

A dynamic model for the mutual constitution of individuals and time-ordered events with internal structure

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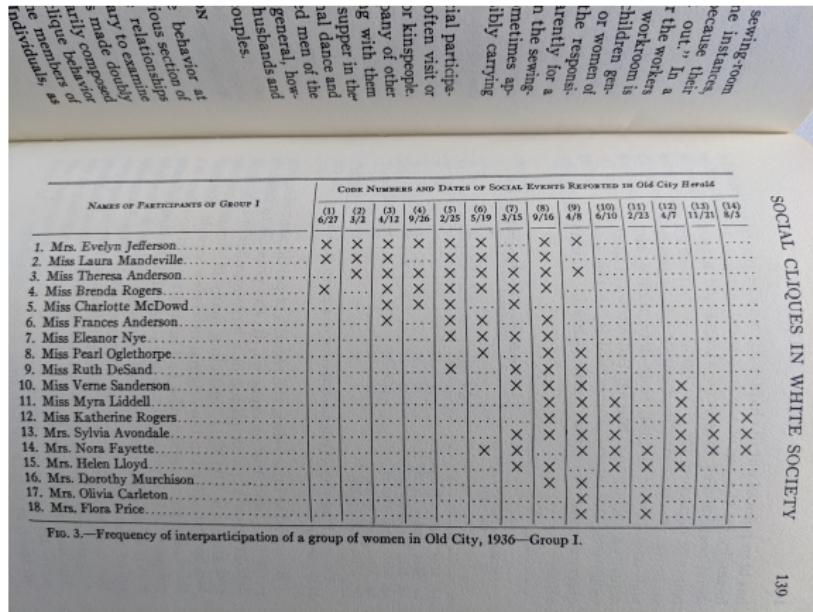
Duality@50

Ascona, 14–18 April, 2024

<https://github.com/juergenlerner/eventnet>

Individuals and time-ordered events.

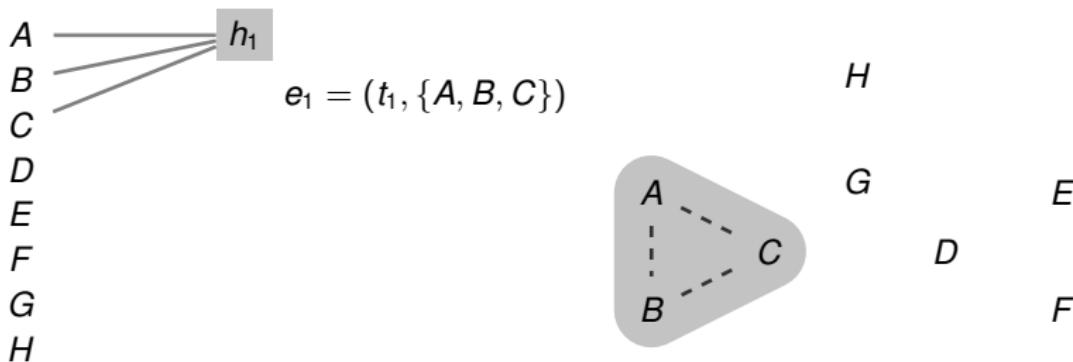
Example: Davis, Gardner, and Gardner (1941). **Deep South.**



Events are ordered in time.

Here: events as time-ordered hyperedges.

Event nodes (squares) become “active” at a single point in time; in which they simultaneously create all their edges to actors; afterwards, edges never get updated.

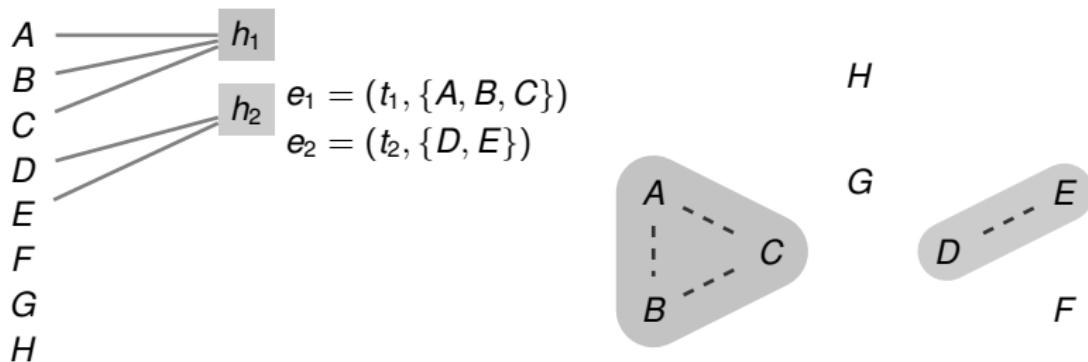


Events represent interaction among individuals.

Prefer to consider **events as hyperedges** (not as nodes).

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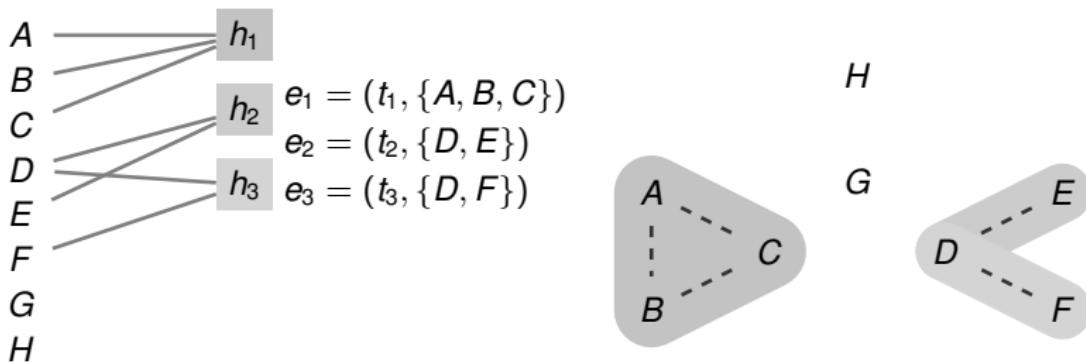


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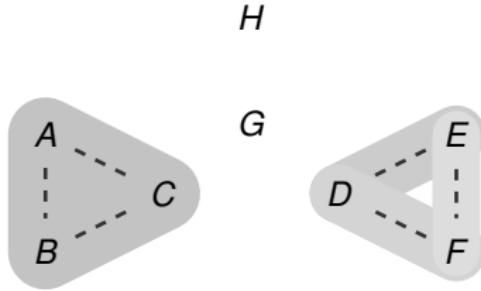
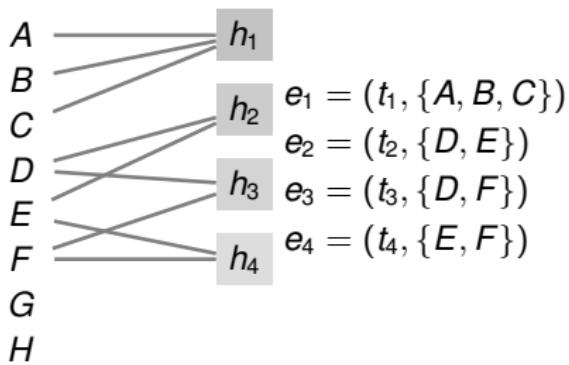


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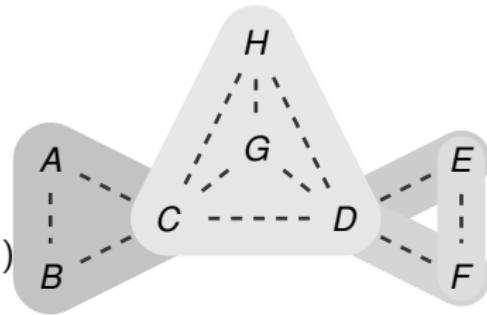
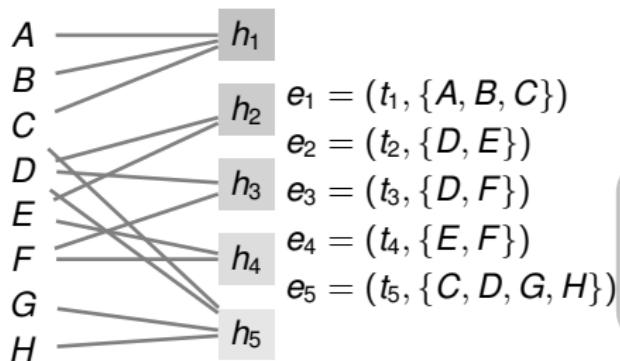


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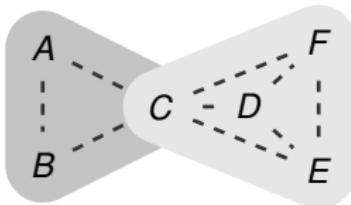
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What is meant by **internal structure**?

The structure of hyperevents (I, II, III).

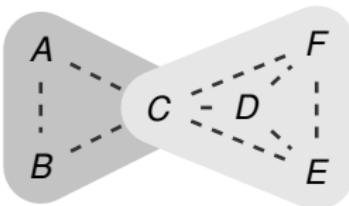
undirected events:
meetings, coauthoring



participants form a
clique

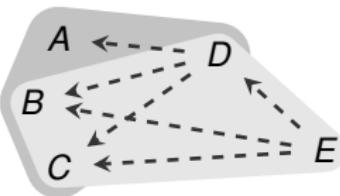
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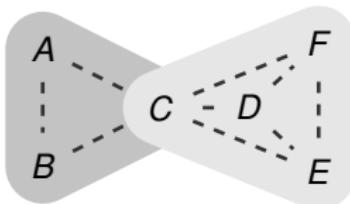
directed events: multi-cast communication,
citation



participants form a
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(senders – receivers)

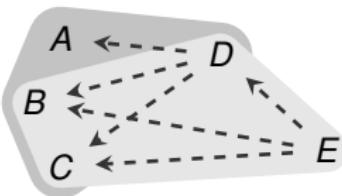
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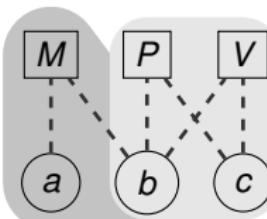
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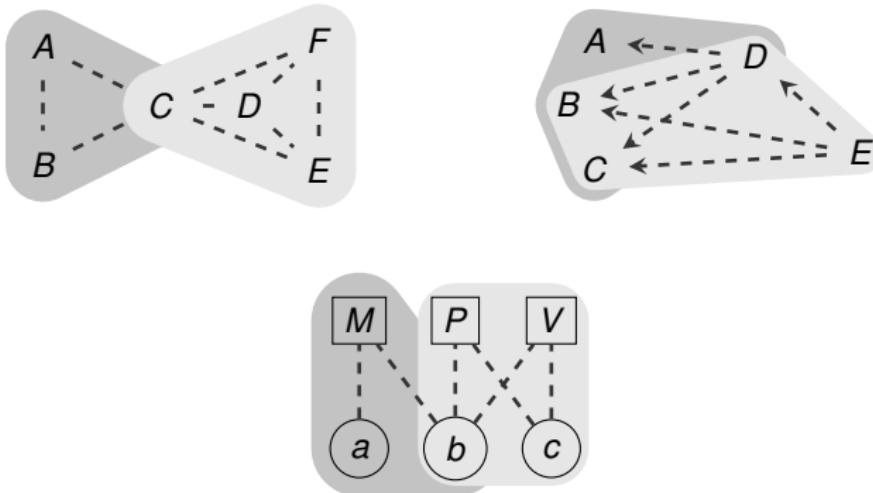
labeled events: e.g.,
co-offending labeled by
crime-categories



bi-clique in a two-mode network
(actors – labels)

Relational hyperevent models (RHEM).

When events are time-ordered, RHEM seek to explain the selection of **events that happen** from the space of **events that could have happened**.



RHEM explain the **occurrence of hyperedges (not collections of derived dyadic edges)**.

More general event structure (glimpse into the literature).

Beyond actors and events.

Relations among more than just two types of nodes.

- ▶ k -partite concept lattices (actors, groups, discourses, events).
Mische & Pattison (2000). **Composing a civic arena: Publics, projects, and social settings.** *Poetics*.
- ▶ Folksonomies: ternary relations among users – tags – resources.
Cattuto et al. (2007). **Network properties of folksonomies.** *AI Communications*.
- ▶ “*Going full Breiger*” / D -uniform hypergraphs.
Lee & Martin (2018). **Doorway to the dharma of duality.** *Poetics*.

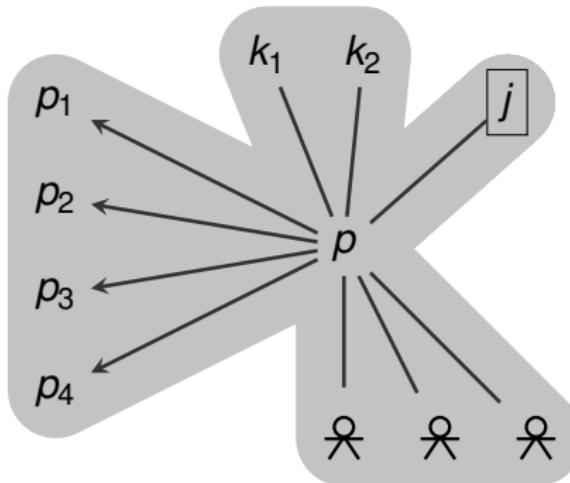
General internal hyperevent structure.

Goal: combine analytic capabilities and efficiency of R(H)EM with algebraic generality of “going full Breiger” (or similar generalizations).

(IV) Mixed multi-mode hyperevents.

e.g., scientific publications

Paper p with **keywords** k_1, k_2, \dots published by **authors** a_1, a_2, a_3, \dots in **journal** j , citing **references** p_1, p_2, \dots



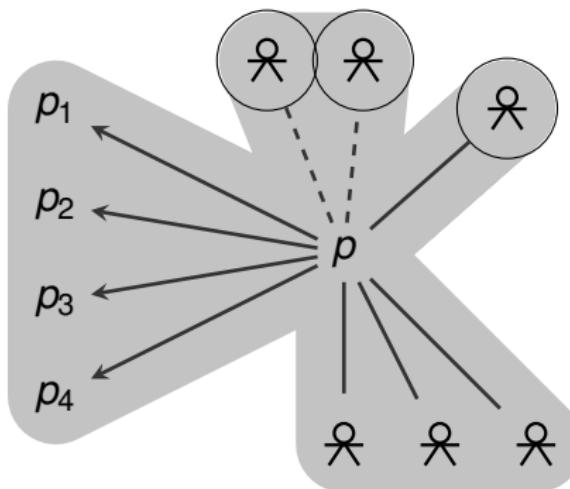
Internal structure: **k -partite clique**.

Many higher-order effects possible.

(V) Positions or roles within hyperevents.

e.g., scientific publications; movie production

Persons linked to a publication event have different positions:
author, editor, reviewer, ...



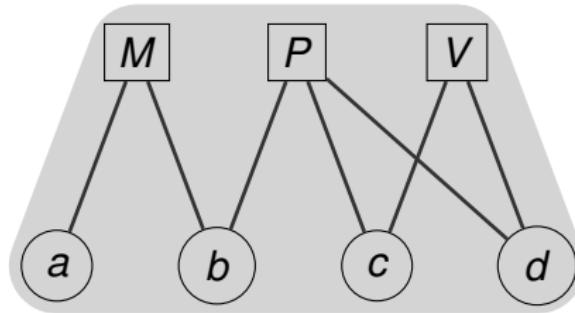
Possibility of **effects across positions**:

does a paper cite prior papers of its editor, etc.

(VI) Hyperevent with varied internal adjacency.

e.g., co-offending events with crime categories

Group of actors jointly committing a crime, associated with various crime categories (e.g., market, property, violence).



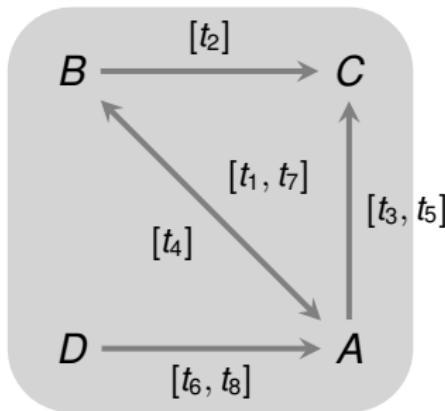
Work might be divided:

not necessarily a fully connected bi-clique.

(VII) Hyperevent with general internal dynamics.

e.g., meetings with communication events; coauthoring with paper writing; conferences with position-trace data; Wikipedia: contributing to article, interacting within article

The “outer” network dynamics explain
the selection of participating nodes;
the “inner” network dynamics explain their interaction.



Processes might mutually influence each other.

RHEM for events with internal structure.

Sequence of events: $(t_1, G_1), \dots, (t_n, G_n)$.

- ▶ t_m **time** of the m 'th event
- ▶ $G_m = (I_m, Y_m, z_m)$ (**generalized**) **hyperedge**,
or **graph**, representing the m 'th event:
 - ▶ I_m **participating nodes** (possibly: types of nodes)
 - ▶ Y_m **ties** among participants (weighted, time-stamped)
 - ▶ z_m **attributes** of the event, nodes, ties

What is already possible? What can / has to be done?

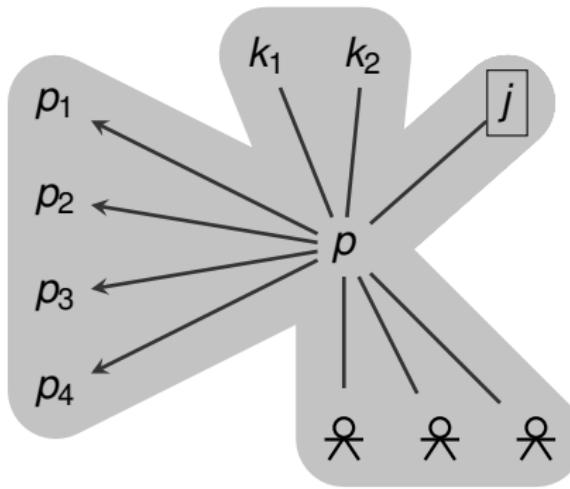
This refers to “*possible in the **eventnet** software*”.

<https://github.com/juergenlerner/eventnet>

Multi-mode hyperevents / positions within events.

Eventnet already allows **any number of node sets**.

But, **relations** assumed to **involve only two sets** at a time.

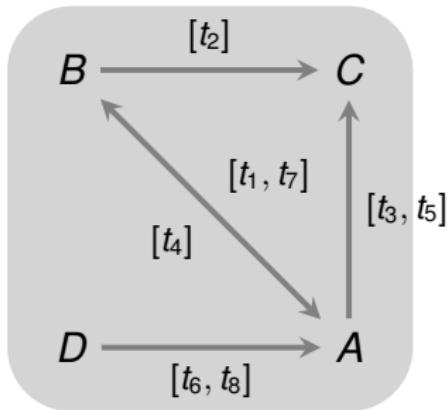
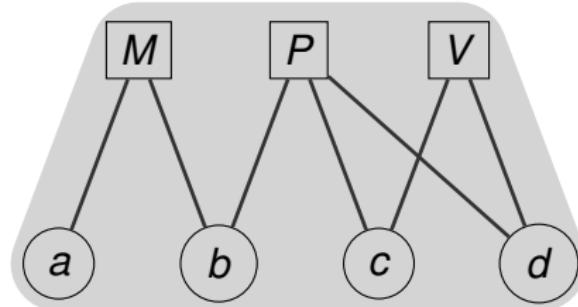


This discards some plausible and relevant effects.

Future work: models explaining k -partite hyperevents.

General internal structure/dynamics.

(Possible) future work: **hierarchical models**, REM, RHEM, ...



Patterns of the participant-selection process may influence inner structure/dynamics.

Inner structure/dynamics may influence participant-selection of future events.

Summary.

Nodes participating in the same events can be different

- ▶ actors, labels, organizations, event positions, ...

and can be differently related

- ▶ internal structure / dynamics.

Induces multiple interdependent dualities.

Raises the possibility of

many **new effects explaining event dynamics.**