Creation constructions and frames

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Introduction

- what does the grammar contribute to the interpretation of clause arguments, what does world knowledge contribute?
- how do these two resources interact in argument linking?
- empirical domain: the interpretation of clauses involving three related German creation/transformation constructions:
  - the simple creation construction, the
  - *zu*-construction and
  - the *aus*-construction
- main claim: full interpretation of clause arguments depends (in some cases) on abductive reasoning
  - verbs introduce functional (specific) semantic roles
  - constructions (or event schemas) introduce relational (generalized) semantic roles
  - the assignment of a specific semantic role to a clause argument depends (in some cases) on abductive reasoning

Outline

Creation constructions and flexible orientation

Basic assumptions and semantic composition

Conceptualization and enrichment via abduction

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Creation constructions (1)

(1) Maria faltet ein Blatt
Maria-NOM is folding a sheet-ACC

- transitive syntax (subj. + V + dir. obj.)
- interpretation:
  - Mary is the person folding in the event e, i.e. $\mathbf{fold}_1(e) = \mathsf{m}$
  - some sheet of paper undergoes the folding process, i.e. $\mathbf{fold}_2(e) = y \wedge \mathbf{sheet}(y)$

Creation constructions (2)

(2) Maria faltet ein Flugzeug
Maria-NOM is folding a-ACC plane

- transitive syntax (subj. + V + dir. obj.)
- (default) interpretation:
  - Mary is the person folding in the event e, i.e. $\mathbf{fold}_1(e) = \mathsf{m}$
  - something undergoes the folding process, i.e. $\mathbf{fold}_2(e) = y \wedge \mathbf{sheet}(y)$
  - as a result of e a plane z comes into existence, i.e. $\mathbf{result}(e, z) \wedge \mathbf{plane}(z)$

Creation constructions (3)

(3) Maria faltet einen Umschlag
Maria-NOM is folding an-ACC envelope

- transitive syntax (subj. + V + dir. obj.)
- two possible interpretations:
  1. an envelope undergoes the folding process
  2. something (probably a sheet of paper) undergoes a folding process; as a result an envelope is created
- the choice among these options is determined (or constrained) by extragrammatical resources, in particular contextual information and general reasoning mechanisms

Verbs with flexible orientation – Examples from German

(4)
a. Blatt / Flieger falten (fold sheet / plane)
b. Teig / Würstchen kneten (knead dough / sausage)
c. Fleisch / Kugel rollen (roll meat / ball)
d. Würfel / Turm stapeln (stack dice / tower)
e. Schnee / Pumptrack schaufeln (shovel snow / pumptrack)

(extracted from corpus research on the corpus of the IDS Mannheim)

Creation by convention

- Verbs involving **conventional consequences** display a similar alternation:

(5) a. einen Ball werfen (throw a ball)
b. ein Tor werfen (throw a goal)

(6) a. 100 Meter laufen (run 100 metres)
b. einen Weltrekord laufen (run a world record)

- (under certain circumstances) throwing the ball into the goal_1 **constitutes** (scoring) a goal_2
- (under certain circumstances) running 100 Meters **constitutes** (running) a world record

Material-oriented verbs

- direct object must be interpreted as 'material' (or 'input' to the process denoted by the verb):

(7)
a. die Photos ordnen – "sort the photos"
b. die Photos zu einem Halbkreis ordnen – "sort the photos into a semicircle" ("zu"-construction)
c. #einen Halbkreis (aus den Photos) ordnen – "sort a semicircle (out of the photos)" (SCC, "aus"-construction)

- what prevents the SCC/"aus"-construction from occuring with material-oriented verbs?
- other material oriented verbs:

(8)
a. das Gesicht / # eine Grimasse verzerren
b. das Obst / # einen Smoothie verarbeiten
c. die Photos / # einen Halbkreis ordnen

Result-oriented verbs

- direct object must be interpreted as 'result':

(9) a. Strom (aus Holz) produzieren – "produce electricity (out of wood)"
b. *Holz zu Strom produzieren – "produce wood into electricity"

- what prevents the "zu-construction" from occurring with *produzieren*?
- other 'result' oriented verbs:

(10) a. (aus Kohle) Strom erzeugen,
Kohle zu Strom erzeugen
b. (aus Phrasen) einen Satz bilden,
Phrasen zu einem Satz bilden

Motivating *zu*- and *aus*-constructions

(11) a. das Blatt zu einem Papierflugzeug falten
b. aus dem Blatt ein Papierflugzeug falten

(12) a. *Kohle zu Strom erzeugen
b. aus Kohle Strom erzeugen

(13) a. die Photos zu einem Halbkreis ordnen
b. *aus den Photos einen Halbkreis ordnen

(14) a. *den Ball zu einem Tor werfen
b. *aus dem Ball ein Tor werfen

(15) a. Obama zum Präsidenten wählen
b. *aus Obama den Präsidenten wählen

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Basic assumptions (I)

- General strategy:
  - Assume constant lexical meaning for verbs across their use in different constructions
  - Apparent polysemy arises through combination of the same verb with different constructions.

Basic assumptions (II)

- Architecture:
  - the semantics of lexical entries and constructions is analysed in terms of discourse representation structures (Kamp and Reyle 1993)
  - we use a declarative approach to DRT, as opposed to the classical procedural approach in Kamp and Reyle (1993)
  - semantic composition boils down to the identification of free variables in discourse representation structures (DRSs)
  - each DRS is associated with a referent system containing the morhposyntactic information relevant for the identification of variables (Kracht 1999, Kracht 2002)
  - referent systems also determine hierarchical structure, word order and other aspects of syntactic structure
  - constructions are triples consisting of an exponent, a referent system and a discourse representation structure

Basic assumptions (III)

- distinguish between lexical and argument structure constructions
- verbs introduce specific (functional) semantic roles, e.g. $\mathbf{fold}_1(e) = x \wedge \mathbf{fold}_2(e) = y$,
- constructions are form-meaning pairs that introduce abstract (relational) semantic roles, e.g. $\mathbf{actor}(e, x) \wedge \mathbf{result}(e, y)$

Lexical restrictions

- One way of capturing the difference between 'material'/'result'- and flexible-orientation verbs is to specify this information lexically:

flexible verbs: /falten/	*'material-oriented' verbs: /ordnen/*	*'result-oriented' verbs: /produzieren/*
$e : [\text{CAT} : \text{fin}]$ $x : [\text{GR} : 1]$	$e : [\text{CAT} : \text{fin}]$ $x : [\text{GR} : 1]$ $y : [\text{GR} : 2]$	$e : [\text{CAT} : \text{fin}]$ $x : [\text{GR} : 1]$ $y : [\text{GR} : 2]$
e, x, y	e, x, y	e, x, y
$\mathbf{fold}_1(e) = x$ $\mathbf{fold}_2(e) = y$	$\mathbf{sort}_1(e) = x$ $\mathbf{sort}_2(e) = y$	$\mathbf{produce}_1(e) = x$ $\mathbf{produce}_2(e) = y$

Simple creation construction

(16) a. ein Flugzeug falten
b. ein Tor werfen

in order to capture

- similar syntactic realization: resulting entity y realized as direct object
- similar semantic paraphrase: V-ing (something) results in y

we introduce the SIMPLE CREATION CONSTRUCTION:

SCC

e : [CAT : fin] x : [GR : 1] y : [GR : 2]
e, x, y
actor(e, x) **result**(e, y)

Decomposing **result**(x, e)

- if we are to capture the semantic similarity between the sentences in (16) the result role has to be sufficiently abstract and therefore cannot be reduced to notion of incremental theme (Krifka 1998)
- x is the result of e iff
  - x exists at end of e
  - x does not exist before
  - existence of x depends on e, meaning that (for all worlds and times) if x exists at t (in w), then e occurred in w
- $$\begin{aligned}\mathbf{result}(e, x, w) \quad \leftrightarrow \quad & \mathbf{exist}(x, w, \mathbf{end}(e)) \wedge \\ & (\forall t)(t \prec \mathbf{end}(e) \rightarrow \neg \mathbf{exist}(x, w, t)) \\ & \mathbf{depend}(y, e))\end{aligned}$$
- $\mathbf{depend}(x, e) \leftrightarrow (\forall w)(\forall t)(\mathbf{exist}(x, w, t) \rightarrow \mathbf{occured}(e, w))$

Transitive construal, passive and case

TR-CONSTR

$e : [\text{CAT} : \mathsf{fin}]$ $x : [\text{GR} : 1]$ $y : [\text{GR} : 2]$
e, x, y
$\mathbf{actor}(e, x)$ $\mathbf{theme}(e, y)$

PASS

$e : [\text{CAT} : \mathsf{fin}]$ $x : [\text{GR} : 1 \mapsto 3]$ $y : [\text{GR} : 2 \mapsto 1]$
e, x, y

NOM

$x : [\text{GR} : 1 \mapsto \mathsf{nom}]$
x

ACC

$x : [\text{GR} : 2 \mapsto \mathsf{acc}]$
x

Transitive construal, passive and case

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TR-CONSTR

$e : [\text{CAT} : \text{fin}]$ $x : [\text{GR} : 1]$ $y : [\text{GR} : 2]$
e, x, y
$\textbf{actor}(e, x)$ $\textbf{theme}(e, y)$

$\bullet$

ACC

$x : [\text{GR} : 2 \mapsto \text{acc}]$
x

$=$

TR + ACC

$e1 : [\text{CAT} : \text{fin}]$ $x1 : [\text{GR} : 1]$ $y1 : [\text{GR} : \text{acc}]$
$e1, x1, y1, x2$
$\textbf{actor}(e1, x1)$ $\textbf{theme}(e1, y1)$ $y1 = x2$

Transitive construal, passive and case

TR-CONSTR

$e : [\text{CAT} : \text{fin}]$
$x : [\text{GR} : 1]$
$y : [\text{GR} : 2]$
e, x, y
$\mathbf{actor}(e, x)$
$\mathbf{theme}(e, y)$

PASS

$e : [\text{CAT} : \text{fin}]$
$x : [\text{GR} : 1 \mapsto 3]$
$y : [\text{GR} : 2 \mapsto 1]$
e, x, y

NOM

$x : [\text{GR} : 1 \mapsto \text{nom}]$
x

ACC

$x : [\text{GR} : 2 \mapsto \text{acc}]$
x

TR-CONSTR

$e : [\text{CAT} : \text{fin}]$
$x : [\text{GR} : 1]$
$y : [\text{GR} : 2]$
e, x, y
$\mathbf{actor}(e, x)$
$\mathbf{theme}(e, y)$

$\bullet$

ACC

$x : [\text{GR} : 2 \mapsto \text{acc}]$
x

$=$

TR + ACC

$e1 : [\text{CAT} : \text{fin}]$
$x1 : [\text{GR} : 1]$
$y1 : [\text{GR} : \text{acc}]$
$e1, x1, y1, x2$
$\mathbf{actor}(e1, x1)$
$\mathbf{theme}(e1, y1)$
$y1 = x2$

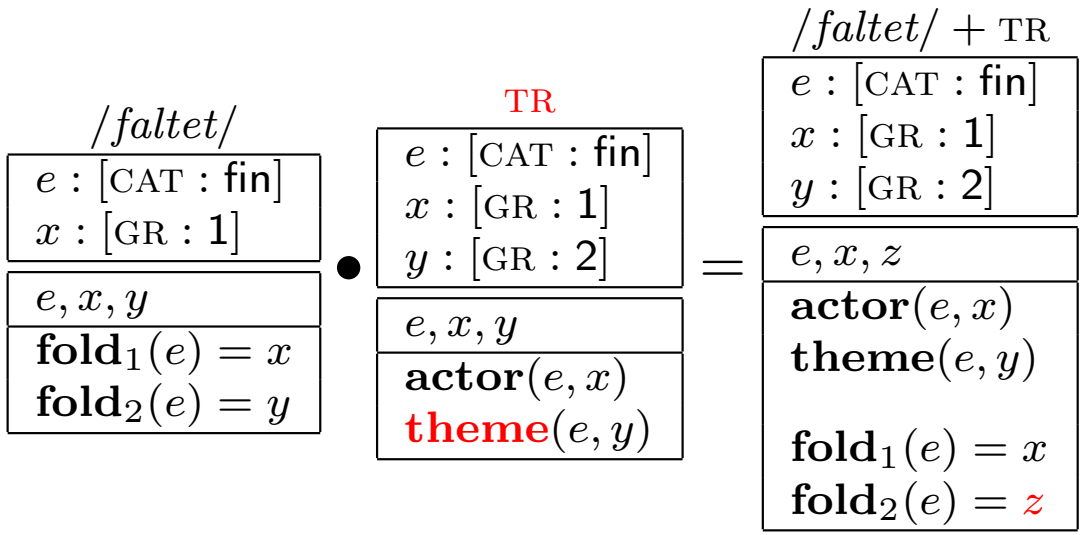
$\equiv$

TR + ACC

$e : [\text{CAT} : \text{fin}]$
$x : [\text{GR} : 1]$
$y : [\text{GR} : \text{acc}]$
e, x, y
$\mathbf{actor}(e, x)$
$\mathbf{theme}(e, y)$

Combining verb and construction meaning - example

- semantic composition boils down to identifying those free variables of two DRSs whose morphosyntactic information matches



- if two variables are not identified by the merge operation •, then they are kept distinct (by renaming) – note that the variable y in TR gets renamed to z to keep it distinct from the variable y of *faltet*

Combining verb and construction meaning - example

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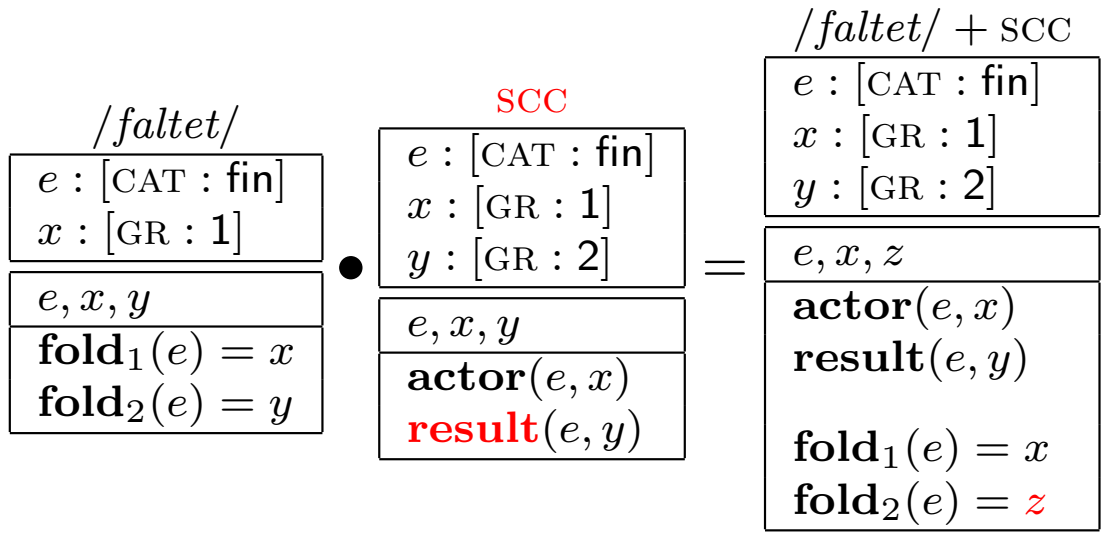
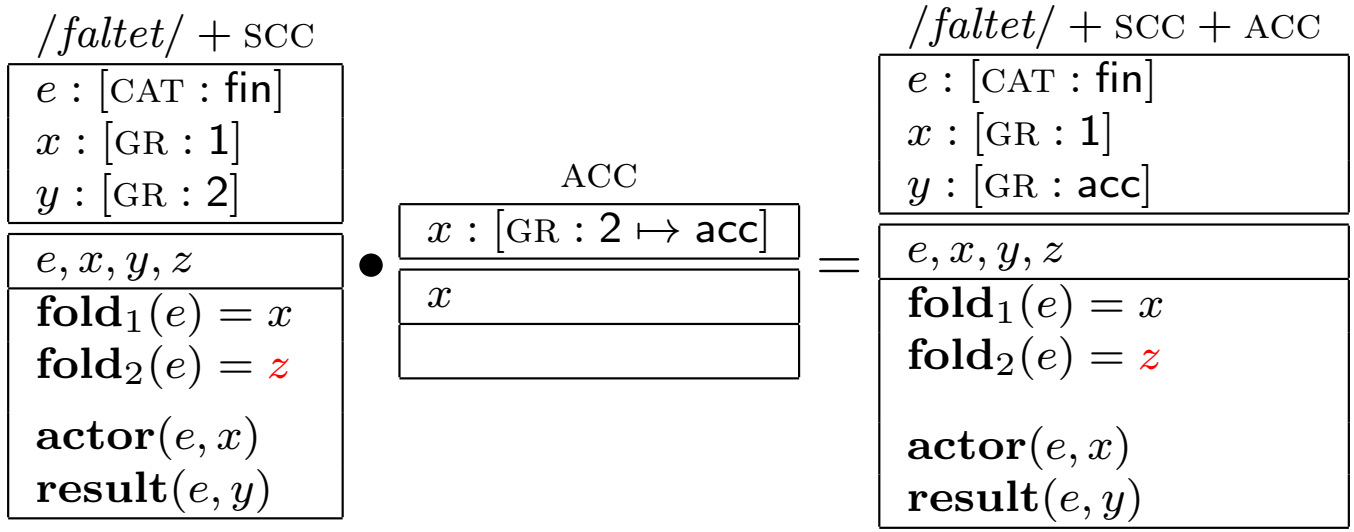
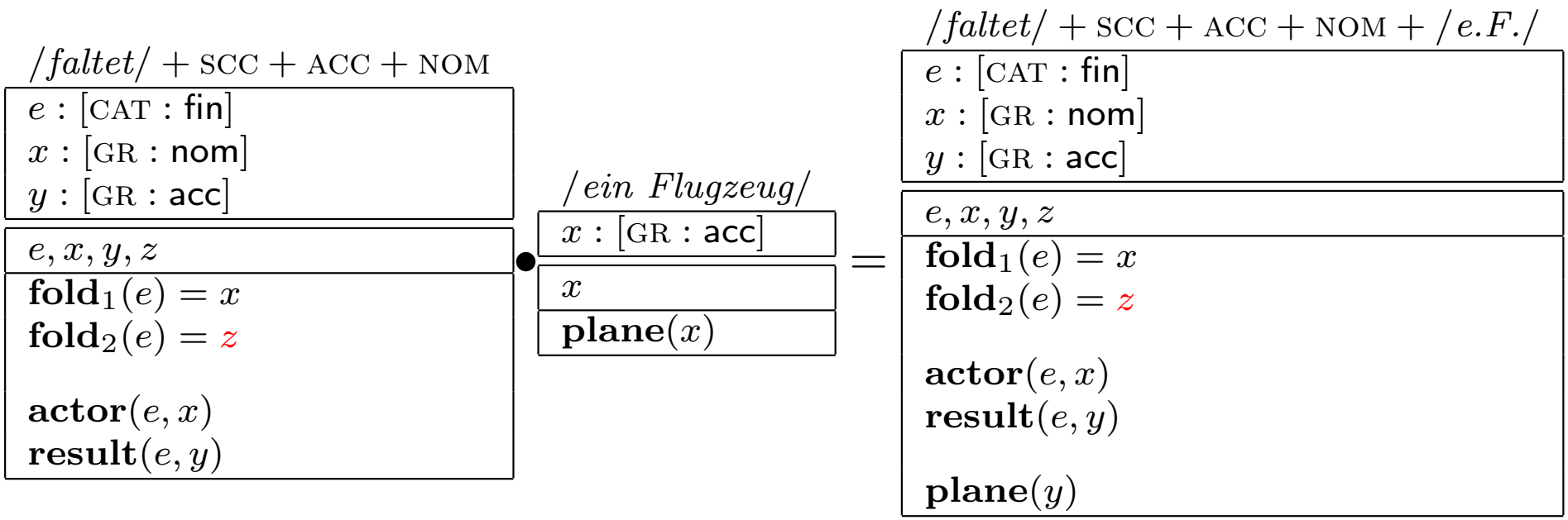


- if two variables are not identified by the merge operation •, then they are kept distinct (by renaming) – note that the variable y in SCC gets renamed to z to keep it distinct from the variable y of *faltet*

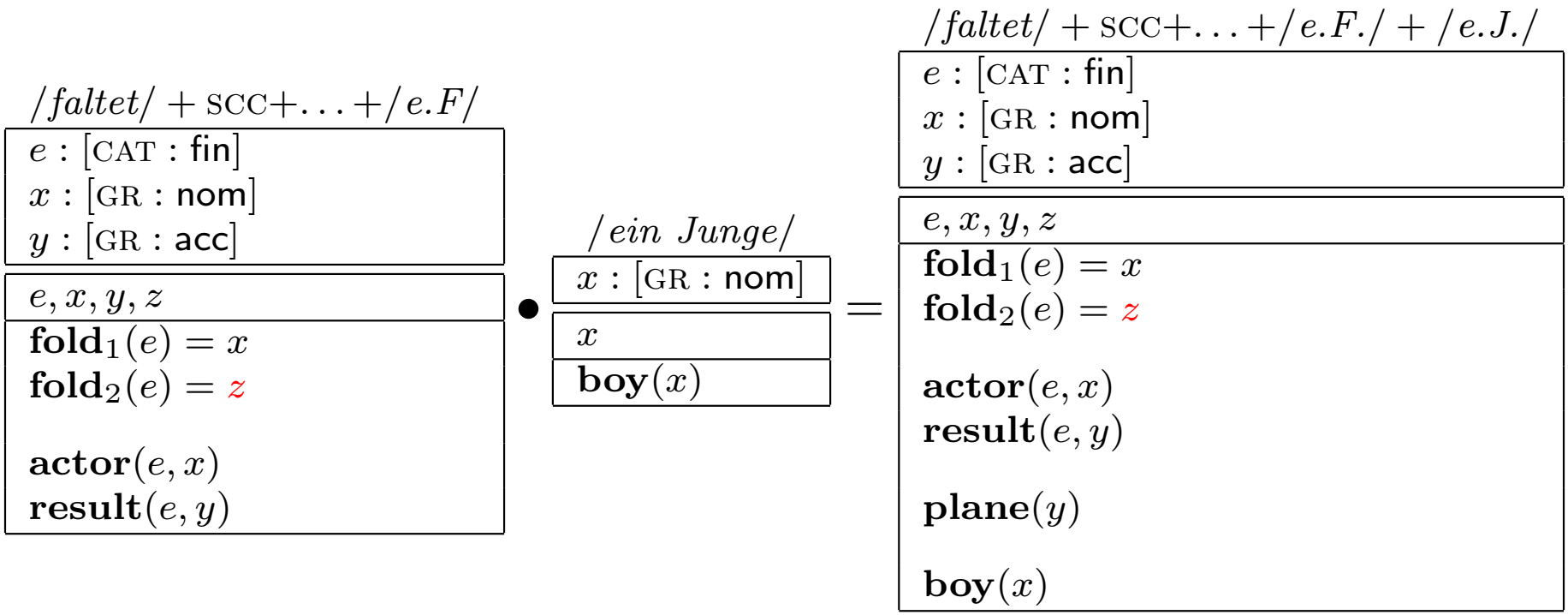
Combining verb and construction meaning - example



Combining the direct object



Combining the subject



Combining verb and construction meaning – an example

/Ein Junge faltet ein Flugzeug/

e : [CAT : fin] x : [GR : nom] y : [GR : acc]
e, x, y, z
$\mathbf{fold}_1(e) = x$ $\mathbf{fold}_2(e) = z$ $\mathbf{actor}(e, x)$ $\mathbf{result}(e, y)$ $\mathbf{plane}(y)$ $\mathbf{boy}(x)$

- by default we interpret the plane as consisting of a folded sheet of paper
- however, the grammar does not specify the relation between the plane y and the folded entity z.
- our claim: this relation is specified by contextual enrichment, in particular by abductive reasoning

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Contextual enrichment

- Why is the paperplane interpreted as consisting of the folded sheet of paper?
- a good/plausible explanation for the coming into existence of the paperplane given a folding event is that a sheet has been folded
- why is the goal_1 (the abstract entity) interpreted as resulting from throwing the ball into the goal_2 (the physical entity)?
- a good/plausible explanation for the coming into existence of the goal given a throwing event is that a ball has been thrown into the goal

Framing/conceptualizing folding events and abduction

- conceptualization of shape-changing events:

  (17) $(\forall e \forall v \forall y)(\textbf{change.shape}(e, v, y) \rightarrow \textbf{result}(e, y))$

- (situated) conceptualizations of folding events:

  (18) $\textbf{sheet}(v) \wedge \textbf{fold}_2(v) \wedge \textbf{change.shape}(e, v, y) \wedge \textbf{plane}(y) \rightarrow \textbf{result}(e, y)$

  (19) $\textbf{fold}_2(e) = v \rightarrow \textbf{theme}(e, v)$

- Inference by Abduction: Given ψ and $\phi \rightarrow \psi$, we can assume (defeasably) ϕ.

Abduction – an example

(20) $\mathbf{sheet}(v) \wedge \mathbf{fold}_2(v) \wedge \mathbf{change.shape}(e, v, y) \wedge \mathbf{plane}(y) \rightarrow \mathbf{result}(e, y)$

- enrichment of *Ein Junge faltet ein Flugzeug* by means of (20):

Ein Junge faltet ein Flugzeug/

e : [CAT : fin]
x : [GR : nom]
y : [GR : acc]

e, x, y, z
$\mathbf{fold}_1(e) = x$
$\mathbf{fold}_2(e) = z$
$\mathbf{actor}(e, x)$
$\mathbf{result}(e, y)$
$\mathbf{plane}(y)$
$\mathbf{boy}(x)$

$\xrightarrow{abduction}$

Ein Junge faltet ein Flugzeug/

e : [CAT : fin]
x : [GR : nom]
y : [GR : acc]

e, x, y, z, v
$\mathbf{fold}_1(e) = x$
$\mathbf{fold}_2(e) = z$
$\mathbf{actor}(e, x)$
$\mathbf{result}(e, y)$
$\mathbf{plane}(y)$
$\mathbf{boy}(x)$
$\mathbf{sheet}(v)$
$\mathbf{fold}_2(e) = v$
$\mathbf{change.shape}(e, v, y)$
$\mathbf{plane}(y)$

Motivating the *zu*-construction

(21)
a. das Blatt zu einem Papierflugzeug falten
b. den Sand zu einer Sandburg schaufeln
c. *Kohle zu Strom erzeugen
d. *den Ball zu einem Tor werfen
e. *100 Meter zu einem Weltrekord laufen
f. Obama zum Präsidenten wählen

Syntax and semantics of the *zu*-construction

ZU-CONSTR

e : [CAT : fin] x : [GR : 1] y : [GR : 2] z : [GR : 3, P : zu]
e, x, y
actor(e, x) **result**$(e,$ **become**$(y, z))$

- a ball cannot be conceived as becoming a goal, therefore the condition that y becomes z cannot be satisfied, explaining ungrammaticality of (21-d)
- on the other hand there is no problem conceiving Obama as becoming president, licensing (21-f)

Motivating the *aus*-construction

(22)
a. aus dem Blatt ein Papierflugzeug falten
b. *aus dem Gesicht eine Grimasse verzerren
c. aus Kohle Strom erzeugen
d. *aus dem Ball ein Tor werfen
e. *aus Obama den Präsidenten wählen

Syntax and semantics of the *aus*-construction

AUS-CONSTR

e : [CAT : fin] x : [GR : 1] z : [GR : 2] y : [GR : 3, P : aus]
e, x, y
actor(e, x) **result**$(e,$ **inherent.change**$(y, z))$

- Since becoming a president involves no inherent/physical change, this semantic condition/requirement cannot be satisfied, explaining the semantic anomaly of

  (23) Aus Obama den Präsidenten wählen.

- On the other hand, the coal inherently changes (into electric power), thus licensing the grammaticality of (22-a)

Summary

- the semantic role introduced by the simple creation construction must be sufficiently abstract to accomodate verbs involving conventional facts (e.g. ‘run a world record’)
- the grammar does not always determine the full interpretation of clause arguments
- abductive inference based on world knowledge has been used to model the process of contextual enrichment
- this interaction of grammatical and extragrammatical resources hinges on the assumption that semantic composition boils down to identifying variables, either by matching morphosyntactic information or by enrichment based on abductive inference

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Thank you!