The dynamics of personal belief networks

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Ideological polarisation is typically understood as differences in beliefs about societal issues. We propose that polarisation can manifest not just at the level of beliefs, but at the level of how individuals perceive belief relations. A person's beliefs are embedded and structured within a broader belief system— their personal belief network. Beliefs that are not aligned with the rest of the personal network create dissonance. Previous research has explored how dissonance induces belief change (node values) but has neglected how individuals update their perceptions of the relationships between the beliefs (edge weights). We present a model of belief network formation at the individual level based on two psychological drivers: social conformity and internal coherence. Social conformity leads individuals to adopt personal belief networks that are similar across society. When individuals observe that the beliefs of others are (anti-)correlated to each other, this will influence their personal belief network such that the relations between beliefs converge towards those observed in society. However, internal coherence seeking leads individuals to reinforce the edges connecting aligned beliefs, which induce a feeling of reassurance, and weaken the edges connecting misaligned beliefs, which induce dissonance—a process akin to Hebbian learning. Although reducing the subjective feeling of dissonance for any individual, internal coherence pressure can drive the personal networks of individuals apart. By applying the model to panel data on the political beliefs of German [1], Dutch, and Austrian citizens, we infer the dynamics of individuals' personal belief networks (Figure 1**A** and 1**B**) and also predict which beliefs are most central in individuals' networks, depending on the interplay between social and internal pressures. We find that individual beliefs have changed in recent years, but there is little to no trend on the aggregate level (Figure 1**C**). However, our model suggests that individuals' personal belief networks have, on aggregate, become more interconnected and ideological (Figure 1**D**). The model also suggests that the average networks of political groups have diverged, reinforcing partisan divisions. Individuals polarise not only in terms of their beliefs but also more fundamentally in terms of how they structure these beliefs and what they perceive as coherent. This aspect of polarisation can widen ideological divides, can reinforce affective polarisation, and can thus undermine social cohesion.

[1] GLES (2016–2024). *GLES Panel, Waves 1–27*. GESIS, Cologone. Retrieved from `https://www.gesis.org/gles`.
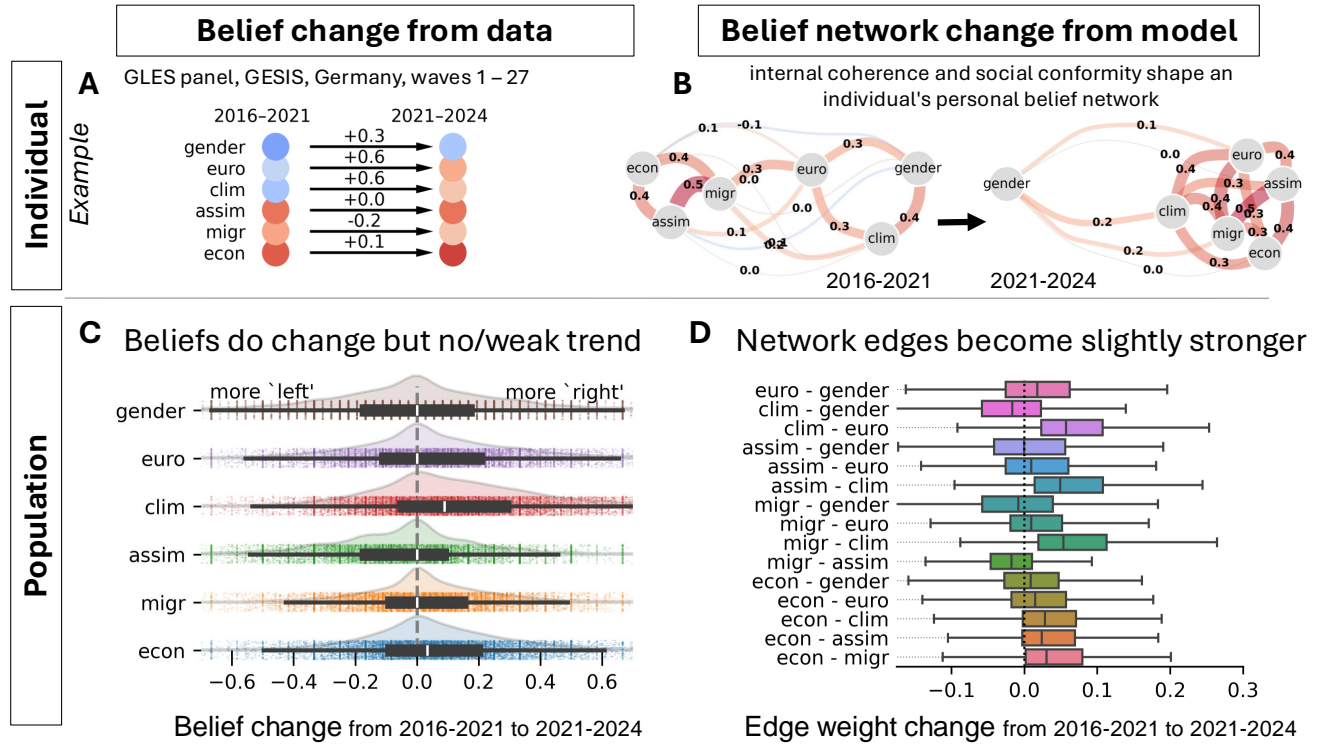
Figure 1: Using panel data (here, for German participants in the GLES panel [1]), we show how the beliefs on political issues have changed between two time periods—before and after the 2021 national election—and model how this might have shaped the personal belief networks of individuals. We chose political issues that are relevant to current debates, including to what extent individuals (dis-)agree with restricting state measures for equality of women in society (*gender*), ending further European Unification (*euro*), enhancing economic growth over combatting climate change (*clim*), requiring migrants to assimilate the German culture (*assim*), restricting immigration opportunities (*migr*), and lowering taxes over enhanced social security (*econ*). Panel **A** shows the beliefs (and belief changes), averaged over the period 2016-2021 and 2021-2024, of one example survey participant. Panel **B** shows the corresponding belief networks of this participant before and after the 2021 national election according to our model with one particular set of parameters. Panels **C** and **D** show the distribution of the changes in beliefs and the changes in belief network edge weights over all participants. We included only participants who responded to each of the six questions at least once before and once after the 2021 nation election; we averaged an individual's responses if they participated multiple times. The final sample size is $n = 14,356$. The beliefs exhibit no or only a weak trend on average (except for beliefs on climate change, which have shifted somewhat more towards a preference for economic growth over implementing measures against climate change). Our model suggests, however, that the edges connecting these beliefs in the individuals' personal belief networks have generally increased, and thus that the personal belief networks of the individuals have become more interconnected.