

Understanding Group Polarization with Bipolar Argumentation Frameworks

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COMMA 2016, Potsdam 14-16 September 2016

Outline

- 1 Group polarization
- 2 A formal approach with Argumentation Frameworks
- 3 Dynamics
- 4 Modelling psychological processes
- 5 Likelihoods

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Group polarization (Stoner 1961)

Group-induced attitude polarization occurs “when an initial tendency of individual group members toward a given direction is enhanced following group discussion. [Isenberg 1986]

When it happens:

- decision in groups [Stoner 1961]
- political debate [Sunstein 2003]
- online debate, chats ... [Yardi & Boyd 2010]

Often gives rise to **bi-polarization** effects

no possibility of finding an agreement via collective debate

not to be confused with *Belief Polarization* [Lord et al. 1979]

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Explanations

Two main explanations tested with lab and field experiments

(a) **Social comparison** [Festinger 1957]:

Individuals tend to uniform to what they perceive to be the average opinion of their group, but go a bit more extreme

(b) **Persuasive Arguments Theory (PAT)**

[Vinokur & Burnstein 1974]:

Individuals are sensible to new persuasive arguments *pro* or *contra* and to revise their opinion accordingly

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PAT in the lab (Vinokur and Burnstein 1974)

Questionnaire

- A binary choice
 - c_1 = low risk - low gain
 - c_2 = high risk - high gain
- Test subjects should provide the *odds* for accepting c_2 together with **arguments**.

Experiments showing

- (a) a culturally given pool of pro and contra arguments determines the initial choice of odds. **Number** and **persuasiveness ranking** are correlated with the odds
- (b) Sharing of arguments is a necessary condition for shift
- (c) persuasiveness has an impact on shift
- (d) face to face discussion is **not** a necessary condition

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Elements

Qualitative

- An issue a
- Many agents
- arguments *pro* and *con*
- information exchange

Quantitative

- Prior and posterior degrees of belief about a
- persuasiveness

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Big questions (normative)

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- Is bi-polarization “rational”?
- Can bi-polarization “rational” arise in a group with mixed opinions?

‘Belief Polarization is not always irrational’ [Jern, Chang and Kemp 2014]

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Bipolar AFs (Cayrol and Lagasquie-Schiex 2005)

Definition (BAF)

A Bipolar Argumentation Framework \mathcal{BAF} is a tuple $(\mathcal{A}, \mathcal{R}^a, \mathcal{R}^s)$ where \mathcal{A} is a finite and non-empty set of arguments and $\mathcal{R}^a, \mathcal{R}^s \subseteq \mathcal{A} \times \mathcal{A}$

can be used as the **culturally given pool of arguments**

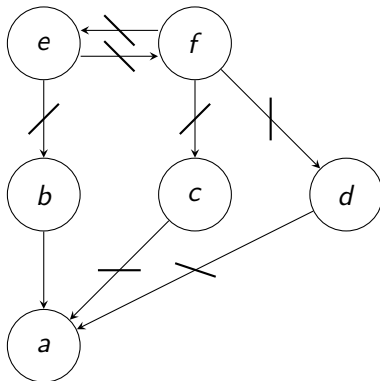
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A BAF



Semantics

Definition (defeat and support)

- 1) a is a **supported attack** of b iff there exists a sequence $aR_1 \dots R_nb$ s.t. $R_1, \dots, R_{n-1} = R_s$ and $R_n = R_a$.
- 2) a is an **indirect attack** of b iff there exists a sequence $aR_1 \dots R_nb$ s.t. $R_2, \dots, R_n = R_s$ and $R_1 = R_a$.
- 3) a **supports** b iff there exists a sequence $aR_1 \dots R_nb$ s.t. $R_1, \dots, R_n = R_s$.

- a set S is **conflict-free** if there is no $a, b \in S$ s.t. a attacks b
- a set S is **admissible** iff it is conflict-free and **defends** all its elements
- ...

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Many agents

Definition (Multiagent scenario)

Given a \mathcal{BAF} a multiagent scenario is a vector $(\mathcal{BAF}_1, \dots, \mathcal{BAF}_n)$ of \mathcal{BAFs} where each \mathcal{BAF}_i (for $1 \leq i \leq n$) is a subgraph of \mathcal{BAF}

- **Universal Argumentation Frameworks** M. Caminada and C. Sakama. *On the Issue of Argumentation and Informedness* (2015)
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Polarization with two participants



Information exchange

Definition (Union)

Given a vector (BAF_1, \dots, BAF_n) of BAFs we define, for each i , the update after information exchange as

$$BAF_i^* = (\bigcup_{i=1}^n \mathcal{A}, \bigcup_{i=1}^n \mathcal{R}_i^a, \bigcup_{i=1}^n \mathcal{R}_i^s)$$

In scenarios like ours we avoid complications induced by merging procedures: Coste-Marquis et al. (2007), Delobelle et al. (2015, 2016)

Information exchange

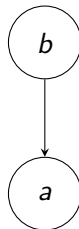
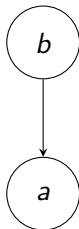
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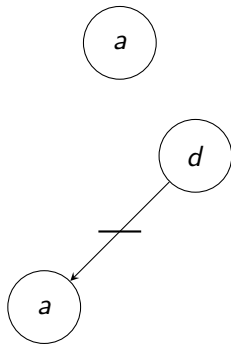
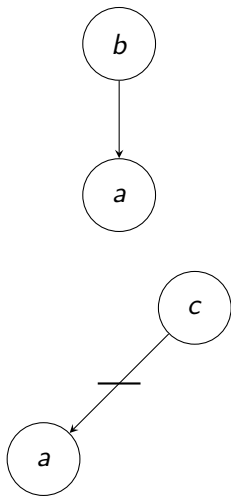
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After information exchange

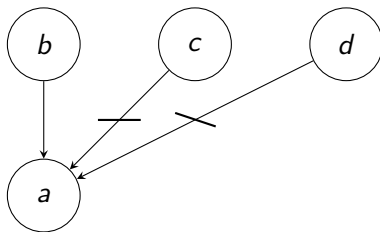


Four participants with different attitudes



After debate...

They need o break the tie



Intermezzo: decomposing the process

At least two phases:

- 1 **Information transmission:** truthful, strategic, lies, stonewalling etc.
- 2 **Belief update:** more or less open to new information

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Cognitive dissonance (Festinger 1957)

The presence of inconsistent information usually makes individuals uncomfortable and motivates them to reduce **dissonance**.

- by avoiding information
- by discarding evidence
- devote more scrutiny to hypotheses and explanations that speak against their prior beliefs [Gilovich 1991]

The latter is common in scientific debate (sticking to the **paradigm**).

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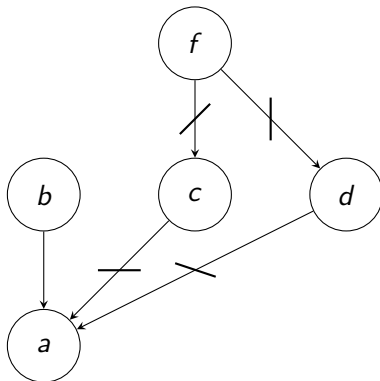
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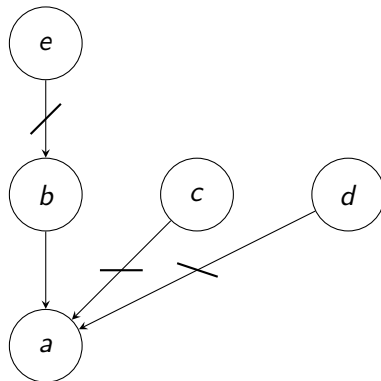
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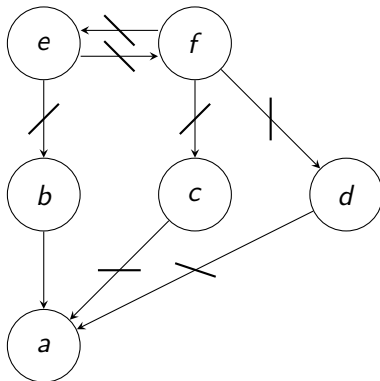
Agent 1 and 2



Agent 3 and 4



What may happen yet



Value-based argumentation

Typically arguments in a debate over a practical issue are related to different **values**

Definition (VBAF, Bench-Capon 2003)

A Value-based Bipolar Argumentation Framework \mathcal{VBAF} is a tuple $(\mathcal{A}, \mathcal{R}^a, \mathcal{R}^s, V, val, P)$ where \mathcal{A} , \mathcal{R}^a and \mathcal{R}^s are as before, V is a set of values, val is an assignment $\mathcal{A} \rightarrow V$ and P is a set of “possible audiences” where $p \in P$ is a ranking on V

- An argument a *defeats* b for audience p iff $a\mathcal{R}^a b$ and not $a <_p b$
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Value-based argumentation

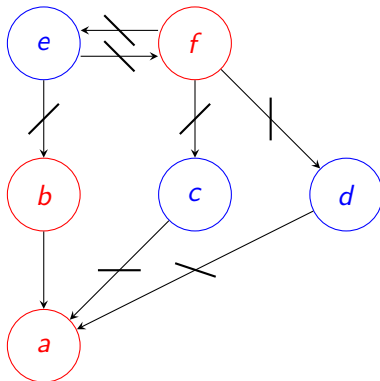
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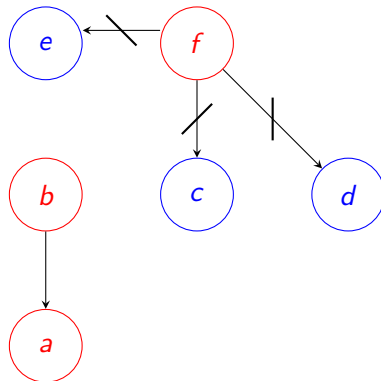
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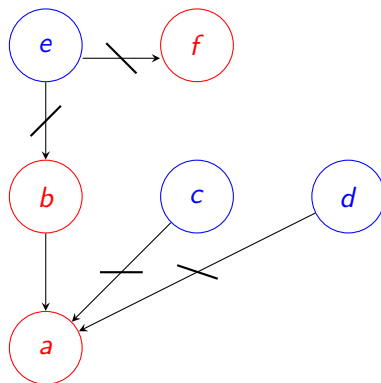
Two values



Agents 1 and 2



Agents 3 and 4



Adding probabilities (Li et al. 2013)



- likelihood of arguments (aka validity)
- likelihood of support/defeat (aka pertinence etc.)

$$PrBAF = (A, P_A, R^a, P_{R^a}, R^s, P_{R^s})$$

Measures

Let $I(PrBAF)$ = the set of all BAFs induced by PrBAF (see Li et al.)

Let $G = (A', R'^a, R'^s) \in I(PrBAF)$


$$p(G) = \left(\prod_{a \in A'} P_A(a) \right) \left(\prod_{a \in A \setminus A'} 1 - P_A(a) \right) \left(\prod_{r \in R'^a} P_{Ra}(r) \right) \left(\prod_{r \in R_{A'}^a \setminus R'^a} 1 - P_{Rr}(r) \right) \\ \left(\prod_{r \in R'^d} P_{Rd}(r) \right) \left(\prod_{r \in R_{A'}^d \setminus R'^d} 1 - P_{Rd}(r) \right)$$

Conclusions and future work


- Modelling information dynamics
- Modelling psychological processes
- Quantitative aspects
- Answer the big question!

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