SDAL SOCIAL & DECISION ANALYTICS LABORATORY

Data Science for the Public Good

ON VARIATIONS OF COMPUTATIONAL MODELS OF ATTITUDE

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Background

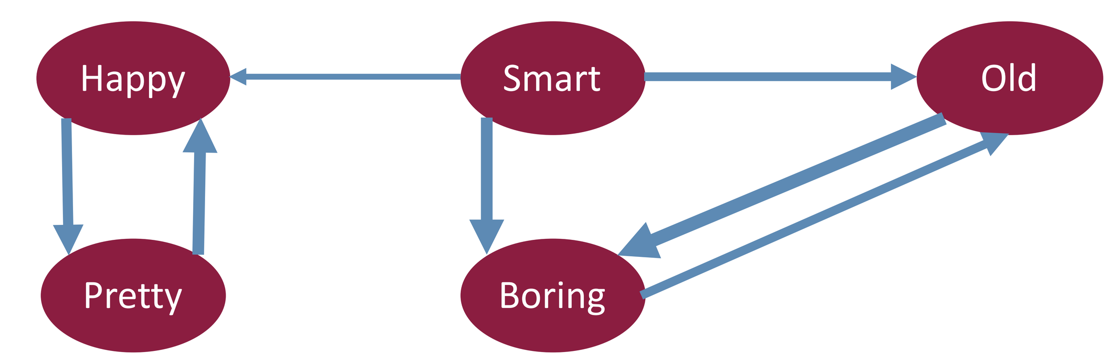
Attitude formation is important to virtually every aspect of the modern world. However, very little is known about how our brains undergo the process. Psychologists have begun to investigate this using computational models, but no consensus has been reached.

Most models agree on some form on constraint satisfaction as a means of stabilization within the network, however there are divergent theories about the best way to model beyond that.

- Some models stress the learning component of the network, or how well-equipped is the model to adapt to new information.
- Other models rely on well-established methods to create inter-connected networks from data as a whole.

Understanding Attitude Networks

- Each **circle, *or node*, represents a judgment** that a person may make about someone else.
- These nodes are connected by **arrows, *or edges*, that display relationships.**
- The **size of the arrow, *or weight*, also conveys information** about the relationships.



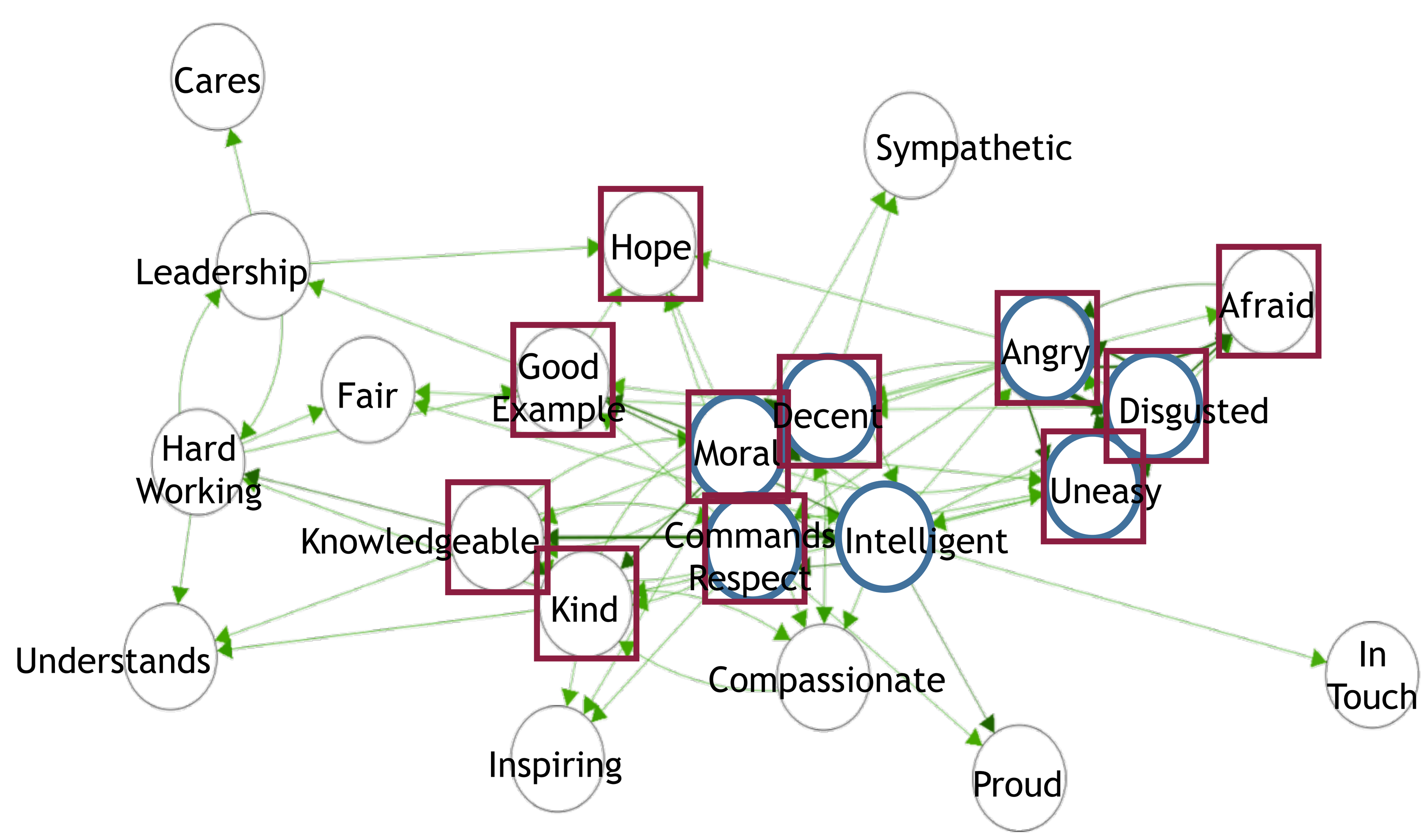
If this network thinks a person is **Smart**, it may also think the person is **Happy** or **Old**, but more likely **Boring** since that is the strongest weight radiating from **Smart**.

This study specifically addresses the comparison of Connectionist Psychology and Network Psychometric Approaches to modelling Attitude Formation. For consistency, both models are built with the American National Election Studies Survey from 1984 to model attitudes about Ronald Reagan before his re-election.[1] The two models have different characteristics, despite begin modelled off the same survey responses. We are comparing network topologies, as well as theoretical implications.

Connectionist Psychology

Connectionist Psychology aims to create a model directly out of the psychological understanding of attitude formation. It attempts to mimic cognitive coherence and the ability to adapt with a recurrent network that learns from social contexts.

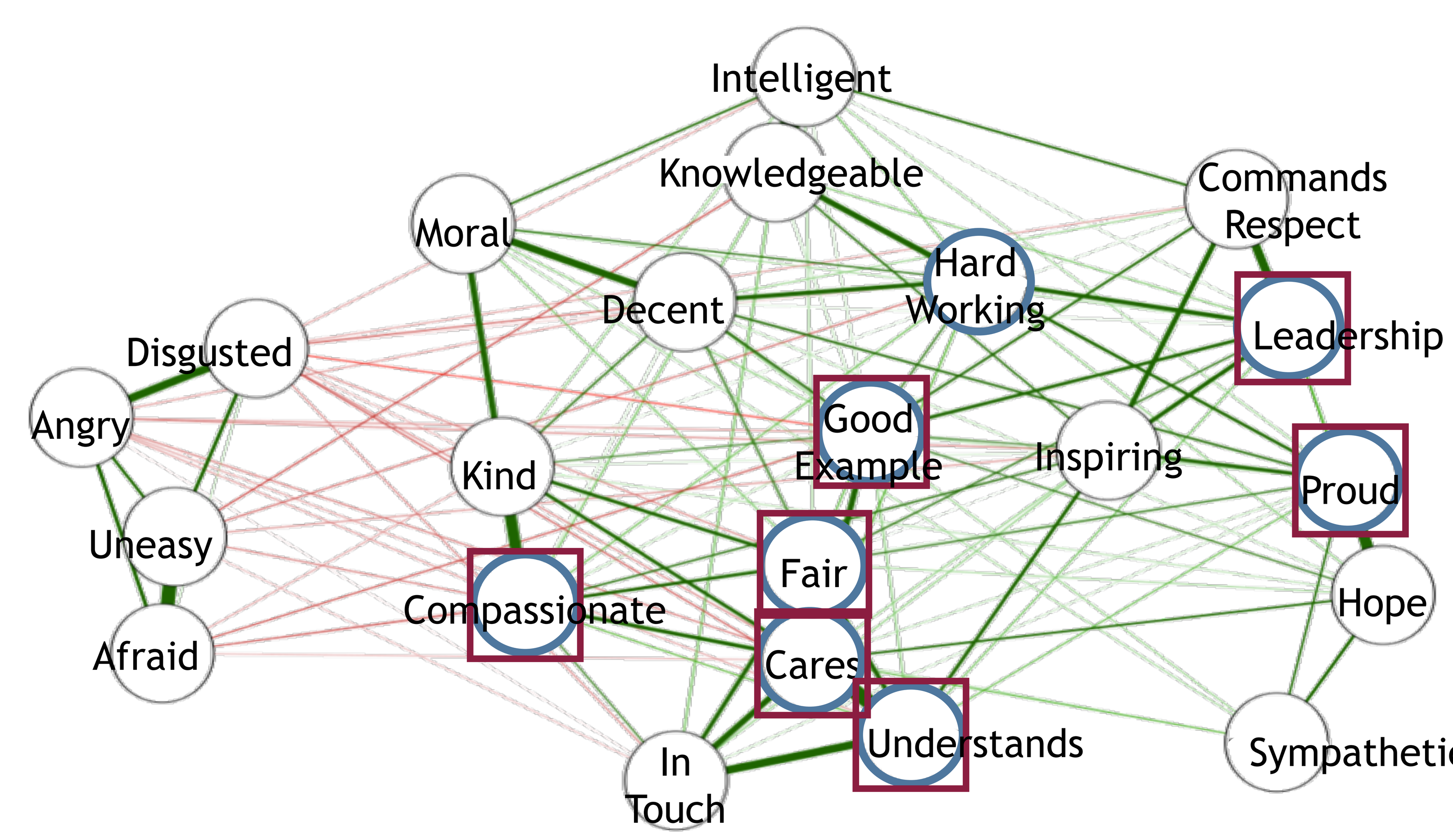
- The model attempts to mimic the structure of the survey response.
- The model is tested to see how accurately it captures the response.
- The model learns from the error produced.



Network Psychometrics

The Network Psychometrics Model is taken from a publication in Psychological Review by Jonas Dalege.[2] It assumes psychological representations can be conceptualized as graphs and that processing is similar to the dynamics of an Ising spin model. However, it does not specify how the network is learned.

- Characteristics are logarithmically regressed pair-wise.
- The regression is subjected to shrinkage based on the extended Bayesian Information Criterion.[3]
- Relevant relationships are identified and preserved.



Network Comparisons

To compare the two network topologies, SDAL considered both the clustering of the nodes and influence of nodes had over one another. This provides two different comparisons that each summarize information about the process which these networks model.

Centrality Measures			
	Highest Closeness	Highest Betweenness	Highest Degree
Psychometrics	Good Example	Cares	Cares
Connectionist	Moral	Moral	Moral

Nodal Influence

Using Maximum Flow Rate as a measure of influence, we have identified critical nodes in each model illustrated above where:

highly influential nodes are circled in blue, and
highly influenced nodes are boxed in red.

- In the Network Psychometrics Model, there is practically a 1:1 relationship between highly influential and highly influenced nodes.
- In the Connectionist Psychology model we see influence more broadly distributed from the highly influential nodes.

References

[1] American National Election Studies (1984), *ANES 1984 Time Series Study* [Data set]. Retrieved from http://www.electionstudies.org/studypages/download/datacenter_all_NoData.php

[2] Dalege, J., Borsboom, D., van Harreveld, F., van den Berg, H., Conner, M., & van der Maas, H. L. J. (2015). *Toward a formalized account of attitudes: The Causal Attitude Network (CAN) model. Psychological Review, 123*, 2-22.

[3] Borkulo, C. D., Borsboom, D., Epskamp, S., Blanken, T. F., Boschloo, L., Schoevers, R. A., & Waldorp, L. J. (2014). A new method for constructing networks from binary data. *Sci. Rep. Scientific Reports, 4.* doi:10.1038/srep05918