#### Tracing the Sources of Belief Contestation in Policy Debates

Philip Leifeld and Tim Henrichsen

14 September 2023



= interest groups, legislators...

= in the media, parliament, or other arenas...

= about preferred policies or instruments...

= **network** dependencies

## Discourse Network Analyzer (DNA)



- Discourse Network Analyzer (DNA)
- Download: http://www.github.com/leifeld/dna
- Operating system: any (platform-independent!)
- ▶ Requirements: Java 11 (e.g., Adopt OpenJDK 11).
- Purpose:
  - 1. Assign tags to text data.
  - 2. Convert these structured data into networks.

#### Database Document Statements Export Settings

A /home/philip/Desktop/MUP.dna

Do	icument regex filter			🛃 Add doc	ume	nt 🕒 <u>R</u> en	nove docun	nent(s)	🕈 Edit doo	cument(s)	G Refres	h	パ c	hange coder	
	ID Title	#	Date	Time	Т	Coder	Author	Source	Section	Туре	Notes		ID	Coder	
	14 MULTI-BUY DEALS ON ALCOHOL HEADING FOR THE AXE	9	2012-12-2	8 00:00		Philip	Tim Shi	DAILY M		Papers		*	1892	Gillian	This confirm
	15 Cam's shop booze price hike threat; ALCOHOL	7	2012-12-2	8 00:00		Philip	James	Daily Mi	NEWS;	Newspa			1681	Gillian	including the
	16 Alcohol should cost 'at least 45p a unit'	2	2012-12-2	8 00:00		Philip		The Exp	FEATUR	Newspa			1682	Gillian	including the
	17 Alcohol: May to propose 45p minimum unit price	11	2012-12-2	8 00:00		Philip	Nichola	The Gua	GUARDI	Newspa			1544	Gillian	The Alcohol H
	18 45p minimum alcohol price targets reduction in consumption and crime	15	2012-12-2	8 00:00	ĪĒ	Philip	Alan Tr	Guardia		Newspa			1256	Gillian	Professor lan
	19 A minimum price for booze? That's just middle class puritanism; Statistics	C	2012-12-2	8 00:00	TC	Philip	James	Indepen	COMME	Web Pu			1257	Gillian	Professor lan
	20 Theresa May sets out dearer alcohol plan to end binge-drinking	14	2012-12-2	8 00:00	TĒ	Philip	Martin	Indepen	NEWS	Web Pu			1264	Gillian	Figures show
-	A STR Main de leut enteniete elles fan elles het		0010 10 0	00.00		1 mt 10		1	NEWO	use n.		-	231	Gillian	The Alcohol H
CL	it consumption by 4.3% and lead to 2,000 fewer deaths.											*	232	Gillian	The Alcohol H
											1		235	Gillian	This policy wi
The 45p figure is below the 50p proposed by the Scottish government and the Home Office says it would have to also							Gillian	not only to dr							
assess the impact of cross-border shonning if it were to go ahead.							239	Gillian	Minimum unit						
	sess the impact of cross border shopping if it were to	80	arread.										236	Gillian	A child who li
1	- How Office one that Gibbs and events an electric de l		de Free			and and	والمراجعة والمراجعة						237	Gillian	It is essential
11	he nome UTTICE says that ±42bh was spent on alcohol in a	010	in Eng	tand and	wa	les and o	arank pr	ices ha	ve been	50			190	Gillian	Alcohol Healt
di	iscounted it is now possible to buy a can of lager for a	)s ]	ittle a	s 20p or	a 1	two-litre	e bottle	of cid	ler for	£1.69.	This		0.0	Cillian	boow drinker

has led to a 45% rise in home consumption over the last 20 years.

Professor Sir Ian Gilmore, chairman of the Alcohol Alliance UK, said the minimum price should be 50p rather than 45p. He said: "The evidence shows us that heavy drinkers and young drinkers are more affected by higher alcohol prices than moderate drinkers.

"According to the University of Sheffield, a minimum unit price of 50p would reduce total alcohol consumption	n by 6.7%,
saving around 20,000 hospital admissions in the first year " he coid	-
DNA Statement ID 120 start 4270 end 4404 🔳 Gillian 🔽 🏠	1
Alcohol Concern's chief executive, Eric Appleby, added:	tting a
minimum unit price will help us on the road to changing person Glimore, Ian	
organization Alcohol Health Alliance	
"Evidence shows us that setting the unit price at 50p with concept MUP will reduce health harms/deaths	t protect:
the young and heavy drinkers.	
agreement   yes   no	
"But we cannot cut the misery caused by excessive drinking, whether it's crime or hospitalisation, through p	rice alone;
we need tighter controls around licensing, giving local authorities and police forces all the tools they nee	d to get a
firm grip on the way alcohol is being sold in their area."	

ID         Coder           102         Gillian         Gillian           181         Gillian         Gillian           182         Gillian         Gillian           182         Gillian         Gillian           184         Gillian         Gillian           185         Gillian         Gillian           1         Gillian         Gillian           2         Gillian         Gillian           3         Gillian         Gillian           6         Gillian         Gillian           7         Gillian         Gillian	Test This confirms dedors' impressions. including the Royal College of Physi. Inducing the Royal College of Physi. The Alcohol Health Alliance estimat. Professor Ian Gilmore and Dr Nick S. Professor Ian Gilmore and D
992         Gillian           881         Gillian           882         Gillian           844         Gillian           856         Gillian           864         Gillian           874         Gillian           844         Gillian           955         Gillian           10         Gillian           21         Gillian           22         Gillian           39         Gillian           6         Gillian           6         Gillian           7         Gillian           6         Gillian	This confirms doctors' impressions - including the Royal College of Physi- including the Royal College of Physi- the Alcohol Health Alliance estimat. Professor ian Gilmore and Dr Nick S. Professor ian Gilmore and Dr Nick S. Professor ian Gilmore and Dr Nick S. Professor ian Gilmore and Dr Nick S. The Alcohol Health Alliance UK (AH- This policy will tack head-on the pr- not only to drivers but to those ano- Minimum unit pricing will target the Achild who lews with a problem drin. It is essential that the government st. Alcohol their Million explorements to Alcohol their Million explorements to the service
81         Gillian           82         Gillian           82         Gillian           83         Gillian           84         Gillian           85         Gillian           84         Gillian           84         Gillian           84         Gillian           85         Gillian           9         Gillian	including the Royal College of Physu- including the Royal College of Physu- The Alcohol Health Allance estimatu- Professor Ian Gilmore and Dr Nick S Professor Ian Gilmore and Dr Nick S Professor Ian Gilmore and Dr Nick S Professor Ian Calabra (Strategi Allance UK) The Alcohol Health Allance UK (AH- This policy will tackle head-on the pr- not only to drivers but to those aro. Minimum unit pricing will target the A child who lives with a problem drin R is essential that the government st.
82         Gillian           i44         Gillian           i56         Gillian           257         Gillian           10         Gillian           25         Gillian           12         Gillian           12         Gillian           13         Gillian           14         Gillian           15         Gillian           16         Gillian           16         Gillian           16         Gillian           17         Gillian           18         Gillian	including the Royal College of Physia. The Achold Health Alliance estimat. Professor Ian Gilmore and Dr Nick S. Figures show that alcohol-related inj. The Achold Health Alliance UK (AH. This policy will tackle head-on the pr not only to drivers but to those ano Minimum unit pricing will target the a child where with a problem drin. It is essential that the government ta Achold when the Winners where the
44         Gillian           256         Gillian           257         Gillian           264         Gillian           10         Gillian           11         Gillian           12         Gillian           13         Gillian           14         Gillian           15         Gillian           16         Gillian           17         Gillian           18         Gillian           19         Gillian           10         Gillian           11         Gillian	The Alcohol Health Allance estimat Professor Ian Gilmore and Dr Nick S Professor Ian Gilmore and Dr Nick S Figures show that alcohol-related inj The Alcohol Health Allance UK (AH This policy will tackle head-on the pr not only to drivers but to those aro Minimum unit pricing will target the a child when leve with a problem drin. It is essential that the government set
1         Gillian           157         Gillian           164         Gillian           12         Gillian           12         Gillian           13         Gillian           14         Gillian           15         Gillian           16         Gillian           17         Gillian           18         Gillian           19         Gillian           16         Gillian           17         Gillian	Professor Ian Gilmore and Dr Nick S. Professor Ian Gilmore and Dr Nick S. Figures show that alcohol-related III), The Alcohol Health Alliance UK (AH. This policy will tackle head-on the p not only to drinkers but to those ano. Minimum unit pricing will target the - A child who lives with a problem drin. It is essential that the government S. Alcohol Hubit H Umore whore more
57         Gillian           64         Gillian           11         Gillian           2         Gillian           5         Gillian           8         Gillian           9         Gillian           6         Gillian           7         Gillian           6         Gillian           7         Gillian	Professor Ian Gilmore and Dr Nick S Figures show that alcohol-related inj The Alcohol Health Alliance UK (AH This policy will tackle head-on the pr not only to drinkers but to those aro Minimum unit pricing will target the A child who lives with a problem drin. It is essential that the government as A sched who lives with a problem drin.
11     Gillian       11     Gillian       12     Gillian       15     Gillian       18     Gillian       19     Gillian       6     Gillian       7     Gillian       0     Gillian	Figures show that a loohol-related inj. The Alcohol Health Alliance UK (AH The Alcohol Health Alliance UK (AH This policy will tackle head-on the pr not only to drinkers but to those aro Minimum unit pricing will target the A child who lives with a problem drin. It is essential that the government at. Alcohol known enseme
1     Gillian       12     Gillian       15     Gillian       18     Gillian       19     Gillian       6     Gillian       7     Gillian       0     Gillian	The Alcohol Health Alliance UK (AH The Alcohol Health Alliance UK (AH This policy will tackle head-on the pr not only to drinkers but to those aro Minimum unit pricing will target the A child who lives with a problem drin. It is essential that the government st. Alcohol Health Alliance where mere
2     Gillian       15     Gillian       18     Gillian       19     Gillian       6     Gillian       7     Gillian       0     Gillian	The Alcohol Health Alliance UK (AH This policy will tackle head-on the pr not only to drinkers but to those aro Minimum unit pricing will target the A child who lives with a problem drin. It is essential that the government st Alcohol Health Alliance where mere
5 Gillian 8 Gillian 9 Gillian 6 Gillian 7 Gillian 0 Gillian	This policy will tackle head-on the pr not only to drinkers but to those aro Minimum unit pricing will target the A child who lives with a problem drin. It is essential that the government st Alsohol Hoalth Allingen whose more
8     Gillian       9     Gillian       6     Gillian       7     Gillian       0     Gillian	not only to drinkers but to those aro Minimum unit pricing will target the A child who lives with a problem drin It is essential that the government st Alsehed Health Alliance whose more
9 Gillian 6 Gillian 7 Gillian 0 Gillian	Minimum unit pricing will target the A child who lives with a problem drin. It is essential that the government st
6 Gillian 7 Gillian 0 Gillian	A child who lives with a problem drin. It is essential that the government st.
0 Gillian	It is essential that the government st
0 Gillian	Alcohol Health Alliance where mem-
and a second second	Alconor Health Alliance, whose ment.
🗧 Gillian	heavy drinkers and young drinkers a
6 📕 Gillian	Alcohol Health Alliance UK welcome
7 📕 Gillian	Alcohol Health Alliance UK welcome
8 📕 Gillian	Alcohol Health Alliance UK welcome
0 📕 Gillian	The evidence shows us that heavy dr.
4 📕 Gillian	The evidence shows us that heavy dr.
9 📕 Gillian	The evidence shows us that heavy dr.
0 📕 Gillian	a minimum unit price of 50p would r
7 Gillian	Sir Ian Gilmore, a liver specialist, call
9 Gillian	The evidence shows us that heavy dr
🔾 All 🕓 Current	t
DNA Statemer	nt
tatement ID	
person	
organization	Alcohol Health Alliance
oncept	
areement	
greement	I



#### Discourse Network Analyzer

#### Database Document Statements Export Settings

Document regex filter		Add document	Remove document(s)	ent(s) 🕄 Refresh 🕯 💦 Change coder	Philip			
ID Title 14 MULTI-BUY DEALS ON ALCOHOL HEADING 15 Cam's shop booze price bike threat: ALCO	ि <del>४</del>	Expo	rt data	v ^ × ier	Text This confirms doctors' impressions			
16 Alcohol should cost 'at least 45p a unit'	Type of network	Statement type	File format	n	including the Royal College of Physi			
17 Alcohol: May to propose 45p minimum ur 18 45p minimum alcohol price targets reduc	One-mode network 💌	DNA Statement	.graphml 💌	in an	Professor Ian Gilmore and Dr Nick S			
19 A minimum price for booze? That's just m	Variable 1	Variable 2	Qualifier	Qualifier aggregation	Professor Ian Gilmore and Dr Nick S			
20 Theresa May sets out dearer alconol plan	organization	concept	agreement	subtract 🗸 🖬	The Alcohol Health Alliance UK (AH			
cut consumption by 4.3% and lead				in	The Alcohol Health Alliance UK (AH			
The 45p figure is below the 50p r	Normalization	Isolates	Duplicates	in in	not only to drinkers but to those aro			
assess the impact of cross-border	average	only current nodes	ignore per document	in	Minimum unit pricing will target the			
	Include from	Include until	Moving time window	Time window size	A child who lives with a problem drin It is essential that the government st			
The Home Office says that £42bn w	03 05 2011 🗄 00:00:00 🕔	30 12 2012 🗄 00:00:00 🔇	no time window 💌	100 👘 🖬	Alcohol Health Alliance, whose mem			
has led to a 45% rise in home cor	Exclude from variable	Evoludo values	Proving of evoluted values		Alcohol Health Alliance UK welcome			
	Derron	Centre for Economic Rusiness Ref &	organization: Campaign for Real Ale	in	Alcohol Health Alliance UK welcome			
Professor Sir Ian Gilmore, chairn	organization	Chief Medical Officer	organization: Chief Medical Officer	in in	The evidence shows us that heavy dr			
moderate drinkers.	concept	Chivas Brothers	concept: Population/country has a pr	roblematic relationship with alcohol	The evidence shows us that heavy dr			
	author	Comite Vins Commons Health Select Committe	concept: Problematic alcohol consum	nption driven by social and economic	a minimum unit price of 50p would r			
"According to the University of S	source	Compecon	source: MAIL ON SUNDAY (London)	in a second stry are menecuve	Sir Ian Gilmore, a liver specialist, call			
saving around 20,000 hospitat ad	section	Conservatives Curtin University		in .	The evidence shows us that heavy dr			
Alcohol Concern's chief executive	, ype	Diagon		irrent	1 © Filter			
minimum unit price will help us o	· · · · · · · · · · · · · · · · · · ·			emer	at 💌			
"Evidence shows us that setting t	Display instructions		C Revert X C	ancel Vetwork export				
the young and heavy drinkers.				Person				
"But we cannot cut the misery cau	Plate we cannot sut the misery squared by excessive dripking whether it's crime or hernitalisation through price algorithm (Alcohol Health Alliance							
we need tighter controls around licensing, giving local authorities and police forces all the tools they need to get a								
firm grip on the way alcohol is being sold in their area."								
Chome/philip/Desktop/MUP.dna								



#### rDNA: Connecting DNA to R



### Example: pension politics in Germany

- ► Major policy change in 2001.
- ▶ Agreement on the need for a reform, but direction unclear.
  - Fertility-related measures?
  - Strengthen insurance principle?
  - Labor market measures?
  - Immigration?
  - ► Transition to a capital-cover system?
- ▶ Pension consensus of early 1990s eroded—but how?
- ▶ More generally: transition between policy paradigms.



# Possible solutions for closing the pension gap

solutions offered by actors; not exhaustive

- ► transition to a capital cover system
- ▶ increasing the labor force
  - immigration
  - gender equality
  - work incentives
- decreasing the pension level
- ▶ introduction of a uniform pension
- decreasing the old-age dependency ratio
  - shortening school education
  - ▶ increasing the pension entrance age
  - voluntary work after retirement
- linking a person's pension level to his/her number of children



fertility incentives

- Frankfurter Allgemeine Zeitung (FAZ).
- ▶ 1,879 articles with 7,249 statements from 1993 to 2001.
- ▶ 461 individuals from 246 organizations.
- ▶ 68 policy instruments, or "solution concepts."
- 20 concepts (policy instrument claims) deduced from the economic literature, 48 inductively added.











#### Extension: agreement and disagreement



#### Normalisation of edge weights

German pension politics, Jan–Jun 2000 (Leifeld 2017)



The congruence network: a core-periphery structure.

### Normalisation of edge weights

German pension politics, Jan-Jun 2000 (Leifeld 2017)



Congruence normalised by average statement frequency of dyads.

#### Core–periphery $\rightarrow$ polarisation $\rightarrow$ core–periphery before major reform



Leifeld (2013), Policy Studies Journal.

# Almost 300 applications of DNA and counting

$\leftarrow$ $\rightarrow$ C $\textcircled{a}$ O A ht	tps://github.com/leifeld/dna/blob/master/build/bibliography 🗉 🏠 🛛 😒 🔅 🛃 🌲 😦 🐒 🛢								
Files	dna / build / bibliography.md 个 төр								
ဖု master 👻 + Q	Preview Code Blame Raw 🗗 🕹 🖉 👻								
Q Go to file C	270. Yordy, J., Durnová, A., & Weible, C. M. (2023). Exploring emotional discourses: The case of COVID-19 protests in the US media. <i>Administrative Theory &amp; Praxis</i> . https://doi.org/10.1080/10841806.2023.2176074								
<ul> <li>&gt; in tyrkio</li> <li>&gt; in tyrkio</li> <li>&gt; in tyrkio</li> <li>&gt; in bibliography</li> <li>&gt; in build</li> </ul>	271. Yordy, J., You, J., Park, K., Weible, C. M., & Heikkila, T. (2019). Framing contests and policy conflicts over gas pipelines. <i>Review of Policy Research</i> , <i>36</i> (6), 736–756. https://doi.org/10.1111/ropr.12364								
<ul> <li>bibliography.md</li> <li>b dna</li> </ul>	272. You, J., Yordy, J., Park, K., Heikkila, T., & Weible, C. M. (2020). Policy conflicts in the siting of natural gas pipelines. <i>Journal of Environmental Policy &amp; Planning, 22</i> (4), 501–517. https://doi.org/10.1080/1523908X.2020.1778457								
> in gradle > in manual2 > in rDNA	273. You, J., Yordy, J., Weible, C. M., Park, K., Heikkila, T., & Gilchrist, D. (2021). Comparing policy conflict on electricity transmission line sitings. <i>Public Policy and Administration, 38</i> (1), 107129. https://doi.org/10.1177/09520767211036800								
PDNA2     sample	274. Žaková, K. (2023). <i>Expertization of the Czech climate policy network</i> [Master's thesis, Masaryk University, Faculty of Social Studies]. https://is.muni.cz/th/f9wdw/								

Which concepts together are most important in structuring this network?

How can we partition the concepts into a "backbone set" and a "redundant set" while preserving the (likely polarised) community structure?

For substantive analysis: What are the most central concepts? Which ones are redundant?

For developing a codebook and coding: What is a parsimonious model of the debate? Which concepts can we drop without sacrificing the community structure of the actor network?

 $\Rightarrow$  "Tracing the sources of belief contestation in policy debates"

#### Which concepts lend cluster structure to the actor network?



#### Penalised spectral loss function

How can we assess how much we lose by removing a subset of the concepts?

$$\ell\left(\mathbf{Y},\mathbf{Y}^{B^*},p\right) = \sqrt{\sum_{i=1}^{|A|} \left(\hat{\lambda}_i^{\mathbf{Y}} - \hat{\lambda}_i^{\mathbf{Y}^{B^*}}\right)^2} e^{-p\frac{|B^*|}{|C|}}$$

By computing the Euclidean distance of the ordered and normalised eigenvalues of the Laplacian matrices (= normalised spectrum) for the one-mode projections of the discourse network with and without the concepts.

The Euclidean spectral distance compares the two networks by computing the dissimilarity between their cluster topologies. Penalised by an exponential decay proportional to the backbone size.

Minimise this to get the backbone set of structurally important concepts:

$$B = \arg\min_{B^* \subseteq C} \ell(\mathbf{Y}, \mathbf{Y}^{B^*}, p)$$

#### Identifying backbone and redundant set using simulated annealing

Algorithm 1: Simulated Annea	aling	
Input: X, p, T		if $s = \{swa$
Result: Optimal backbone B a	and redundant concept set R	$c_j \sim 0$
$\mathbf{X}  ightarrow \mathbf{Y}$ ;	/* Map data into full network */	$c_{j'} \sim 0$
$c_j \sim U(C)$ ;		$B_t \leftarrow b_t$
$B \leftarrow B_0^* \leftarrow \{c_j\}$ ;	<pre>/* Start with a single random concept */</pre>	end
$t \leftarrow 1$ ;	<pre>/* Start first iteration */</pre>	$\mathbf{X}  o \mathbf{X}^{B^*_t}$ -
while $t \leq T$ do		if $\ell(\mathbf{Y}, \mathbf{Y}^{B_{t}^{*}})$
$S \leftarrow {add; remove; swap}$ ;	/* Sample space of possible actions */	$B_t^* \leftarrow I$
if $ B_t^*  < 2$ then		if $\ell(\mathbf{Y})$
$S \leftarrow S \setminus \{\text{remove}\}$ ;	/* Never remove all concepts */	B
end		end
if $ B_t^*  >  C-2 $ then		else
$S \leftarrow S \setminus \{add\};$	<pre>/* Never add all concepts */</pre>	$\delta_{1} = 1$
end		$o_t = 1$
$s \leftarrow U(S)$ ;	<pre>/* Pick action randomly */</pre>	$r \sim U_{\rm f0}$
if $s = {add}$ then		
$c_j \sim U(C \setminus B_t^*)$ ;		If <u>r &lt; r</u>
$  B_t^* \leftarrow B_t^* \cap \{c_j\};$	/* Add a random concept */	$B_t^*$
end		else
if <u>s = {remove}</u> then		$B_t^*$
$c_j \sim U(B_t^*)$ ;		end
$  B_t^* \leftarrow B_t^* \setminus \{c_j\};$	/* Remove a random concept */	end
end		end

ap} then (*B*<sup>\*</sup>);  $V(C \setminus B_t^*)$ :  $\{c_{i'}\} \cup B_{t}^{*} \setminus \{c_{i}\};$  /\* Swap out random concepts \*/  $\rightarrow \mathbf{Y}^{B_t^*}$ ; /\* Map data into current backbone network \*/  $(p) < \ell(\mathbf{Y}, \mathbf{Y}^{B^*_{t-1}}, p)$  then B\* ; /\* Accept candidate \*/  $\mathbf{Y}^{B_t^*}, p) \leq \ell(\mathbf{Y}, \mathbf{Y}^B, p)$  then  $\leftarrow B_t^*$ ; /\* Save globally optimal solution \*/ /\* Compute temperature \*/  $-\frac{1}{1+e^{-(-5+\frac{12}{T}t)}};$ /\* Sample random number between 0 and 1 \*/ 0.11  $e^{-\left(\ell(\mathsf{Y},\mathsf{Y}^{B_{t}^{*}},p)-\ell(\mathsf{Y},\mathsf{Y}^{B_{t-1}^{*}},p)\right)} \times \delta_{t}$  then  $\leftarrow B_{r}^{*}$ : /\* Accept candidate sometimes \*/  $\leftarrow B_{*-1}^*$ ; /\* Reject candidate; use previous candidate \*/

### Simulated annealing: Summary statistics



#### D: Number of concepts proposed as backbone in each iteration



#### Results for p = 5.5 and T = 50,000 with the pension data



#### Results for p = 7.5 and T = 50,000 with the pension data



#### Results for p = 12 and T = 50,000 with the pension data



#### Simplified agglomerative variant: nested backbone

The solutions are not necessarily nested. If we assume nestedness, a simple, deterministic algorithm can be used:

- Start with a full backbone and empty redundant set.
- ► For numbers 1 to |*C*|: move one concept from backbone to redundant set at a time.
- ▶ Decide at each step which concept has the smallest spectral loss.

Properties:

- ► Agglomerative and fully nested.
- Nestedness is not optimal, but comes close.
- ▶ Much faster.
- Can be used to rank the concepts.



#### How does the new ranking compare?



Data reduction/feature selection. Nested and non-nested versions.

Contributes to the workshop theme by reducing polarisation to its backbone.

In comparison to PCA/FA/MCA: Not a linear combination of all features. Not projecting on main dimensions. Preserving multidimensional community structure. Not strong loading on factors but rather complementarity in establishing factors.

Should this be applied to ideological measurement? E.g., developing a parsimonious measurement model of ideology among voters or parties by selecting only a few policy preference items.

Should this be applied to psychological traits? E.g., picking a few traits that characterise the personality composition of the population well.