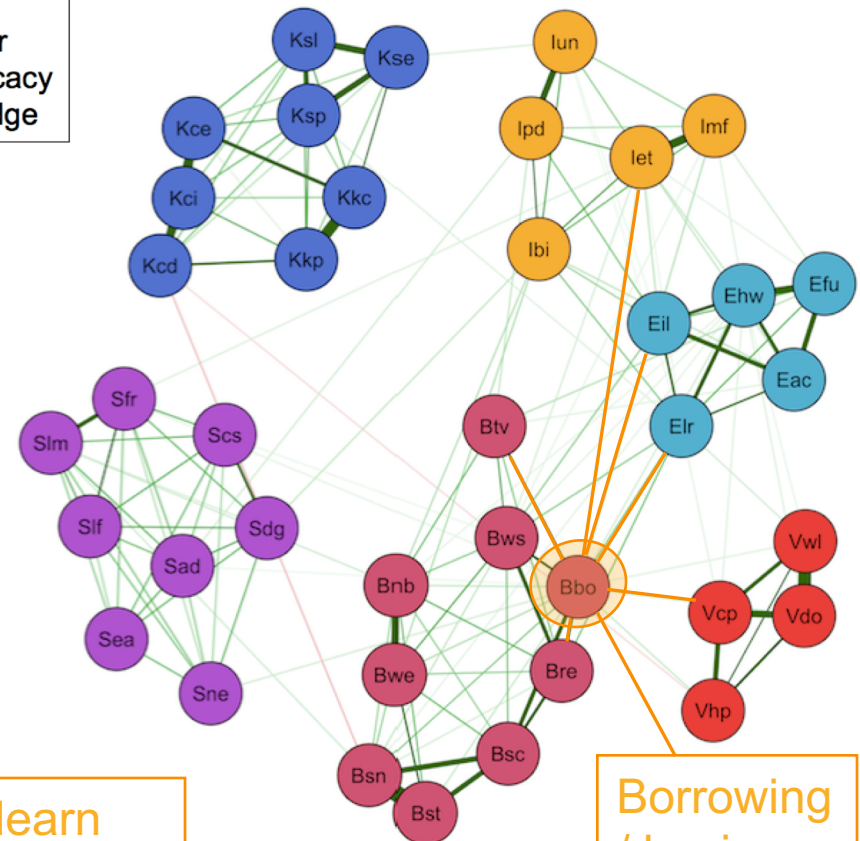
Structural importance: Strength

Dutch



Interested to learn
about science topics

Colombian



Borrowing
/ buying
books

Theoretical implications

- Important structural differences exist in the interest network across countries
 - Indication of differences in domain-specificity
 - More inter-cluster correlations & higher global connectivity in Dutch network
 - Indication of more **mutual interactions** between components
 - Likely higher synergistic effects

Practical implications

- Network approach *sensitive* to cultural differences
 - Different routes to possible interventions:
 - Netherlands: Enjoyment
 - Colombia: Behavior
 - importance of access to opportunities to engage with science



Limitations

- Using existing data set:
 - Cross-sectional data: no causal inferences
 - Items not optimal given theory-driven approach of network analysis (relevance is more important than internal consistency)
 - Personal value items: measuring instrumental motivation
 - Difference in domain-specificity of items

Future outlook

- Using network approach to model **dynamics** of interest development

Major challenge for psychological interest research lies in the identification of combinations of interest components indicative for different levels of interest development

(Ainley, 2017; Renninger & Hidi, 2011)

- ➔ Applying network approach to longitudinal (intervention) data set
- ➔ Personalized network modeling (e.g., Ecological Momentary Assessment)

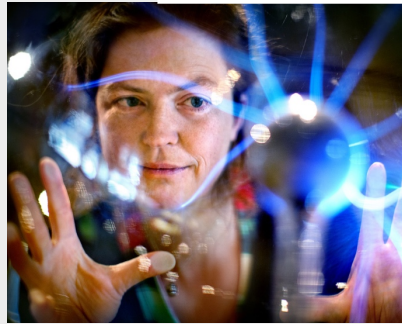
Thank you!

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Introducing a Science Interest Network Model to Reveal Country Differences

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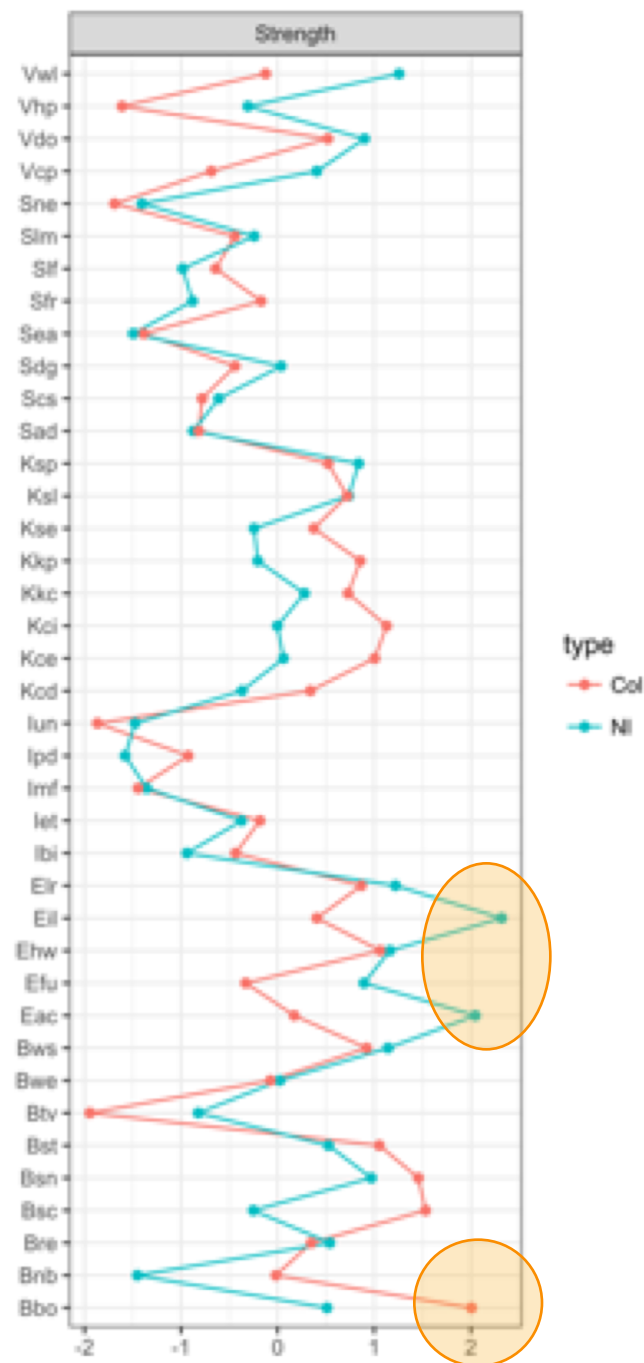
Methods

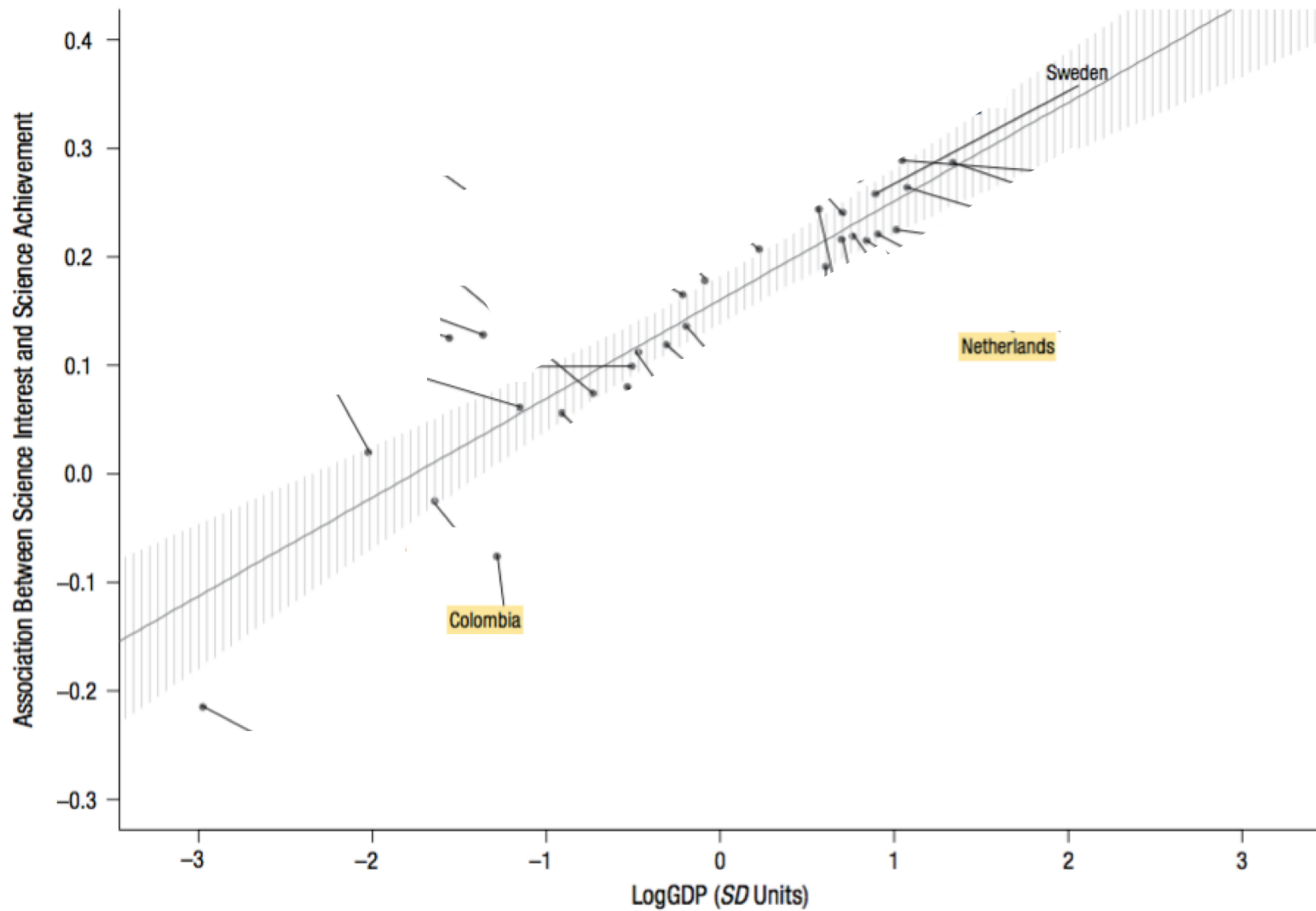
Network estimation:

- All variables binarized

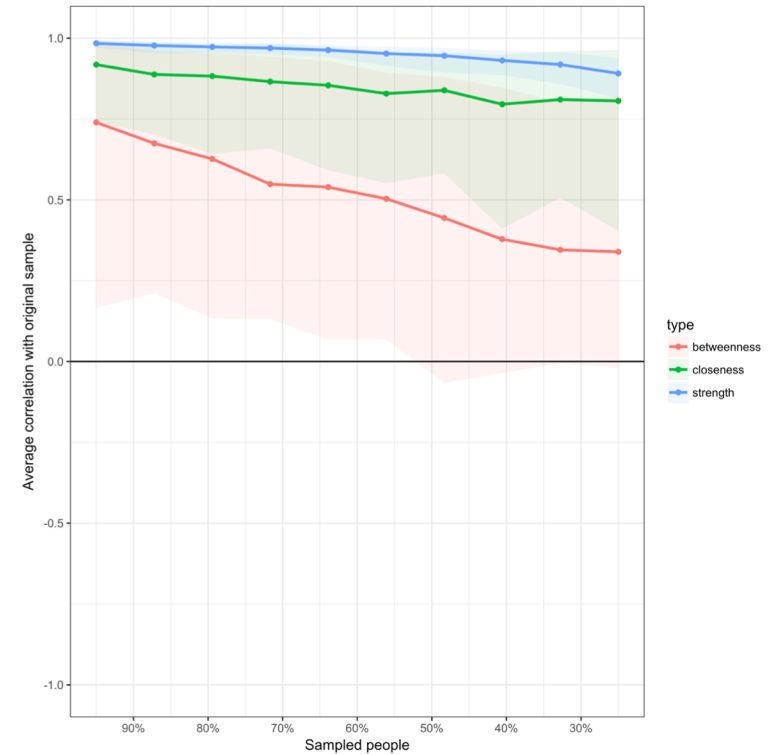
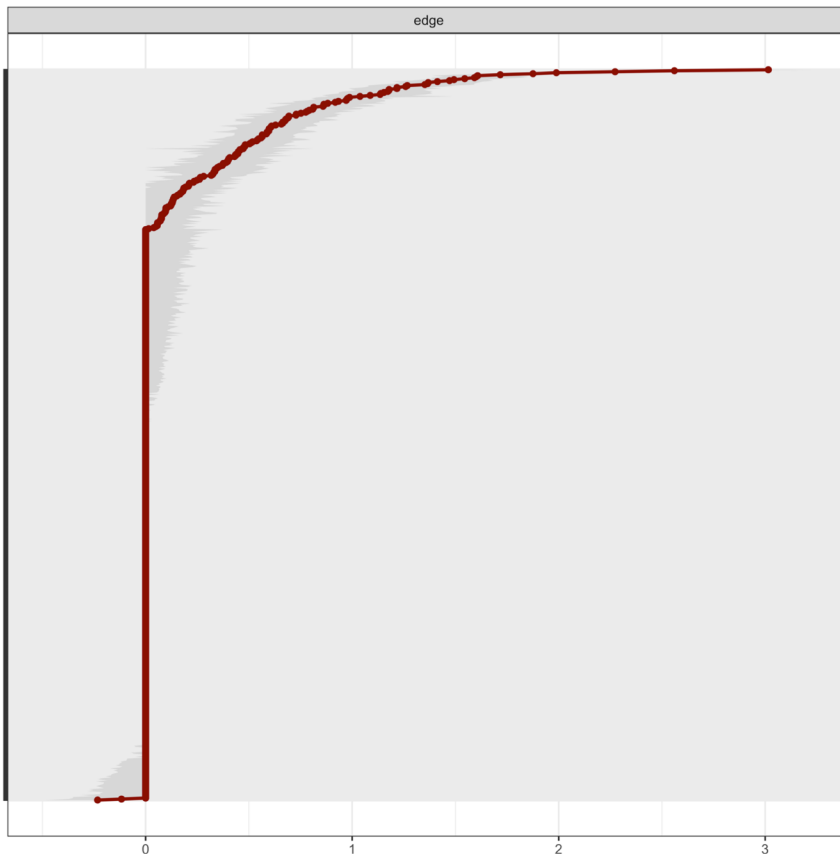
- Ising fit: eLasso procedure (type 1 error reduction)

- Fruchterman-Reingold algorithm (Fruchterman & Reingold, 1991): nodes with strong/more connections in center





Network stability Netherlands



Network stability Colombia

