

Toward a Formalized Account of Attitudes: The Causal Attitude Network (CAN) Model

Jonas Dalege

University of Amsterdam and University of Hamburg

Denny Borsboom and Frenk van Harreveld

University of Amsterdam

Helma van den Berg

TNO (Netherlands Organization for Applied Scientific
Research), Soesterberg, the Netherlands

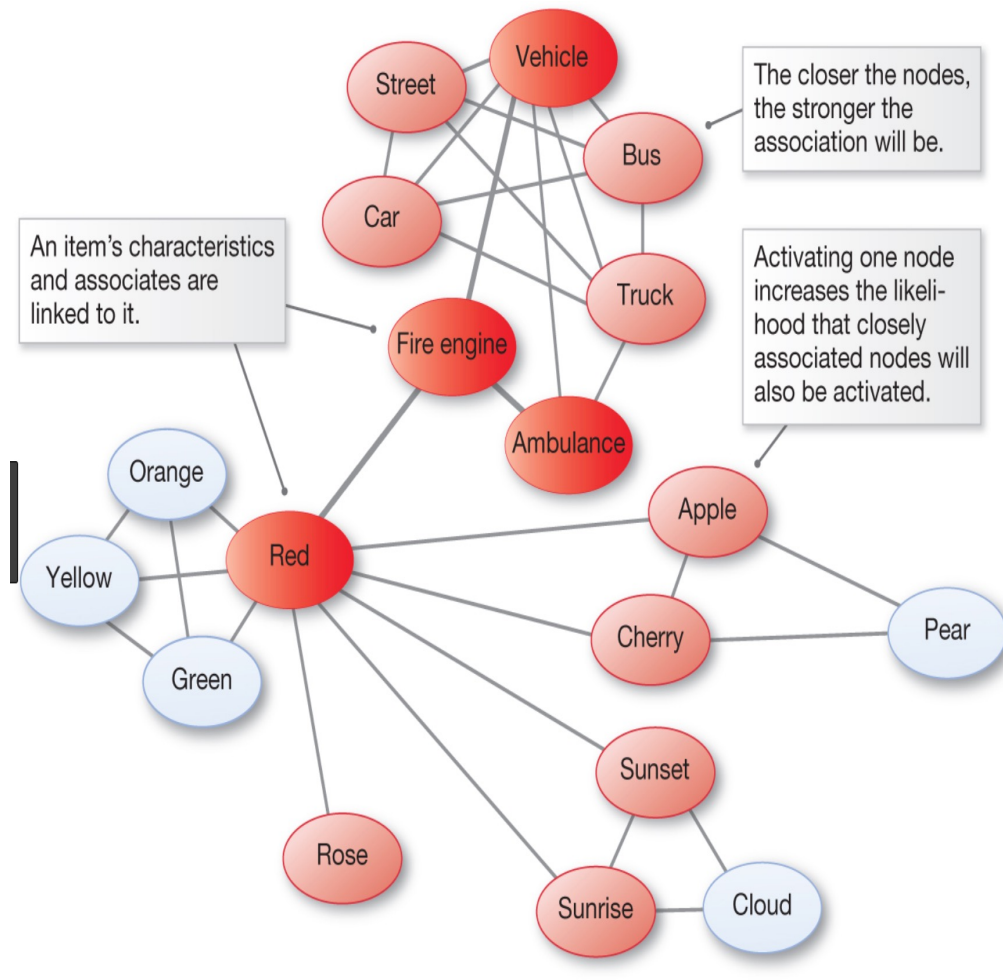
Mark Conner

University of Leeds

Han L. J. van der Maas

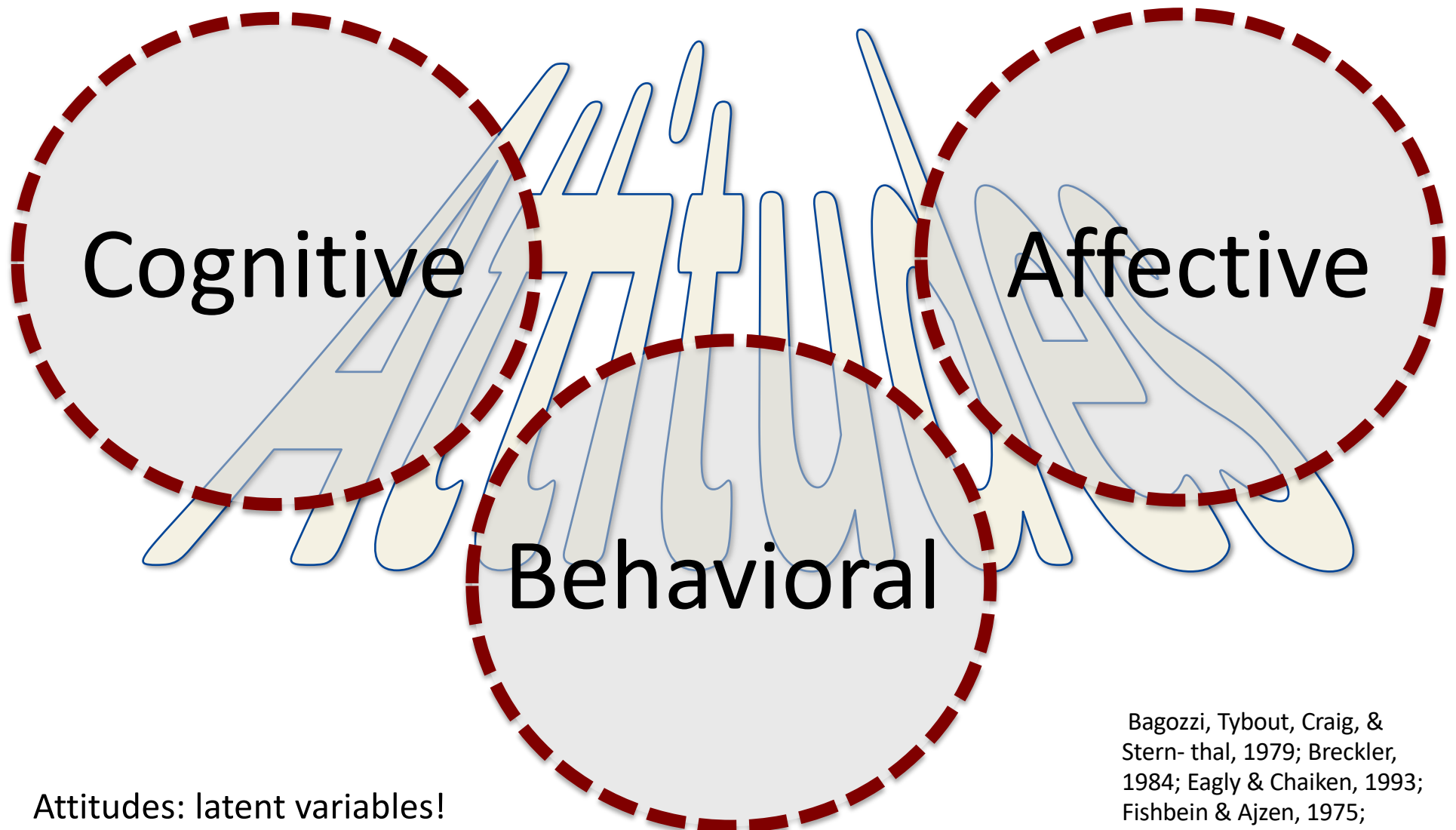
University of Amsterdam

“ mental representation, concepts, associations” = social cognition



Concepts=> ANYTHING! attribute, propositions, memories, personal goals

The tripartite Model: attitudes consists of 3 components

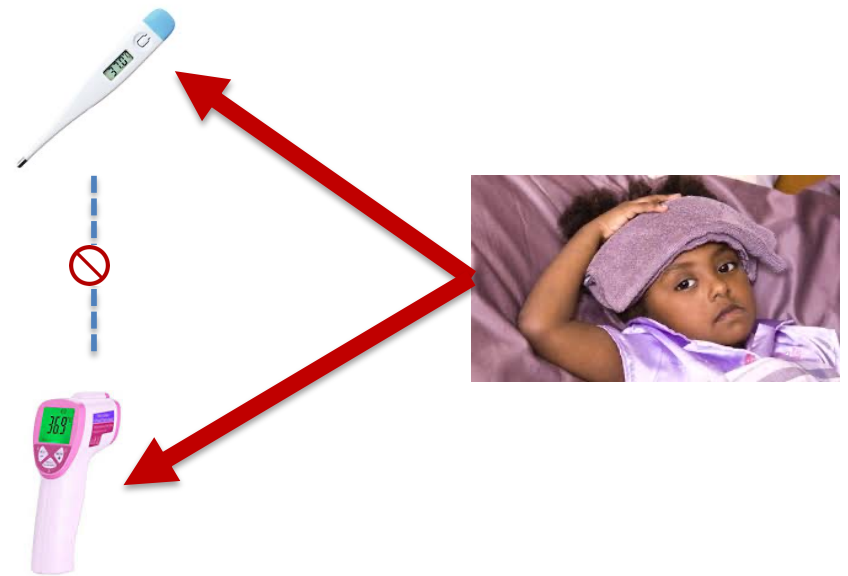


Attitudes: latent variables!
unobservable common causes of observable variables

Bagozzi, Tybout, Craig, &
Sternthal, 1979; Breckler,
1984; Eagly & Chaiken, 1993;
Fishbein & Ajzen, 1975;
Rosenberg, Hovland, McGuire,
Abelson, & Brehm, 1960

2 assumptions of the tripartite model

- Local independence: Indicators measuring the same latent variable have no direct causal influence on each other



- Exchangeability: adding indicators to a questionnaire only increases reliability but not add substantial information



From description



to explanation



The tripartite Model well describes the co-occurrence of the three components

It is easy to fit with common measures

It does not explain the formation and dinamism of attitudes formation and change

Does not explain inconsistencies btw attitudes & bahavior if behavior is one component of attitude

Connectionist models of attitudes

- Connectionism is an approach to cognitive modeling that uses linked networks of concepts to represent cognitive structures
- various beliefs related to an attitude are connected to each other in a network fashion and that activation in some way captures salience or awareness.

Connectionist models of attitudes

- attitudes form and change as a result of the interplay between evaluative reactions that concern the attitude object
- Attitude results from a network of inter-related reactions to the attitude object
- BUT Without empirical evidence: typical measures of attitudes do not provide network data!!!
- It is just a metaphorical description

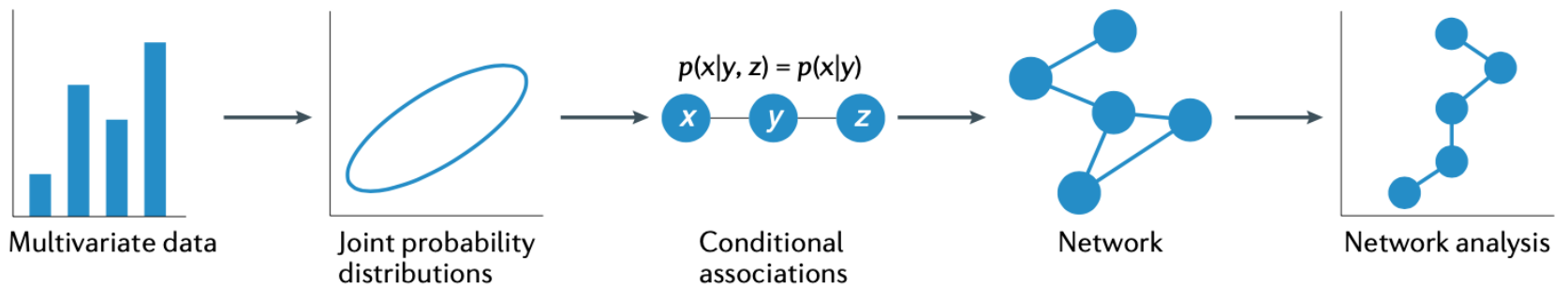


Fig. 1 | **Structure of psychometric network analysis.** Joint probability distribution of multivariate data characterized in terms of conditional associations and independencies. Conditional independencies translate into disconnected nodes; conditional associations translate into links between nodes, typically weighted by the strength of the association. The resulting structure is subsequently described and analysed as a network.

CAN: Causal Attitude Network model

- Attitudes as networks that consist of **evaluative reactions and interactions** between these reactions.
- Relevant reactions include **beliefs, feelings, and behaviors** toward an attitude object
- attitude networks -> **small-world** structure
- allows for the application of *empirical* network models
- Nodes are **causally** related

Cognitive consistency



- humans have a basic need for consistency between their cognitions (e.g., Heider's balance theory; Festinger's Consistency theory; Rosenberg's affective-cognitive consistency)
- people are motivated to reduce inconsistencies within their attitudes (e.g., van Harreveld et al., 2009)
- evaluative reactions have a tendency to align with each other.

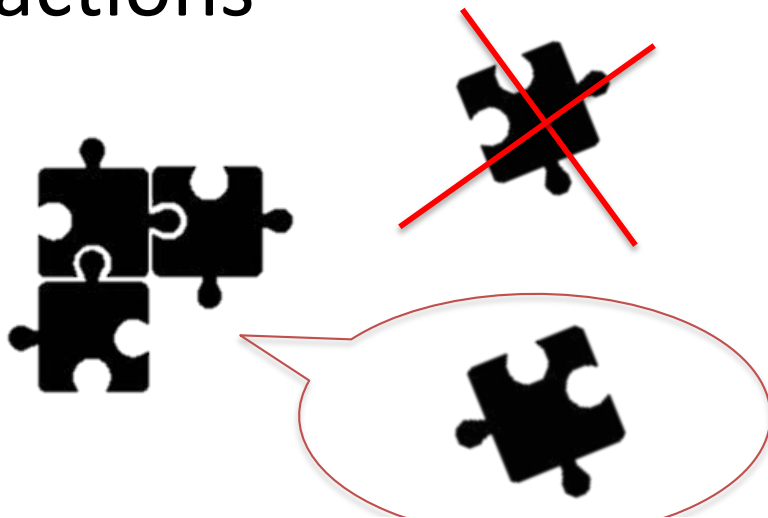
Accuracy



- Sometimes people need to make correct decision
- Accuracy motivation lowers preference for information that supports previous attitudes (Hart et al., 2009).

Consistency

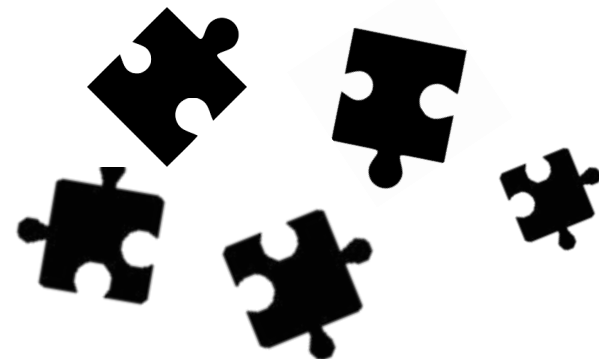
- striving only for consistency would lead to perfectly aligned evaluative reactions



vs

Accuracy

- striving only for accuracy can, in some instances, lead to completely unaligned evaluative reactions.



Clustering



- Clustering allows for
 - energy reduction within clusters
 - e.g. all evaluative reactions toward a person that pertain to the dimension of warmth are highly aligned
 - accuracy by having unaligned or even misaligned clusters that do not cost much energy
 - e.g. the evaluative reactions that pertain to the dimension of warmth are not highly aligned to the evaluative reactions that pertain to the dimension of competence

Preferential attachment

- **nodes are more likely to connect to popular nodes**
-> evaluative reactions that already have many connections are more likely to lead to the activation of additional evaluative reactions

WHY?

-> evaluative reactions that are strongly connected already **have proven to be predictive in the *past***, which makes such evaluative reactions more likely to cause readiness of other evaluative reactions in the *present*.



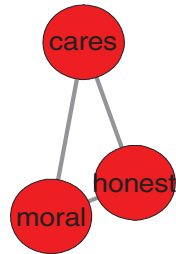
Attitudes as small-worlds!!!



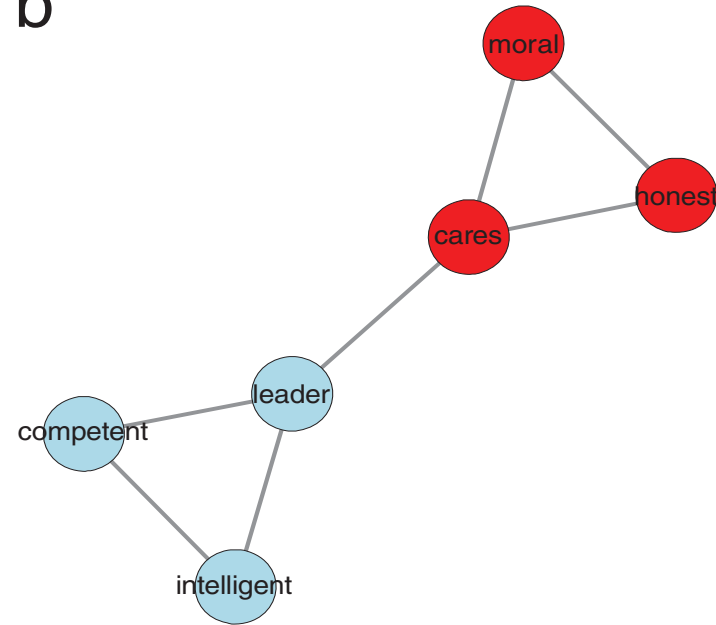
- attitude networks are expected to show
 - **high clustering**, in which these clusters are connected through shortcuts
 - **High connectivity**: Through these shortcuts, attitude networks have high global connectivity (i.e., all nodes on average are closely connected to each other)
- The combination of high clustering and high connectivity is known as a small-world structure (Albert & Barabási, 2002; Watts & Strogatz, 1998).

Hypothetical attitude network at four points in time

a



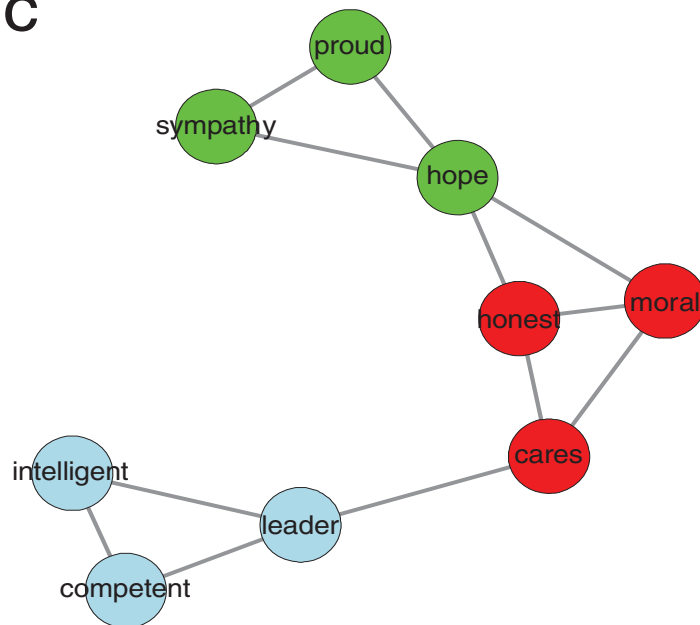
b



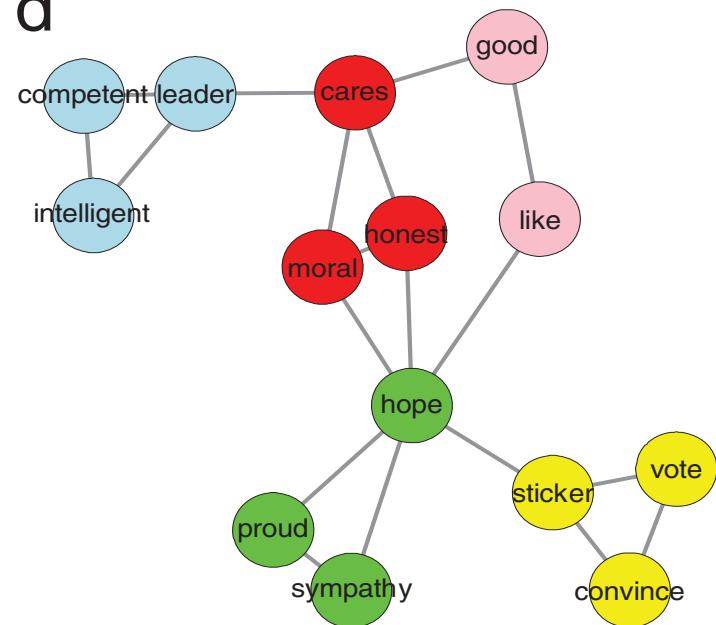
Nodes=evaluative reactions

Edges =causal influence between the evaluative reactions.

c



d





DATA

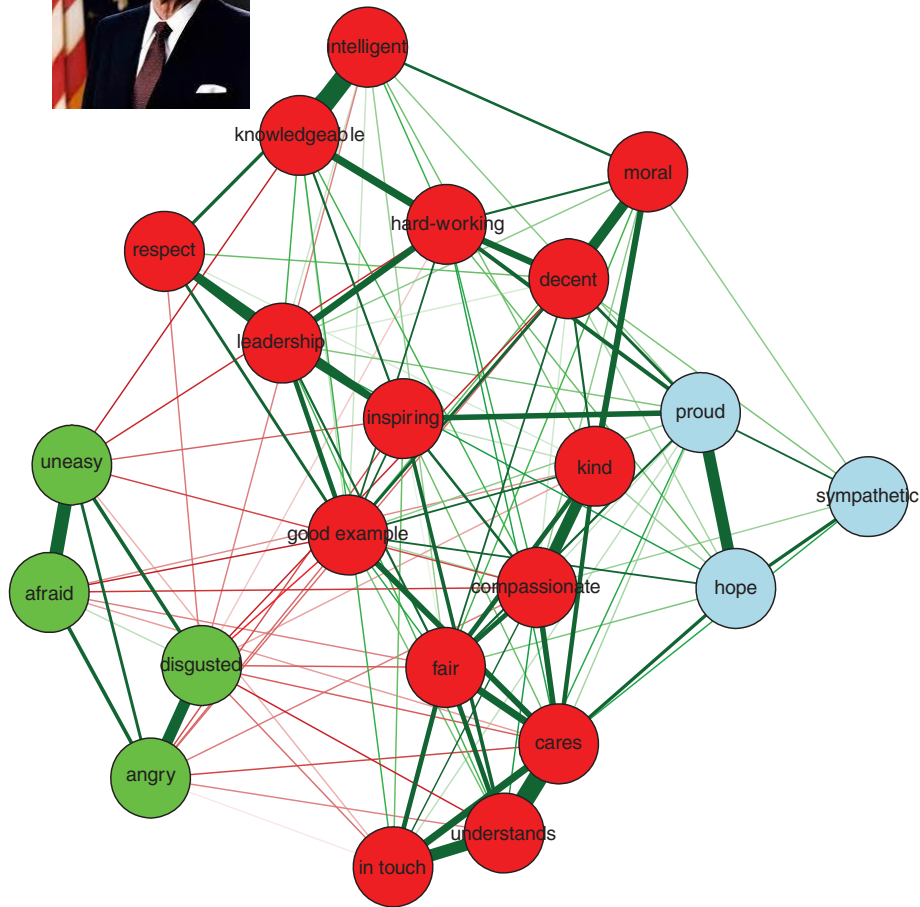


- American National Election Study (ANES) of 1984
- N= 2,257
- Participants were asked whether or not they attributed several positive characteristics to each candidate (e.g., whether the candidate is a decent, intelligent or a moral person) and whether they had ever had positive or negative feelings toward each candidate (e.g., feelings of hope or anger).
- participants' responses toward these evaluative reactions -> attitude networks for the attitudes toward each presidential candidate

Both networks thus had a small-world structure



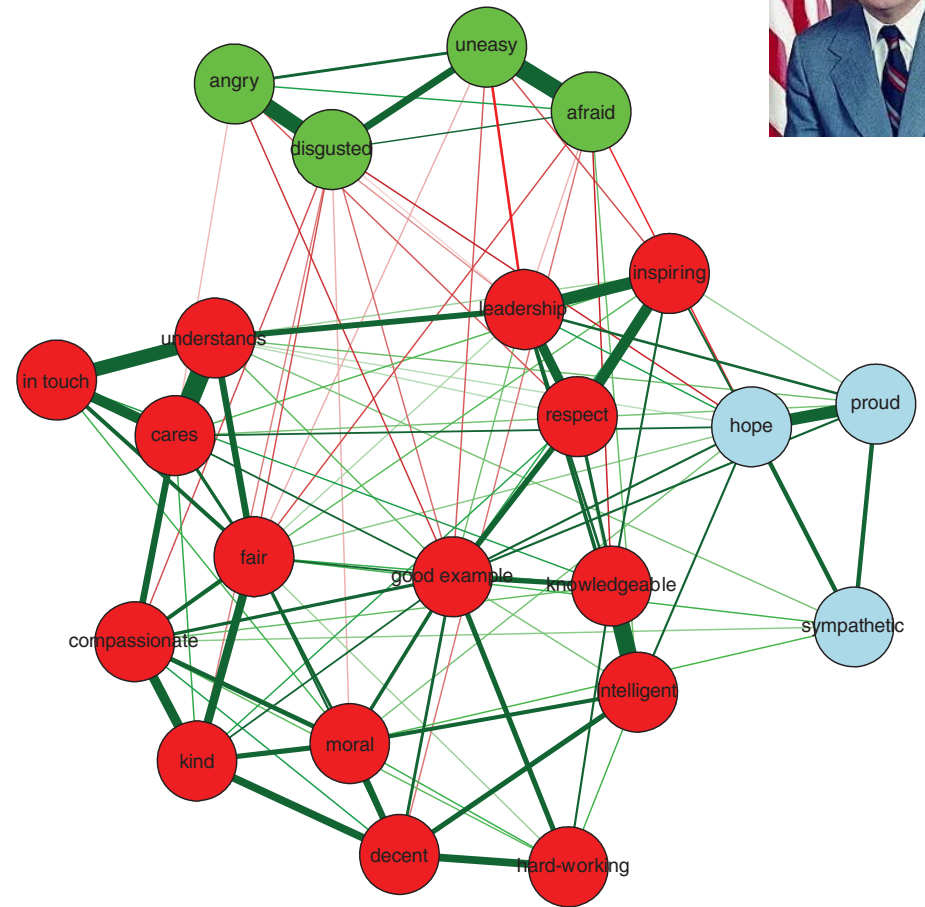
Ronald Reagan



Nodes red = positive judgements
blue = positive feelings
green = negative feelings



Walter Mondale



Edges green = excitatory influence
red = inhibitory

Thicker edges represent higher weights of the edges

- the CAN model holds that evaluative reactions cause readiness of related evaluative reactions to the same attitude object and through this process attitude networks take shape.
- Similar evaluative reactions tend to cluster and these clusters are connected by shortcuts, which give rise to the small-world network structure of attitudes.

Attitude Change

- attitudes can be changed via a plethora of different processes as each node in the attitude network can serve as a gateway to instigate change in the network
- Eg cognitive dissonance; evaluative conditioning; arguments
- function of
 - strength of external pressure
 - state of the neighboring nodes
 - strength of the links between the targeted node and the neighboring nodes (robustness!!)

- If one evaluative reaction changes and this change persists, other evaluative reactions are also likely to change.
- If a node in this cluster were to be changed, this change would mostly spread to other nodes in this cluster.
- whether the change will spread through the whole network depends on the behavior of the nodes that connect this cluster to other parts of the network.
- While highly central evaluative reactions will be likely to resist change, their change will also be more consequential than change in an evaluative reaction that is not central.

Attitude strength as *global connectivity*

- Strong attitudes are defined by their stability, resistance to change, and impact on behavior and information-processing
- *global connectivity* (i.e., average shortest path length; West, 1996) of an attitude network can be regarded as a mathematically formalized conceptualization of attitude strength.

- evaluative reactions that are not aligned to each other cost more energy in a highly connected attitude network
- Highly connected attitude networks are more likely to resist persuasion attempts
- See resistance of strong versus weak attitudes to persuasion attempts (e.g., Bassili, 1996; Visser & Krosnick, 1998).

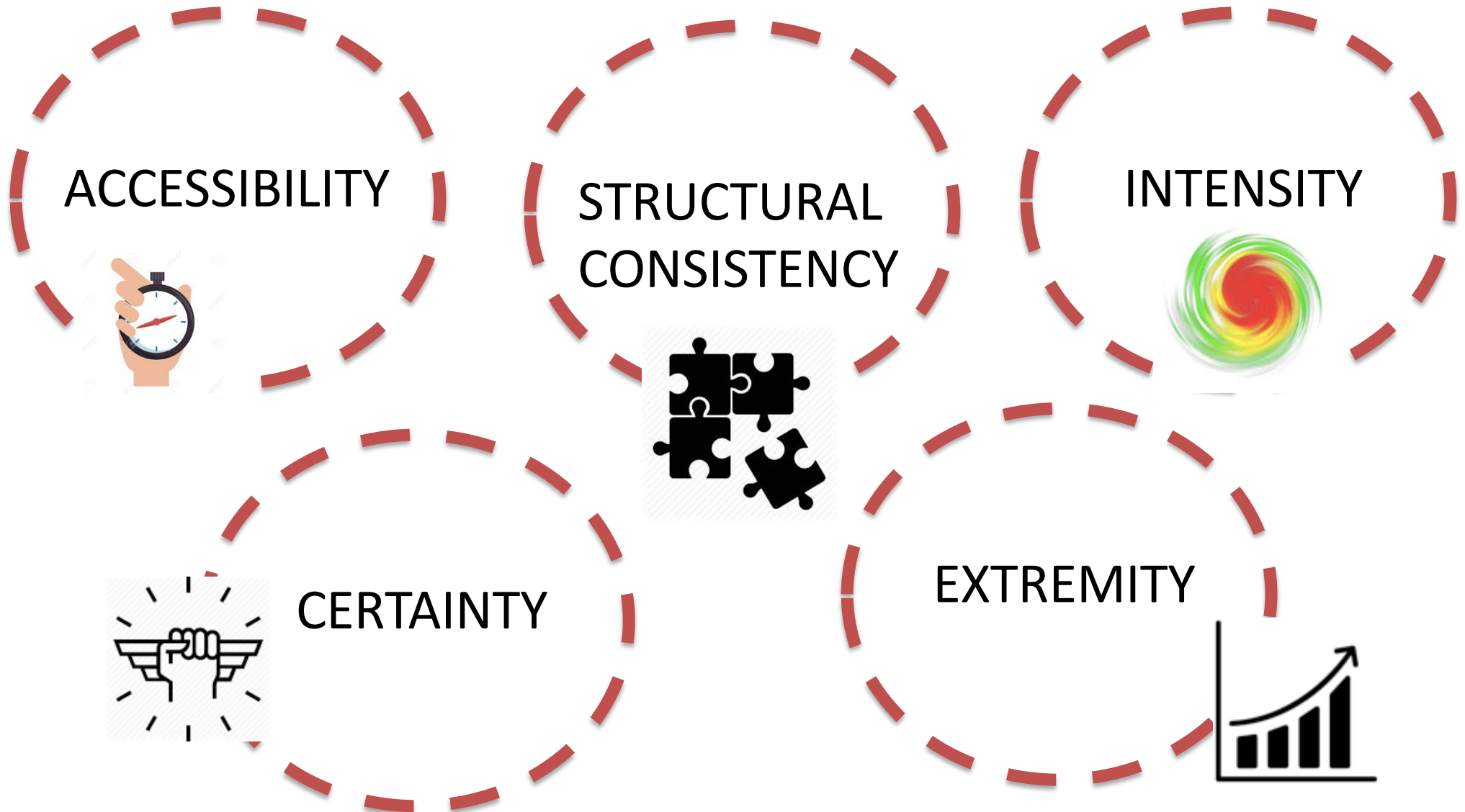
Predictivity of behavior

- evaluative reactions in highly connected attitude networks are more likely to align to each other.
- An aligned attitude network is likely to be more informative for a decision on whether a related behavior should be executed or not.
- highly connected network attitudes are more predictive of behavior

Knowledge: network size

- knowledge amplifies the effects of attitude strength (Wood et al., 1995).
- attitude networks that are both highly connected and consist of many different evaluative reactions will correspond to stronger attitudes

Traditional attitude strenght contributors



all likely to be caused by connectivity

Traditional attitude strength contributors

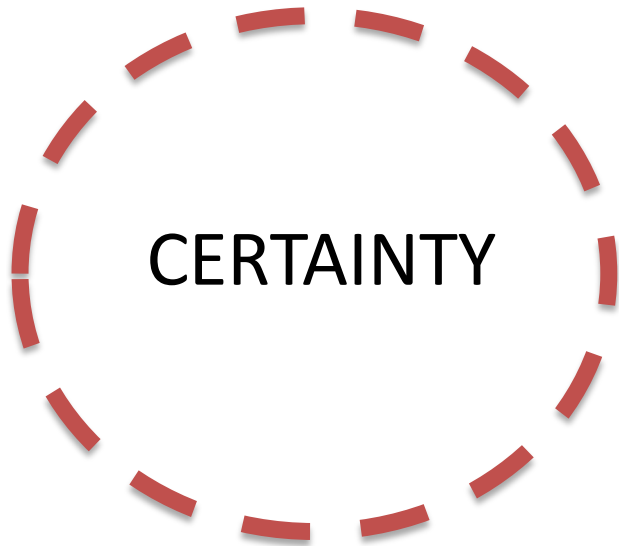


how fast a person can judge whether a given attitude object is positive or negative

FASTER IF evaluative reactions ARE aligned
-> highly connected attitude network



Traditional attitude strenght contributors

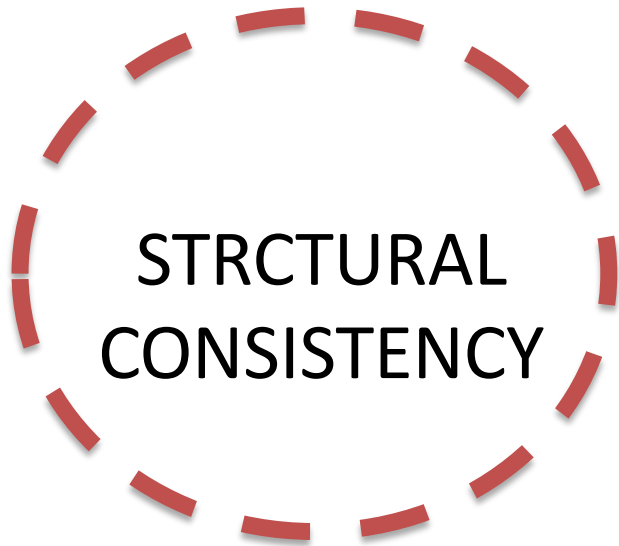


Attitude clarity= CONFIDENCE in the attitude and in its validity

aligned attitude network



Traditional attitude strength contributors



- evaluative- affective consistent
- evaluative-cognitive consistent
- affective- cognitive consistent
(Chaiken et al., 1995)

aligned attitude network



Traditional attitude strength contributors



how strongly an attitude object elicits emotional reactions

Visser et al., 2006

aligned attitude network

Traditional attitude strenght contributors



- POLARIZATION OF ATTITUDES

aligned attitude network



IN SUM... YOU CAN

- Attitude networks are driven by the trade-off between optimization (i.e., consistency between evaluative reactions) and accuracy.
- This trade-off results in a small-world structure, in which evaluative reactions, that are similar to each other, tend to cluster.
- Conceptualizing attitudes as networks provides **testable hypotheses** for attitude change (e.g., change in an evaluative re-action will foremost affect the cluster it belongs to) and a **parsimonious explanation** for the differences between strong and weak attitudes by conceptualizing
- attitude strength = connectivity of attitude networks.

Elaboration → connectivity

- Elaboration imparts more substantial and complex internal structure to attitudes (Haugtvedt & Petty, 1992; Wegener, Petty, Smoak, & Fabrigar, 2004), and it produces stronger attitudes (Shestowsky, Wegener, & Fabrigar, 1998) that are often more resistant to change (Haugtvedt, Shakarchi, Samuelsen, & Liu, 2004; Haugtvedt & Wegener, 1994)
- expertise is related to increased consistency among relevant beliefs, showing that elaboration and consistency are often concomitant (Judd & Krosnick, 1989; Lavine, Thomsen, & Gonzales, 1997)