Eventity concepts and ontological knowledge

SIABO PhD School:
Ontology & Lexicon –
Theory and Applications

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Overview

- Introduction
- Representation framework
- Building blocks
  - dynamic structure elements
  - participant structure elements
  - relational elements
- Conclusion and outlook

INTRODUCTION

RECAP: Ontology for linguistics

- cross-connected network of categories / concepts used for linguistic description and analysis

=> contains building blocks for precise linguistic description and analysis and their network

RECAP: What is an 'ontology'?

- “In the context of computer and information sciences, an ontology defines a set of representational primitives with which to model a domain of knowledge or discourse.”

  (Gruber 2008, http://tomgruber.org/writing/ontology-definition-2007.htm)

What building blocks are needed to model a target domain?

in particular those that are lexicalised

Domain to be modelled: eventities

- events and similar entities (Zaefferer 2002)
- entities which
  - ‘happen, occur, take place’
  - relatively clear temporal boundaries
  - tolerate spatial co-location
  - occurrents – take up time
  - have different parts (stages) at different times

(Casati & Varzi 2006)

- typically coded by verbs in natural languages

Questions

- Which building blocks for the modelling of (potentially lexicalised) eventity concepts are needed?
- How can these be represented and combined appropriately?

Decompositional approach: look at eventities as structured configurations, composed of more general (or basic) components and their internal structure

REPRESENTATION FRAMEWORK

UER: Adaptation of UML

- *Unified Eventity Representation* (UER)
  (Schalley 2004)
- successful adaptation of the object-oriented *Unified Modeling Language* (UML; de-facto standard formalism for software design and analysis)
  (OMG 1997–2008)

UER: Why object-oriented?

- central: concept of ‘object’ (i.e. entity), whose characteristics, relations to other entities, behaviour, and interactions are modelled in a rigorous way
- cognitive system centres around entities and what they are like, how they are related to each other, what happens to them and what they do, and how they interact with one another

correspondence between object-orientation and cognitive organization strongly suggests application of object-orientation for representational task at hand

UER: The basics

- UER adopts object-orientation and graphical nature of UML, as well as general architecture
- UER diagrams composed of well-defined graphical modelling elements, which represent conceptual categories
- UER iconically distinguishes different modelling elements for different conceptual types (sortal distinctions) – respects underlying ontology

Adaptation of modelling elements

- Representation of eventities requires representation of:
  - dynamic structure (course of eventity)
  - participant structure
  - relations
- UML offers modelling elements that suggest themselves for adaptation

dynamic structure elements

participant structure elements

relational elements

BUILDING BLOCKS

states

transitions

interactions

DYNAMIC STRUCTURE ELEMENTS

Dynamic structure

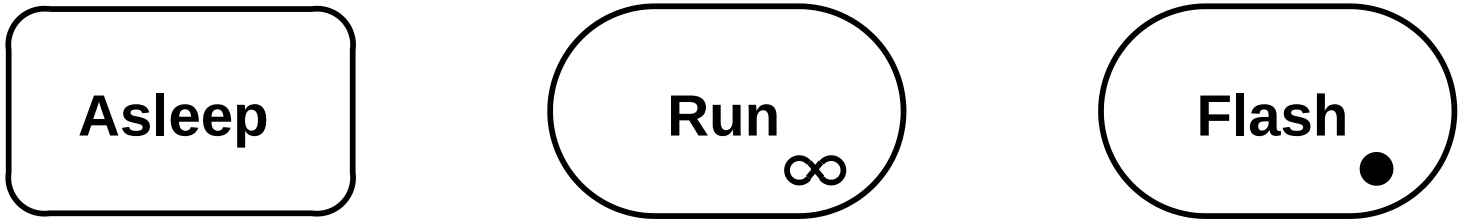
- “dynamism” (Talmy 2000: 215) inherent in eventities perceived as primary or ‘core’ substructure
- focussed on issues related to progression in time
- temporal sequences of states and transitions that participants undergo (cf. OO: behaviour attributed to objects/entities)

Dynamic structure

- dynamic structure elements:
  - **states**
  - **changes of states** (transition)
  - **interactions** of participants
    (where ‘interaction’ is understood very broadly as any impact one participant exercises on another)
- elements attributed to participants
- modeled in the UER by state-transition systems of participants

States

- basic human experience: some entity being in a **state** (i.e. in a situation in which it is conceptualized to show the same qualitative reaction to the same stimulus – whenever this stimulus is received)



States

- holds for some time: more stable dynamic aspects
- different types of states
  - criteria: activeness and durativity
  - reflected in interpretations of linguistic expressions, e.g. adverbial modification:
    (1) *He ran for 2 hours.*
    (2) *The light flashed for 2 hours.*

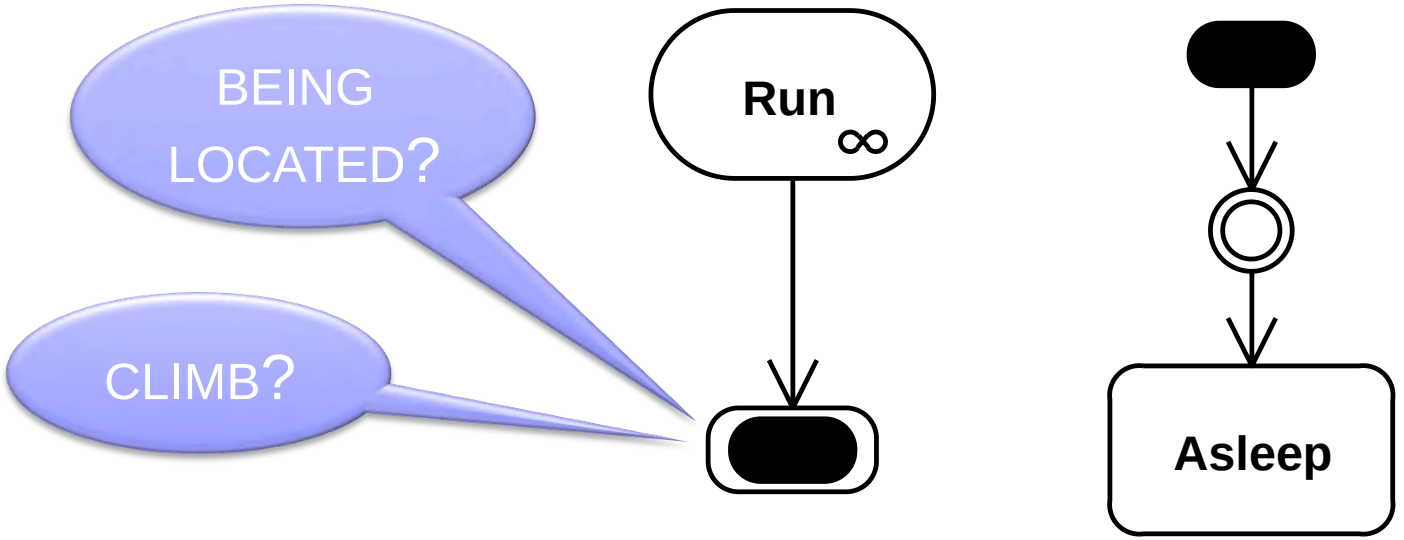
Transitions

- when the entity leaves the state, it enters another state

=> undergoes a change of state or **transition** into this other state

- inherently linked to instability and non-permanence
- transition types:
  - unmarked: conceptualized with no extended duration
  - marked: durative, gradual changes of state

Transitions

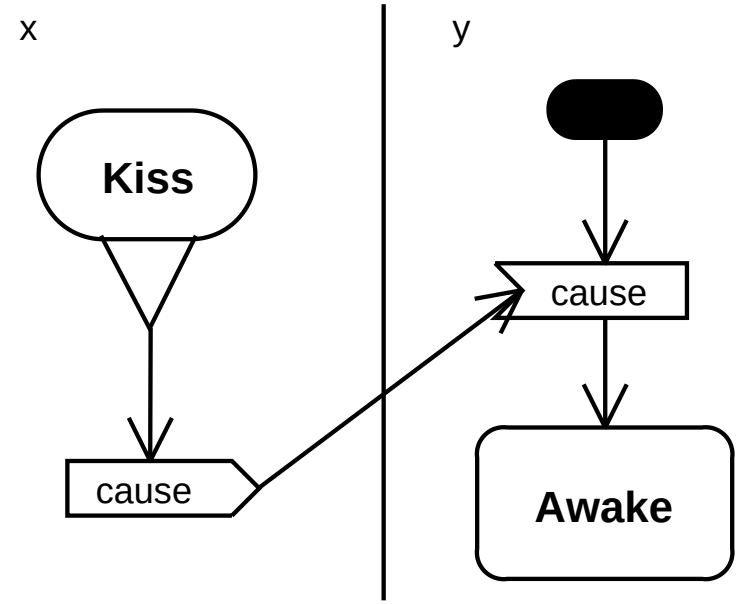


underspecification does not only leave the direct nature of the states unspecified, but also does not make any statements about the type of state (active vs. passive)

Interactions

- any impact one participant exercises on another
- presumably cognitively of high importance
- entities
  - receive stimuli which might trigger particular behavior and transitions in their state-transition system
  - send stimuli which might impact on other entities and cause particular behavior on part of these entities
- stimuli
  - asynchronous in nature
  - function as triggers => causes

Interactions



dynamic aspects of the eventity coded by the German verb *wachküssen* [awake-kiss] ‘wake up by kissing’

Notes:

- temporal alignment of the two entities’ state- transition systems merely takes place at moment of interaction
- no statement made how active state of *x* is otherwise temporally related to the source state of *y*’s transition
- UER does not introduce ordering relations between subevents as, e.g., Pustejovsky (1995: 67–75)

(potential) participants

roles

types

attributes

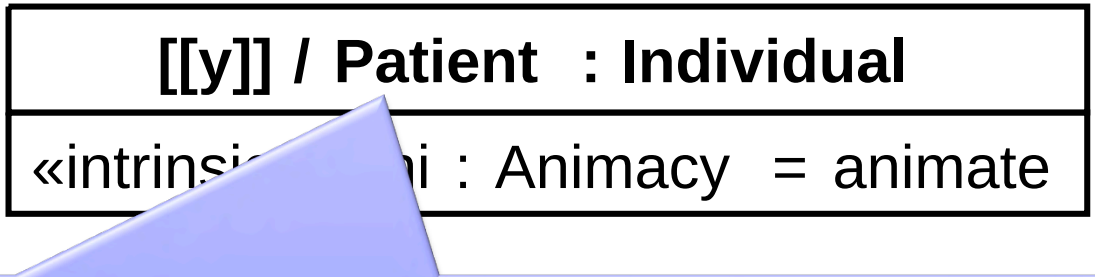
PARTICIPANT STRUCTURE ELEMENTS

Participants

- entities that potentially participate in the respective eventities
- general eventity concept: no context given
- eventity concepts
  - not only feature underspecification to accommodate flexibility in usage
  - also encompass ‘slots’ for participants to be context-dependently added

Participants

- slots entertain certain features and characteristics that restrict which entities can be participants of the eventity in question
- participant class representation:



role of participant in eventity (in contrast to prominent participant): *semantic role*: bundles of features that specify relational characteristics the participating entity has when participating in the eventity, e.g. volitionality

Participants

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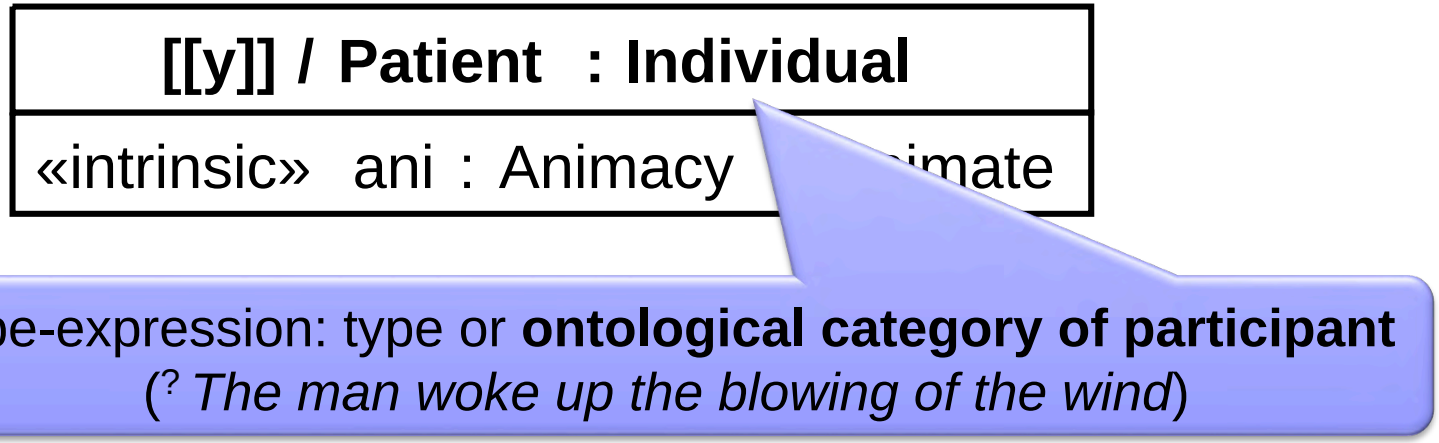
- participant class representation:



Participants

- slots entertain certain features and characteristics that restrict which entities can be participants of the eventity in question
- participant class representation:

[[y]] / Patient : Individual
«intrinsic» ani : Animacy = animate

co-conceptualised selectional restrictions: **additional requirements on potential participants**
(can refine both role and type specification)
– *feature-value pairs* (cf. Barsalou 1992)

Attributes: feature-value pairs

- cognitively salient: reflect underlying recurring cognitive categories (Schalley 2004)
- e.g. Talmy (2007): range of such categories and their values for domain of spatial structure
- also cf. Hellwig (2007:280) about nominal classifier types found in natural languages:

  > “all types draw upon a recurring set of semantic domains: they classify according to animacy (e.g., human vs. non-human), function (e.g., edible vs. non- edible), and physical properties such as extendedness (e.g., one-dimensional vs. two-dimensional; long vs. flat), consistency (e.g., flexible vs. rigid), constitution (e.g., liquid vs. solid), material (e.g., wood vs. metal) etc.”

Attributes: feature-value pairs

- possess no entity-like identity
- values of features such as ‘animacy’:
  - not expected to reflect results of scientific research
  - expected to mirror differences in human cognition – differences reflected in natural language (such as the distinction between humans and other animate beings, cf. Silverstein’s 1976 animacy hierarchy)

Attributes: feature-value pairs

- possible to restrict usage of features to specific modelling elements

  e.g. ontological ‘background’ knowledge such as that colour cannot be a feature of motion can be modeled in the system:
  `colour` not to be used with dynamic elements

  => well-formedness rules on set of recurring categories allow to prevent category mistakes such as COLOURED MOTION (or RED RUNNING)
  [cf. Fellbaum 2007]

association

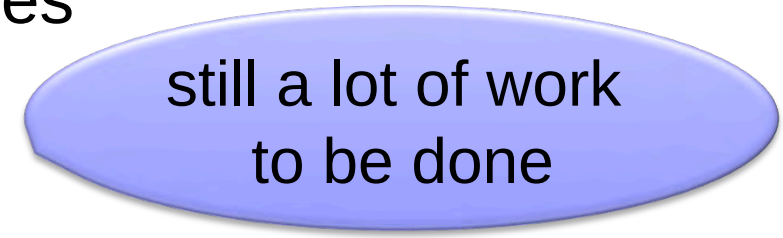
generalisation

aggregation

RELATIONAL ELEMENTS

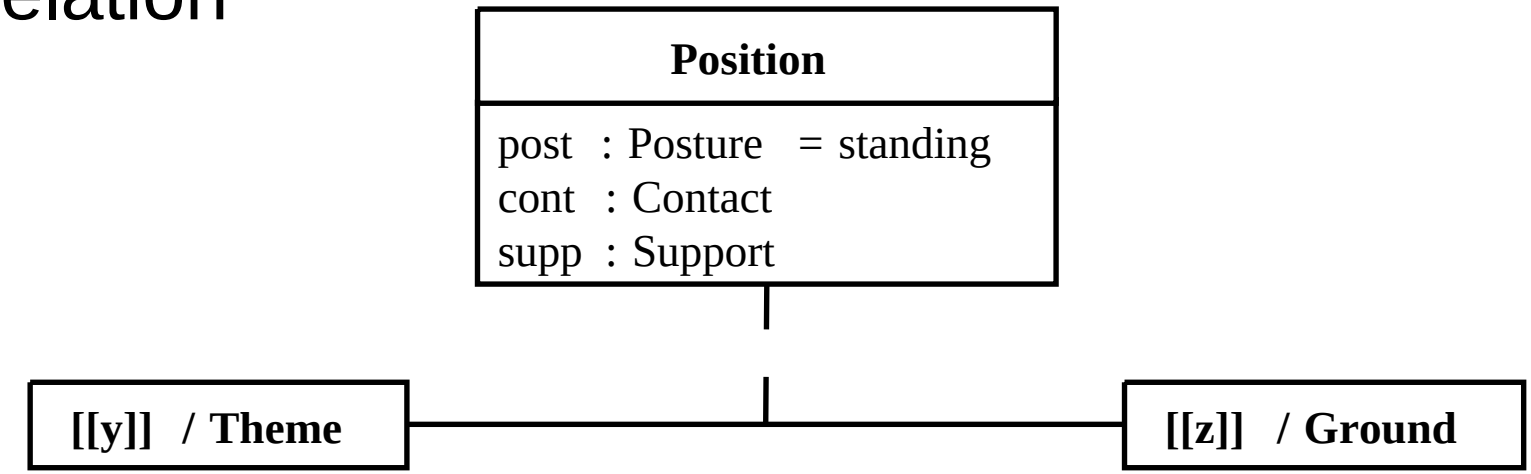
Relations

- relational types:
  - between participants of eventities
  - ontological positioning of entity
  - between eventities
- semantic descriptions usually do not provide a rigorous way to explicitly and specifically represent conceptual relations
- UER relational types: association, generalisation, aggregation



Association

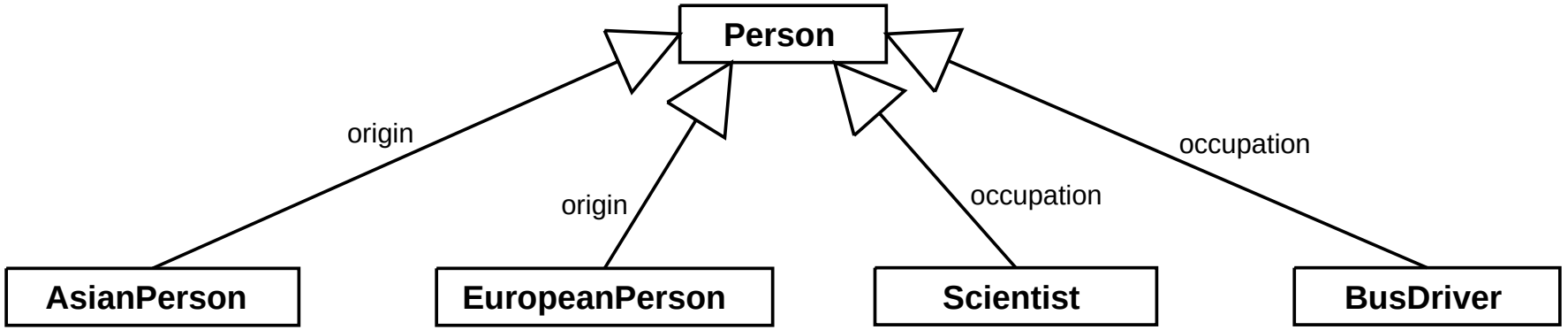
- structural category for ‘general semantic relation’



- also mechanism to account for context-dependent enrichment

Generalisation

- inheritance or hyponomic relation
- relationship between a superordinate and a subordinate
- subordinate is fully consistent with the superordinate element, i.e., it inherits and has all the characteristics and entertains all the relations of the superordinate element



Aggregation

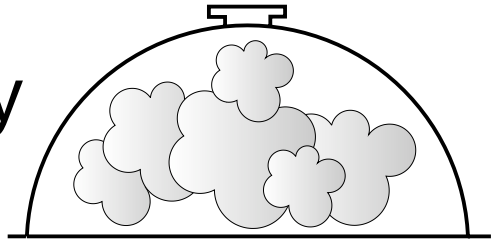
- superordinate to meronomy (part-whole)
- meronomy: to be part of a whole means that the part is restricted in its possible behavior and characteristics

=> the whole either propagates behavior or characteristics, or it controls behavior or characteristics of the part (Schalley 2004)

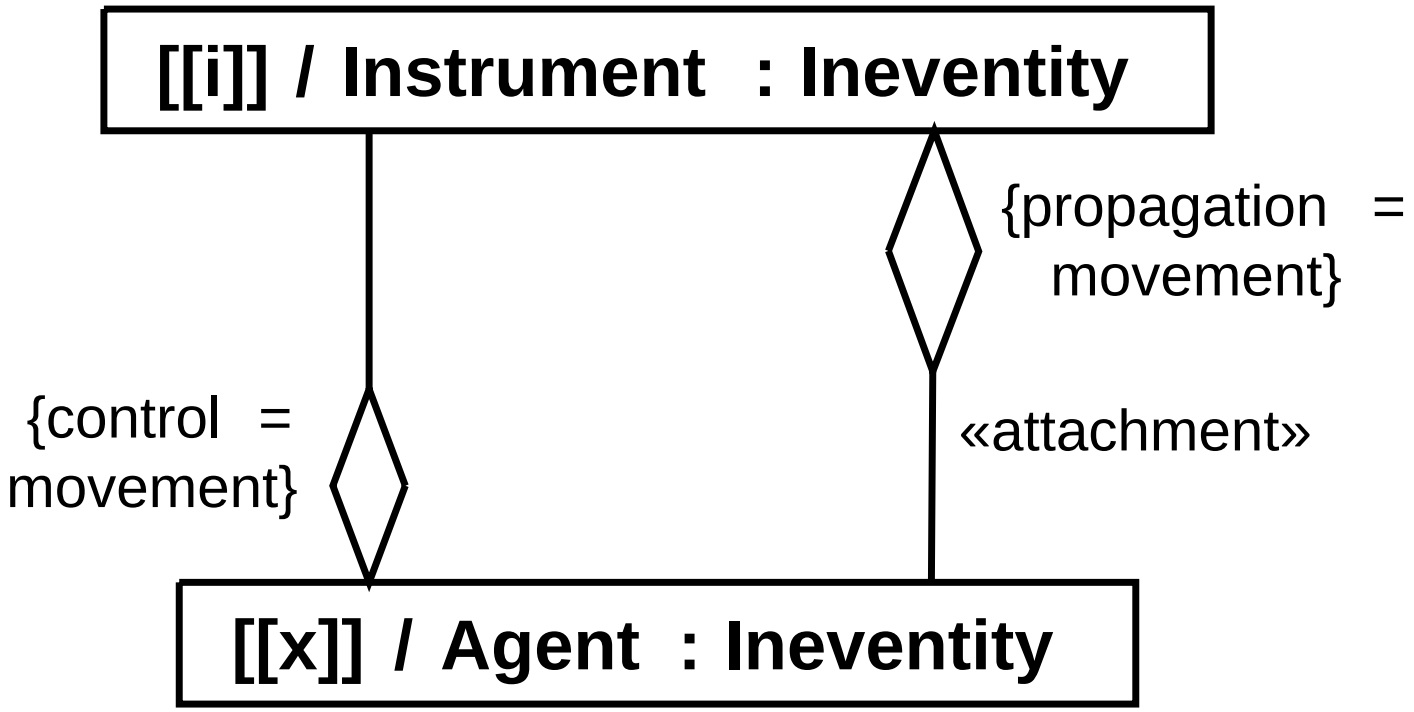
Aggregation

- notion of one entity impacting on another because of a specific relation between them not unique to part-whole relations:
  - attachment
  - possession
- more generally, control and propagation relations play an important role

  e.g.: cheese cover controlling the smoke (although there surely isn't a part-whole, attachment or possession relation involved)



Aggregation



Aggregation

- UER: relation of **aggregation**:
  one entity propagates to or exercises control over the behaviour or characteristics of another entity
- aggregation relation has three distinguished (because cognitively recognised) subtypes:
  - meronomy
  - attachment
  - possession

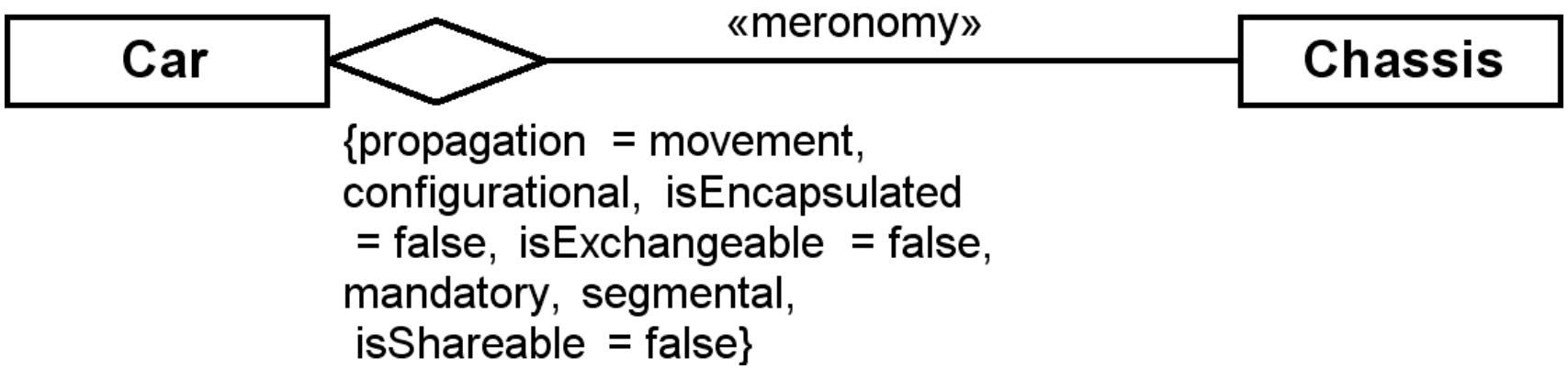
Aggregation

- therefore: no surprise that in many languages part-whole relations are actually encoded using “a grammatical construction associated with ‘possession’.” (Goddard 2007:157)
- does not describe the focussed course of events but a generally eventity-specific relationship that outlines circumstances and conditions under which the two participants interact

  => representation in participant structure adequate

Aggregation

- characteristics of aggregations can be specified to express different flavors of meronomies and attachments



CONCLUSION AND OUTLOOK

Summary

- decompositional approach to eventity concepts
- questions
  - which building blocks for the modelling of (potentially lexicalised) eventity concepts are needed?
  - how can these be represented and combined appropriately?

addressed:

Building blocks

- dynamic structure
  - states
  - transitions
  - interactions
- participant structure
  - participant class
  - role
  - type
  - attributes
- relations
  - association
  - generalisation
  - aggregation

Representation

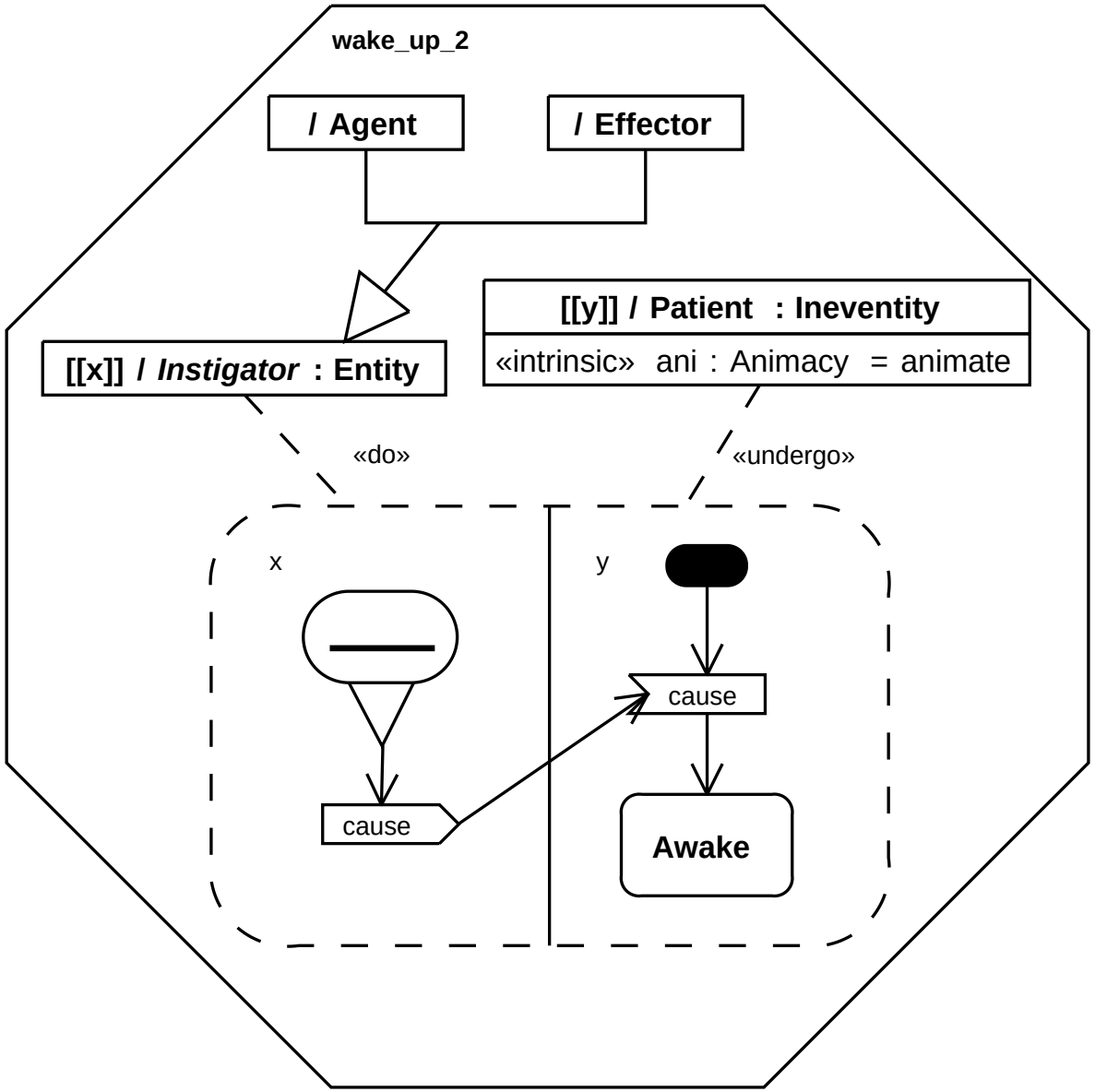
- of the building blocks for the modelling of eventity concepts: with UER, an adaptation of UML
- specified syntax and semantics as well as other well-formedness rules delimit the combinatorics
- other more sophisticated mechanisms present in the UER (such as nesting of eventities via ‘subcore states’)

Conclusion and outlook

- UER reflects ontological knowledge in, e.g., the structural categories (building blocks) presented, which are building blocks for precise linguistic description and analysis (‘ontology for linguistics’)
- structural categories are a “set of representational primitives with which to model a domain of knowledge” (cf. definition of *ontology,* Gruber 2008), namely the domain of eventity concepts
- the specification of the UER (its syntax and semantics) provide information on combinability and how they are related to one another => network of building blocks

Conclusion and outlook

- building blocks:
  - structural categories we expect human cognition to work with
  - reflected in a broad range of natural language phenomena, such as, e.g., adverbial modifications and their interpretation due to underlying Aktionsart differences
- hypotheses:
  - structural categories are more likely to be universal and in principle stable
  - why? they appear to be founded in basic cognitive organization and to incorporate basic human experience


wake_up_2
/ Agent
/ Effector
[[x]] / Instigator : Entity
[[y]] / Patient : Ineventity
«intrinsic» ani : Animacy = animate
«do»
«undergo»
x
y
cause
cause
Awake

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