

Psychometric network analysis of risk perceptions



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Summary

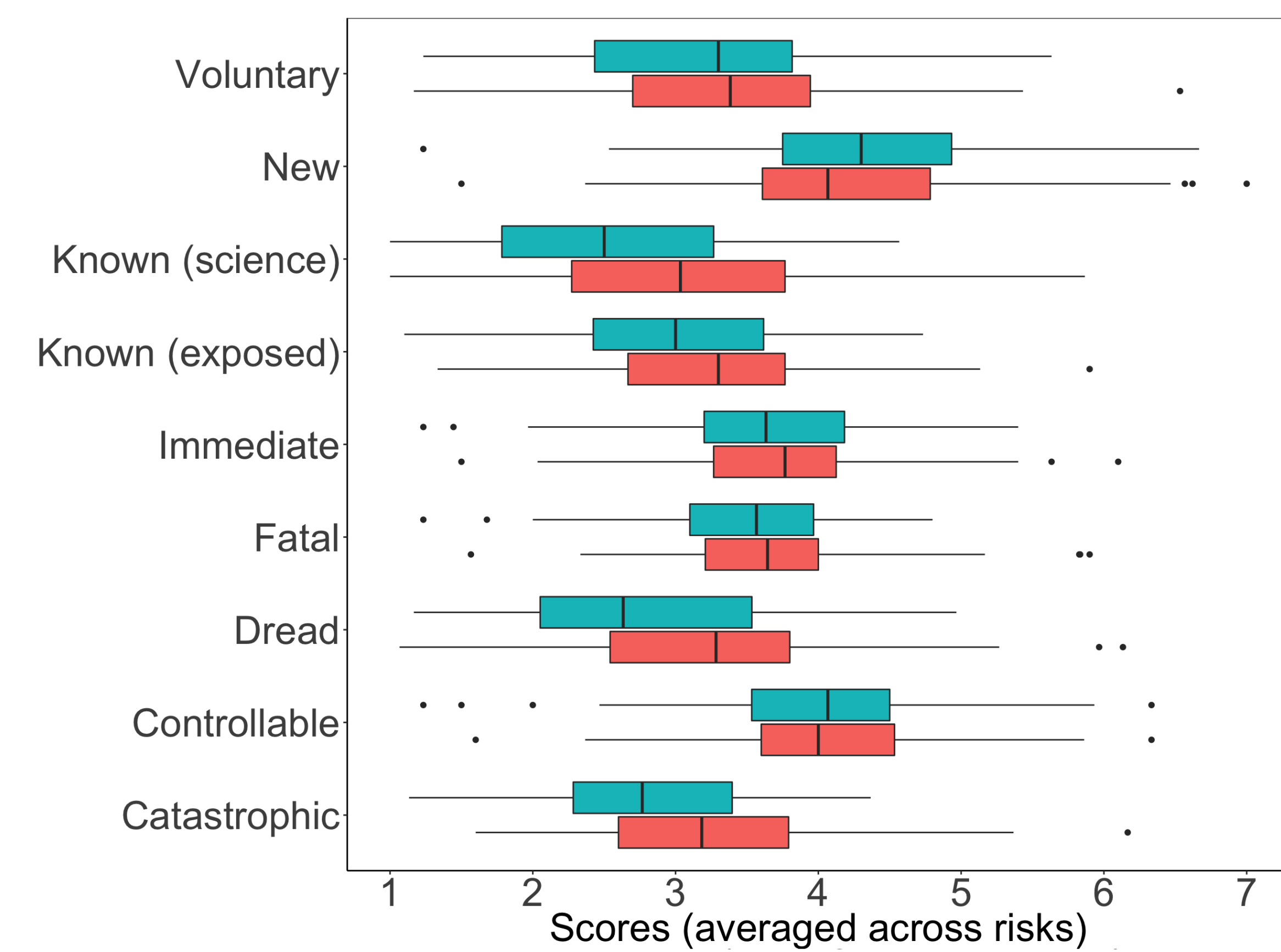
The extent to which activities and technologies are perceived to be risky depends on in part on domain and individual differences. The present study extended previous research on the structure of risk perceptions (Fischhoff et al., 1978) by modeling observed variables as reciprocally causal of each other (as opposed to sharing an unobservable, common cause). The degree to which a risk is perceived to be understood by scientists was the most central node in the network model, though not significantly more so than surrounding nodes (e.g., fear, severity). There were noticeable structural differences in the risk perception networks for individuals with high vs. low numeracy, but stability estimates were less than ideal. A larger sample is required to make robust conclusions.

Method

- 355 undergraduates in the research participation pool completed the study
- Participants reported risk perceptions and emotional responses to the 30 activities/technologies from Fischhoff, Slovic, Lichtenstein, Read & Combs (1978)
- Numeracy was measured with 4 items from the Berlin Numeracy Test (Cokely et al., 2012) and 3 items from Schwartz et al. (1997)

Analysis

- Regularized partial correlation networks were estimated on scores averaged across risks using graphical LASSO (Epskamp & Fried, 2018)
- Network models were estimated on the full sample and subsets of individuals with high vs. low numeracy. Bootstrapping procedures were used to assess the stability of edge weights and centrality criteria.



Distributions of scores for participants with high vs. low numeracy

Less numerate people were more likely to report risks as catastrophic ($p < .001$), dread ($p < .001$), and known by scientists ($p < .001$) and those exposed to the risk ($p < .01$). Scores varied between risks

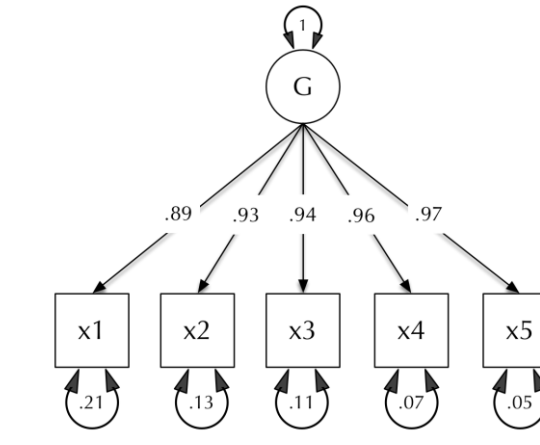
Numeracy
■ High
■ Low

Average risk perception scores by risk

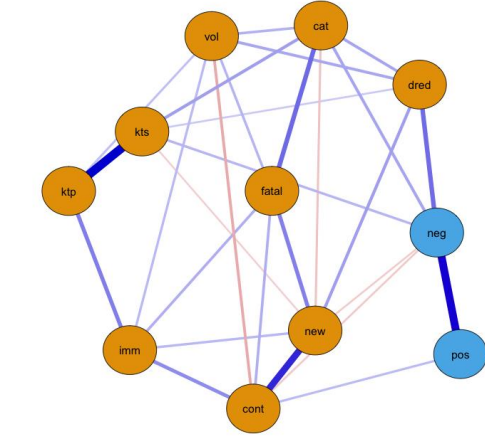
Risk	vol	imm	ktp	kts	cont	new	cat	dred	fatal
Alcoholic beverages	2.94	4.23	2.95	2.59	4.72	5.26	2.92	2.95	4.07
Aviation (commercial)	3.45	2.85	3.03	2.78	3.32	3.88	4.33	3.39	3.96
Aviation (general)	3.16	3.04	3.00	2.84	3.81	3.85	3.41	3.14	3.89
Bicycles	2.75	3.31	2.54	2.54	4.39	4.84	2.26	2.37	2.72
Contraceptives	3.05	4.40	3.05	2.69	4.21	3.78	2.57	2.67	2.95
Electric power	3.61	3.34	3.10	2.85	3.84	3.93	3.10	2.85	3.44
Fire fighting	3.28	3.38	2.94	2.89	3.91	4.97	3.59	3.28	3.94
Food coloring	3.28	4.60	3.68	2.89	3.99	3.60	2.42	2.40	2.41
Food preservatives	3.60	4.71	3.75	3.07	3.97	3.51	3.36	2.92	3.28
Handguns	3.75	2.81	3.09	2.86	4.24	4.73	4.35	4.11	4.68
Football	2.97	4.31	3.26	2.87	4.13	4.02	2.64	2.83	3.28
Home appliances	3.21	3.66	3.00	2.90	4.22	4.04	2.39	2.38	2.66
Hunting	2.99	3.15	2.83	2.79	4.52	4.88	2.63	2.74	3.61
Large construction	3.81	3.47	3.31	3.21	3.78	4.32	3.66	3.04	3.64
Motorcycles	3.30	2.99	2.81	2.67	4.13	4.48	2.85	3.14	4.15
Motor vehicles	3.58	3.12	2.86	2.73	4.00	4.49	3.68	3.10	4.04
Mountain climbing	2.91	3.01	2.83	2.81	4.41	4.72	2.57	3.06	3.91
Nuclear power	4.48	3.61	3.83	3.08	3.28	3.62	5.26	4.69	4.78
Pesticides	4.13	4.70	3.84	2.98	3.94	3.67	3.73	3.19	3.64
Power mowers	3.01	3.22	3.02	2.97	4.39	3.85	2.45	2.65	3.03
Police work	3.52	3.42	3.27	3.25	4.13	4.48	3.18	3.48	3.74
Prescription antibiotics	3.27	4.25	3.38	2.76	3.97	3.81	2.96	2.92	3.47
Railroads	3.36	2.88	2.90	2.76	3.95	4.90	3.41	2.88	3.82
Skiing	2.71	3.18	2.70	2.67	4.19	4.39	2.46	2.67	3.32
Smoking	3.05	5.43	2.92	2.65	4.68	5.22	3.23	3.14	4.82
Spray cans	2.80	4.23	3.30	2.82	4.45	3.89	2.54	2.66	2.82
Surgery	3.66	3.47	3.17	2.84	3.54	4.51	2.58	3.55	3.98
Swimming	2.79	3.04	2.72	2.55	4.46	5.03	2.33	2.61	3.24
Vaccinations	3.21	4.31	3.32	2.69	3.62	3.71	2.86	2.93	3.04
X-rays	3.36	4.83	3.34	2.74	3.68	3.63	2.49	2.77	3.08

Latent variable vs. network models

Latent variable model



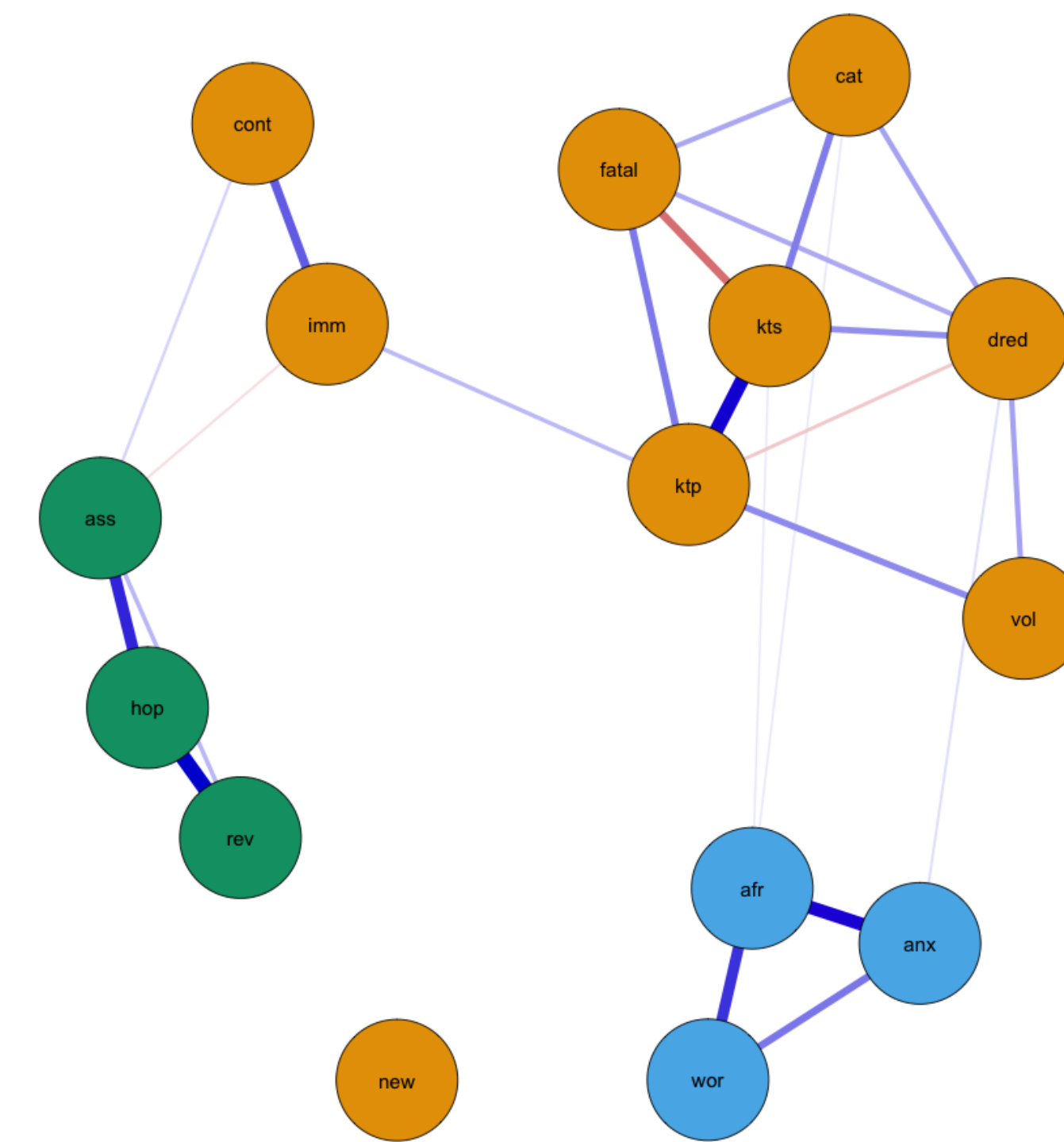
Network model



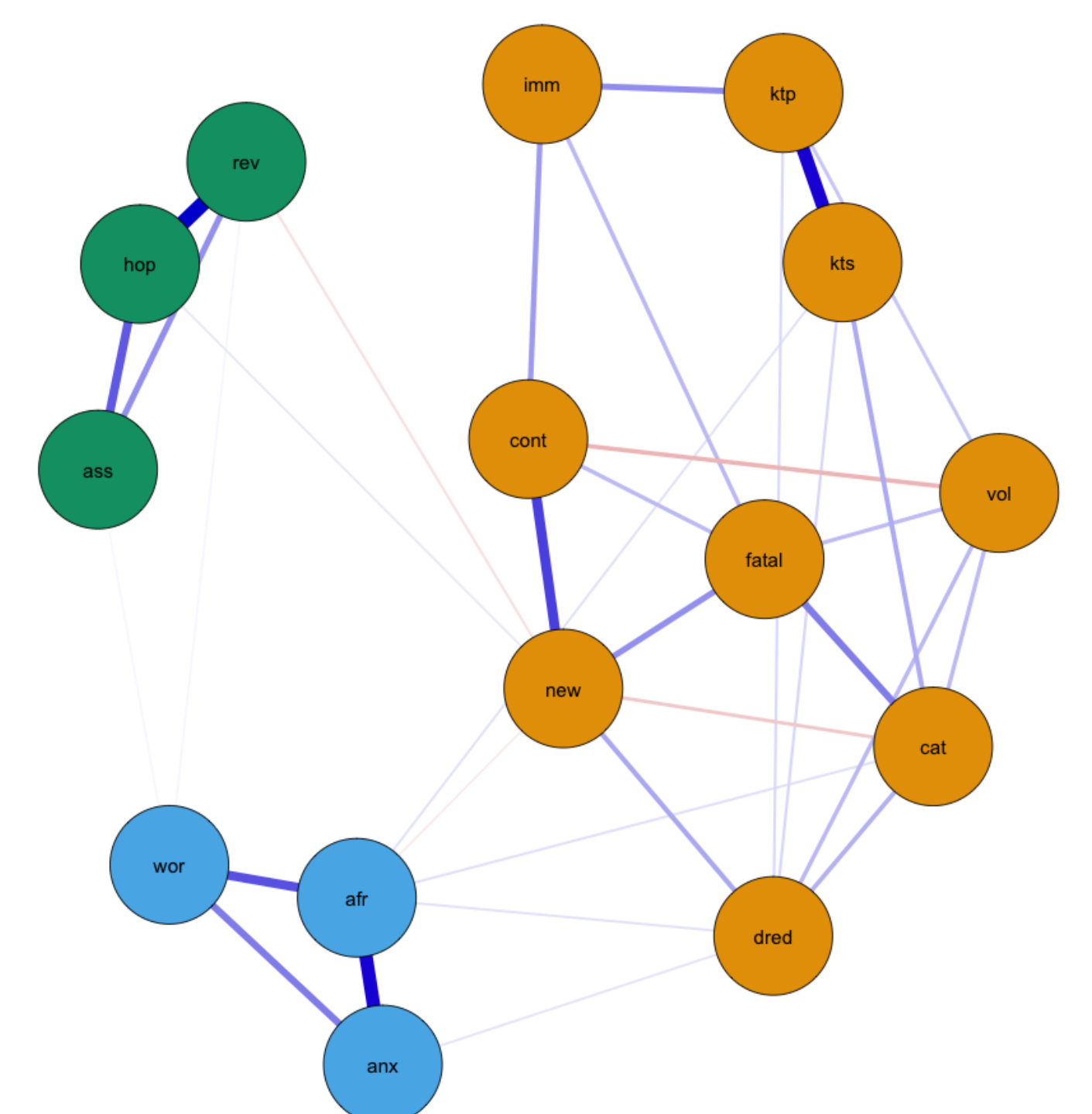
- Hierarchical structure: observed variables are "caused" by a common, underlying latent factor
- Degree to which an observed variable represents the latent factor is determined by its factor loading
- System of nodes are connected to each other by edges with varying degrees of importance
- Edges between pairs of nodes are defined by partial correlations while controlling for all other nodes

Network psychometrics

High numeracy (N = 143)

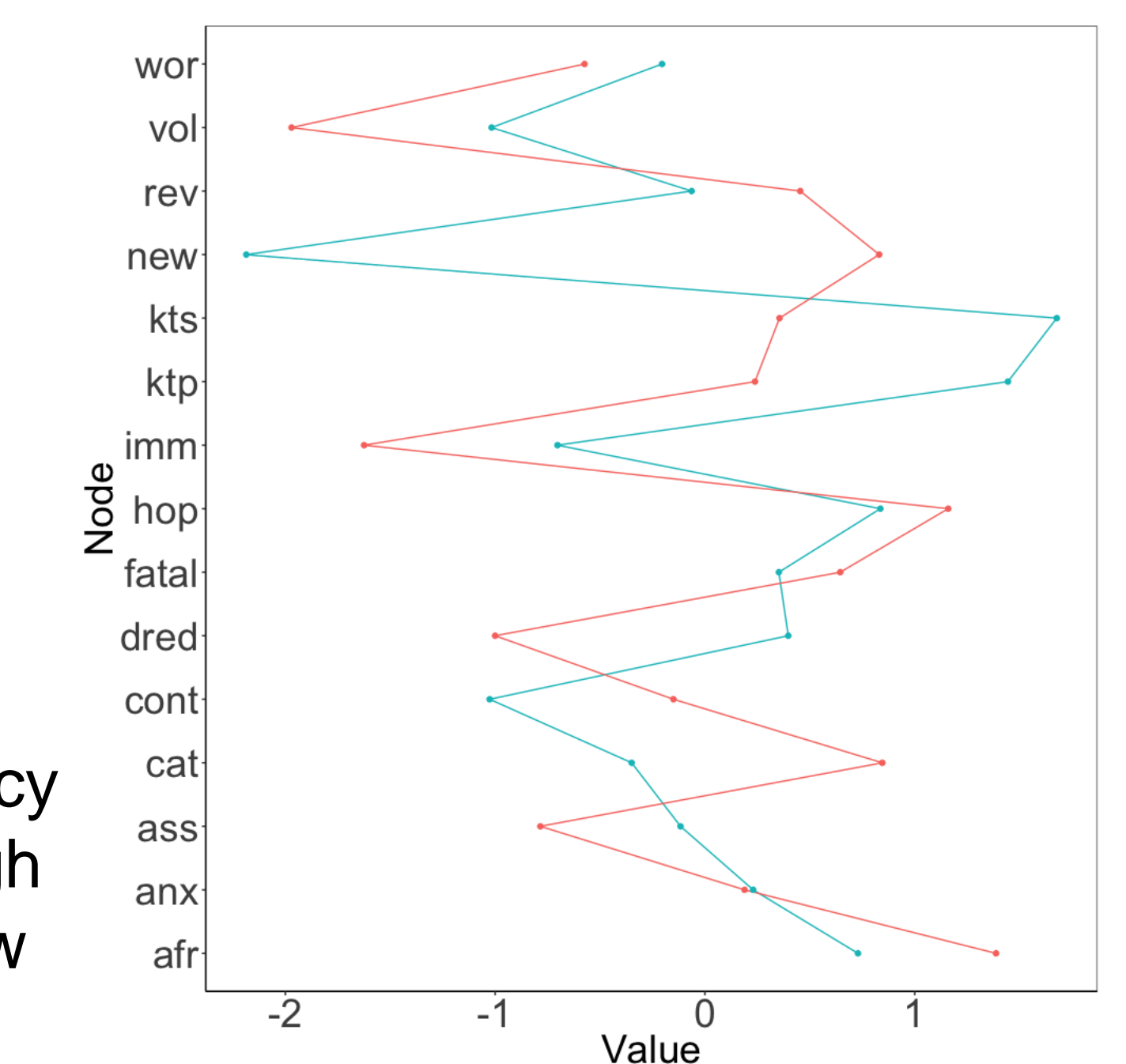


Low numeracy (N = 212)

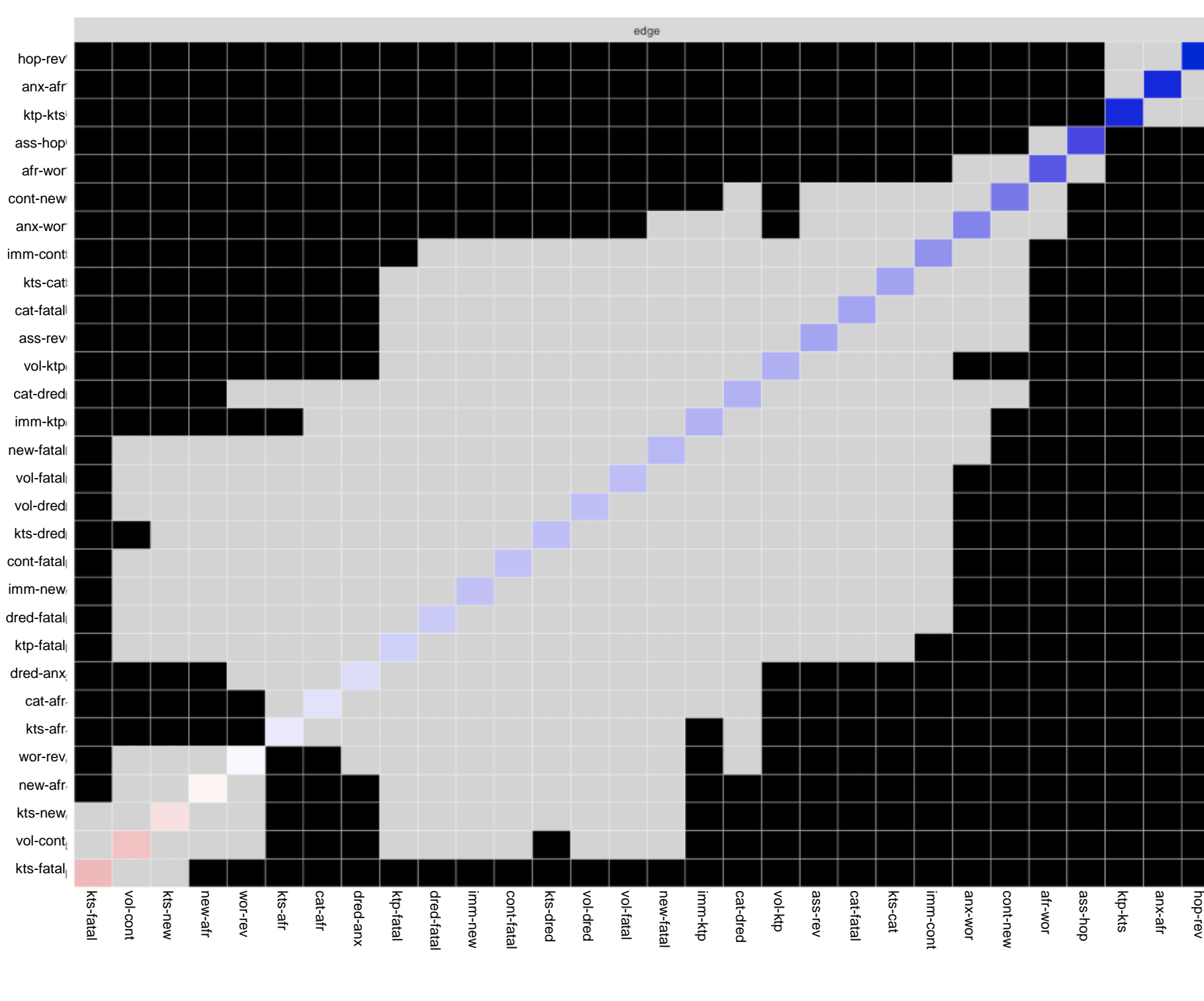


- Risk perceptions**
- cat Catastrophic
 - cont Controllable
 - dred Dread
 - fatal Severity
 - imm Immediate
 - ktp Known (exposed)
 - kts Known (science)
 - new New
 - vol Voluntary
- Positive affect**
- ass Assured
 - hop Hopeful
 - rev Relieved
- Negative affect**
- afr Afraid
 - anx Anxious
 - wor Worried

Centrality (sum of direct connections to each node in network)



Edge weight comparison matrix: Black indicates difference between strengths of the edge weights



Centrality comparison matrix: Black indicates difference between nodes' centrality scores

