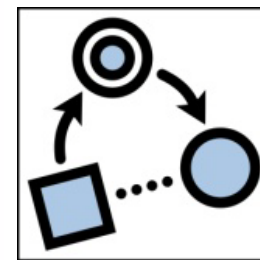


# Decomposing Posture Verbs into Frame Attributes

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# Posture verbs (PVs)

- Posture verbs (e.g. *stand, sit, kneel*) encode gestalt properties and spatial information, which are perceived by gestalt recognition and spatial orientation.
- Posture verbs (PVs) are an excellent object of the investigation of cognition and language (like spatial prepositions and dimensional adjectives).

# General scenario

The garden gnome is sitting on the mushroom.

figure      posture      locational      ground  
relation

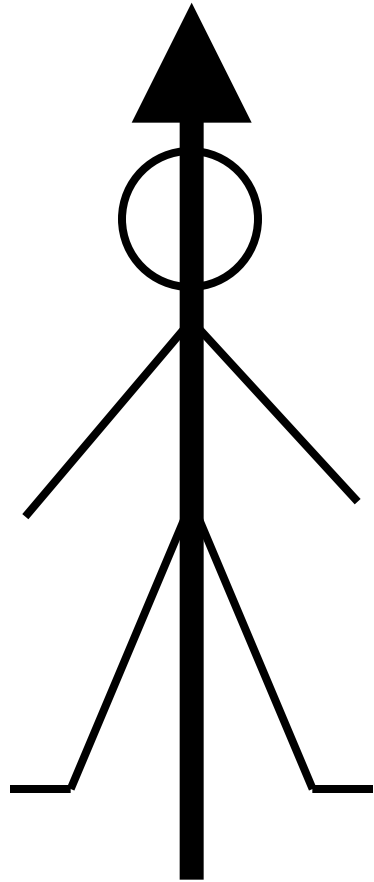


# PVs in German

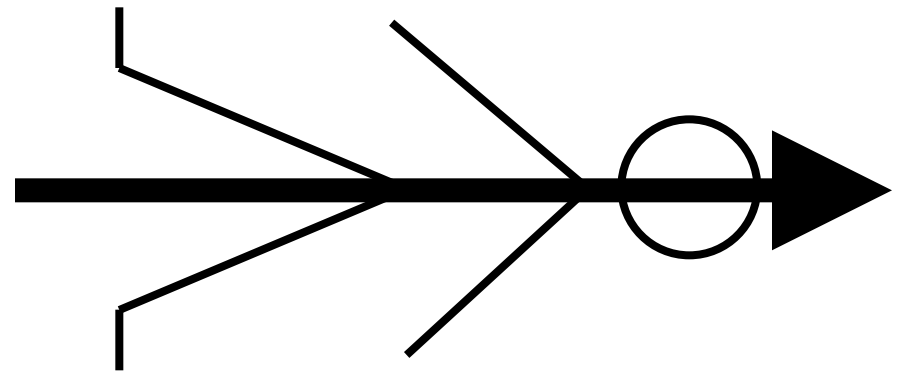
- The meaning and use of PVs and other positional verbs is well described for German:

(Berthele 2004, Gerling & Orthen 1979, Kaufmann 1994, 95; Kutscher & Schultze-Berndt 2007, Lang & Carstensen 1990, Maienborn 1990, 91; Serra Borneto 1996, Schönefeld 2006, Wunderlich & Kaufmann 1990 among others)

# Orientation matters



*stehen* 'stand'



*liegen* 'lie'

# Orientation matters



*Der Gartenzwerg liegt auf der Wiese.*

'The garden gnome is lying on the lawn.'

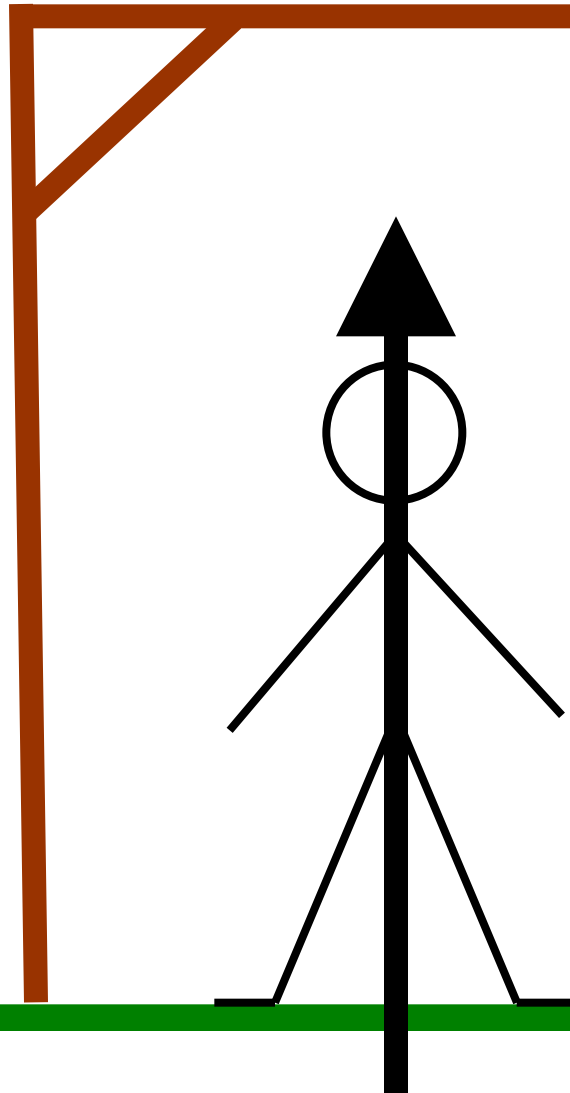


*Der Gartenzwerg steht auf dem Sockel.*

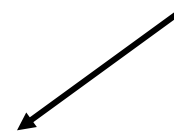
'The garden gnome is standing on the plinth.'

# Support matters, too!

*stehen* 'stand'

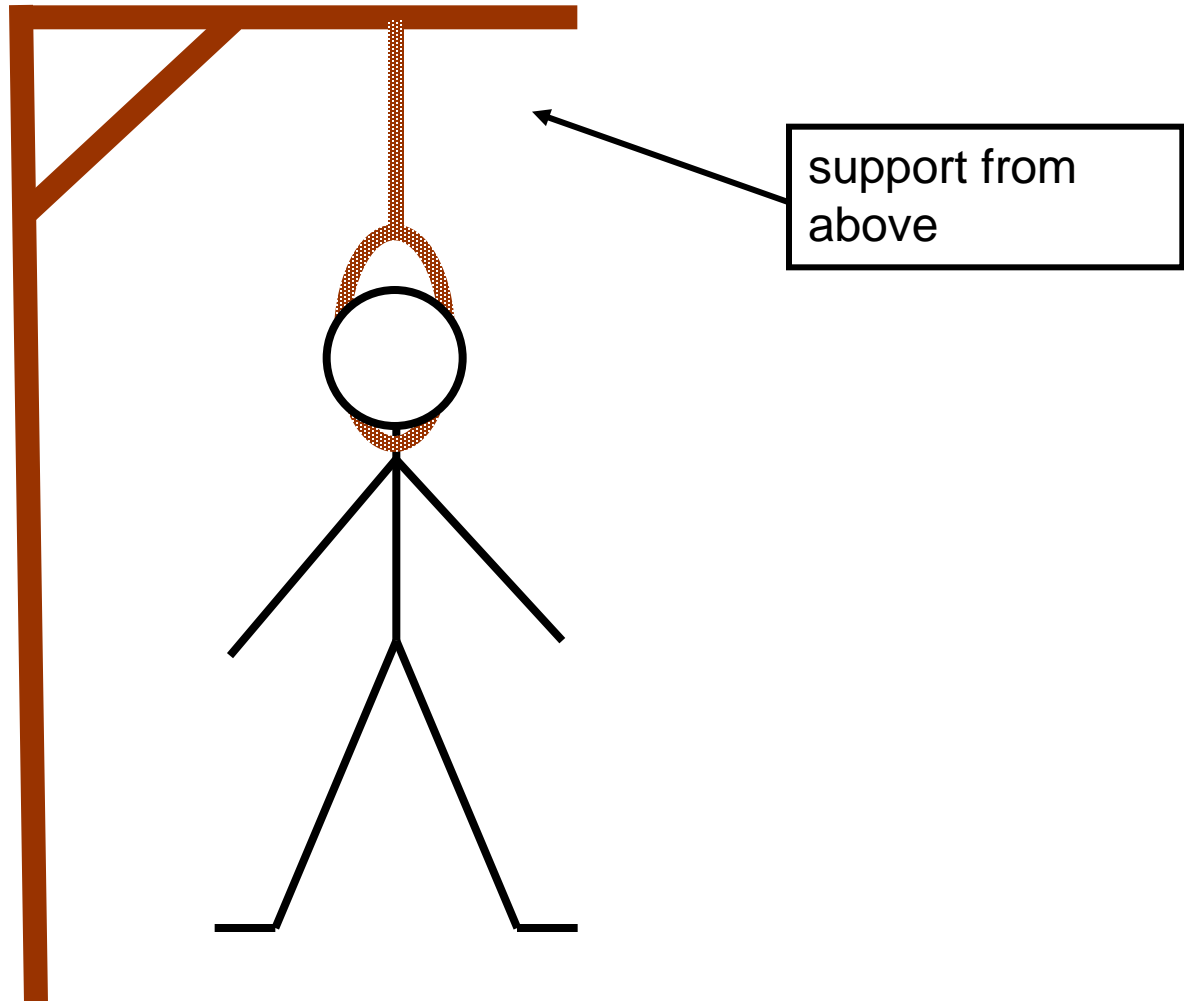


support from  
below



# Support matters, too!

*hängen* 'hang'





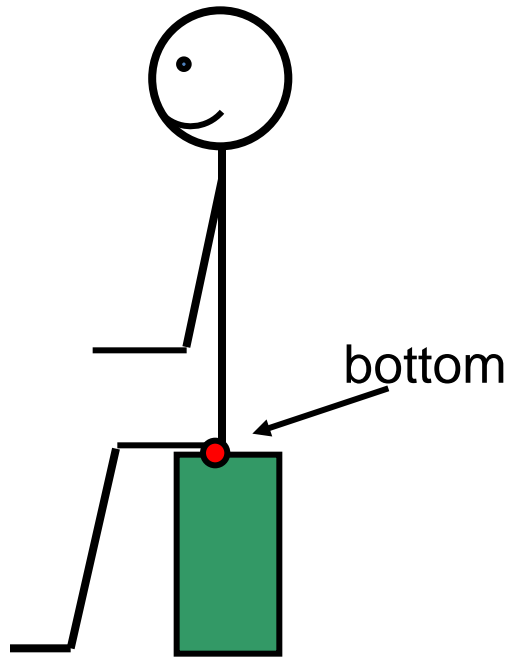
# Support matters, too!



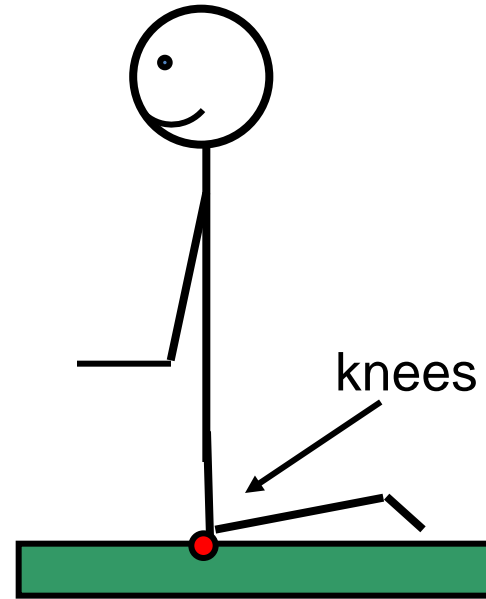
*Der Gartenzwerge hängt am Seil/am Galgen.*  
'The garden gnome is hanging from the rope/the gallows.'



# The supported part (of the body) also matters



*sitzen* 'sit'



*knien* 'kneel'

# The supported part (of the body) also matters



*Der Gartenzwerg sitzt auf der Schaukel.*  
'The garden gnome is sitting on the swing.'



*Der Gartenzwerg kniet auf der Wiese.*  
'The garden gnome is kneeling on the lawn.'

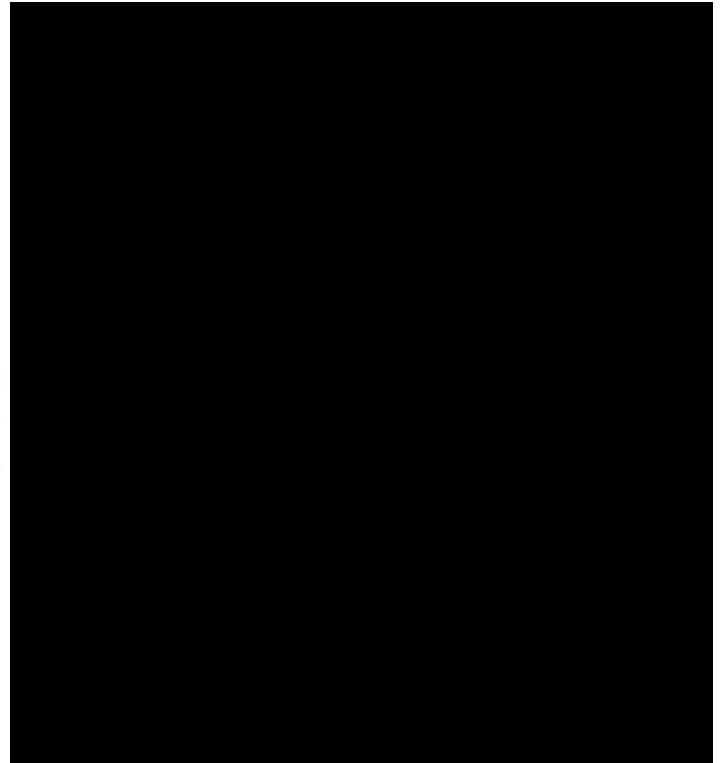
'Standing' and 'lying' do not necessarily involve specific parts of the body



...or other objects



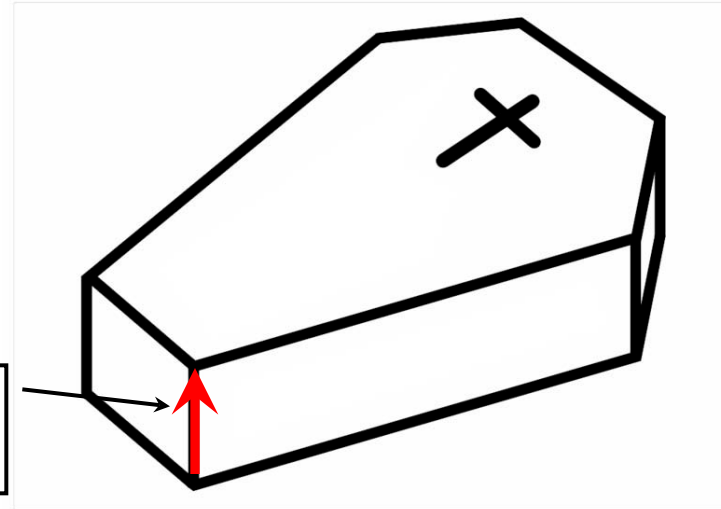
nor does 'hanging'



# 'Standing' and 'lying' are dependent on inherent gestalt properties



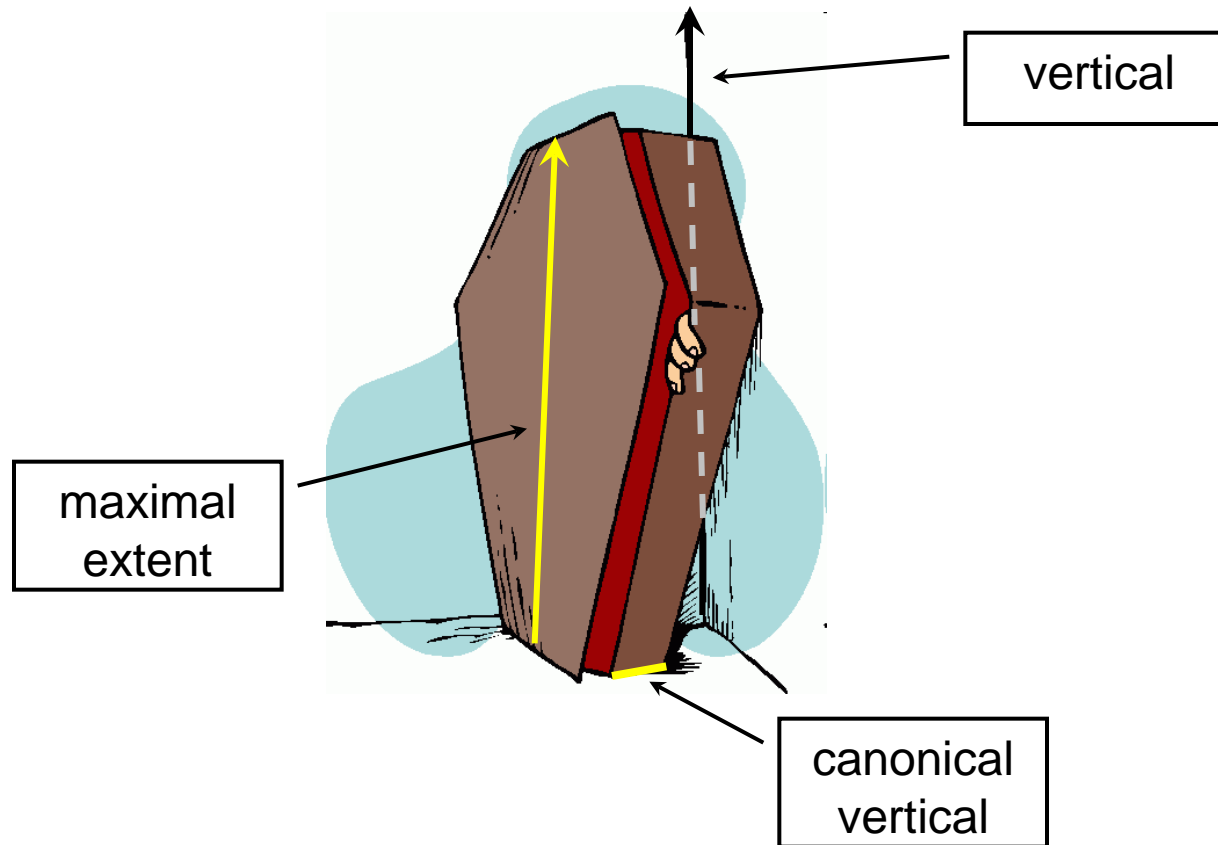
canonical  
vertical



*#stehender / liegender Ziegelstein*  
*#standing / lying brick*

*stehender / (?) liegender Sarg*  
*standing / (?) lying coffin*

# 'Standing' and 'lying' are dependent on inherent object properties



*stehender / # liegender Sarg*  
standing / # lying coffin



# Spatial knowledge of objects can be captured in object schemata (Lang 1987, 2001)

Object schema for *brick* (Lang 2001):

1D	2D	3D
Max	Across	Min

Object schema for *coffin* (Lang 2001):

1D	2D	3D
Max	Across	Min
		(canonic.) Vert

—————→  
salience/prominence of axes

# Representation of PVs in two-level semantics (Kaufmann 1995)

a. *knien* 'kneel':  $\lambda P \lambda x$  [KNEEL(x) & P(x)]

b.  $\text{Int}(\text{KNEEL}(x)) = \exists y$  [support<sub>f</sub> (d-us(y), knee(x))]

a. *stehen* 'stand':  $\lambda P \lambda x$  [STAND(x) & P(x)]

b.  $\text{Int}(\text{STAND}(x)) = \exists y$  [support<sub>f</sub> (d-us(y), s(prom(x)))]

a. *liegen* 'lie':  $\lambda P \lambda x$  [LIE(x) & P(x)]

b.  $\text{Int}(\text{LIE}(x)) = \exists y$  [support<sub>f</sub> (d-us(y), s(nprom(x)))]

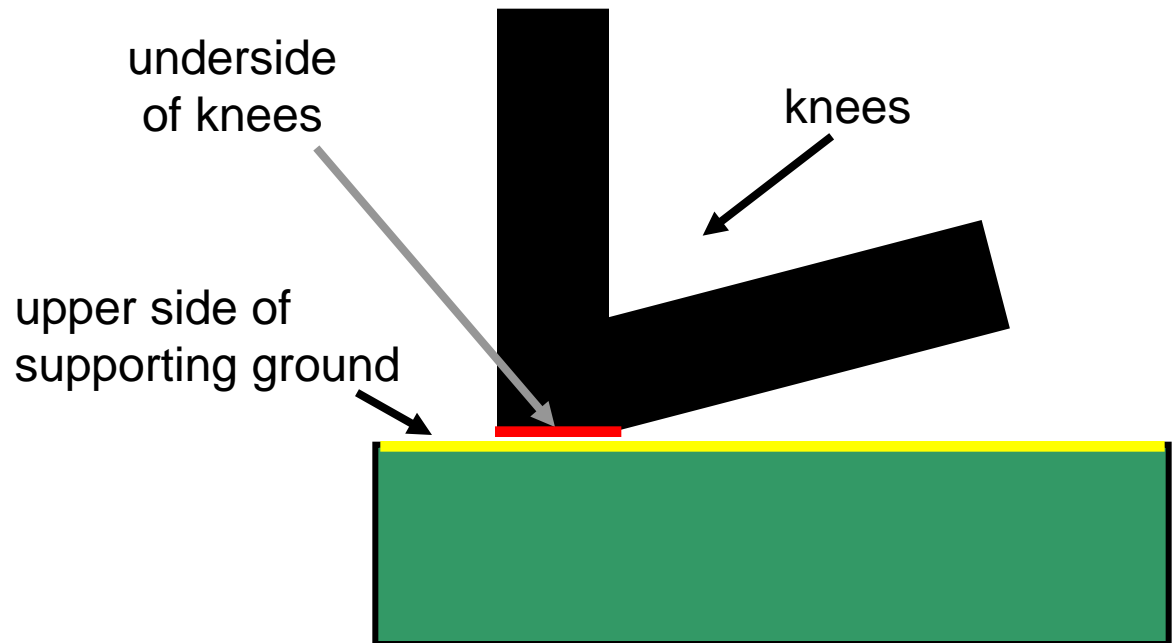
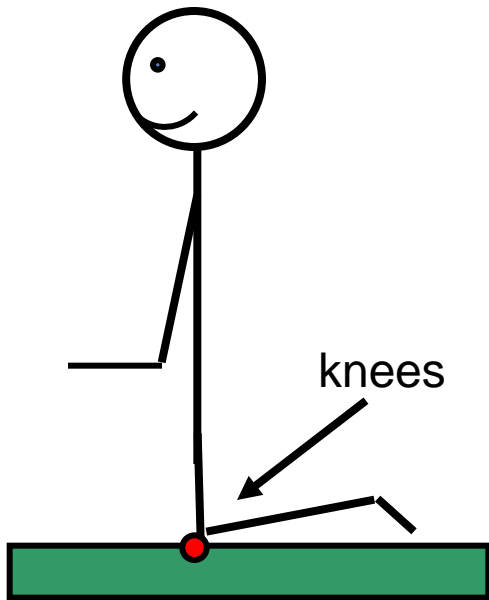
a. *hängen* 'hang':  $\lambda P \lambda x$  [HANG(x) & P(x)]

b.  $\text{Int}(\text{HANG}(X)) = \exists y$  [support<sub>f</sub> (d-nus(y), side(x))]

# Representation of *knien* 'kneel' in two-level semantics (Kaufmann 1995)

*knien* 'kneel':

$\text{Int}(\text{KNEEL}(x)) = \exists y [\text{support}_f(\text{d-us}(y), \text{knee}(x))]$



# Analysis: Framework

- Conceptual knowledge is captured in frame representations.
- Frame representations provide an explicit, variable-free, and cognitively plausible format
- Frames are defined as recursive attribute-value structures (Barsalou 1992).
- The attributes correspond to mathematical functions.

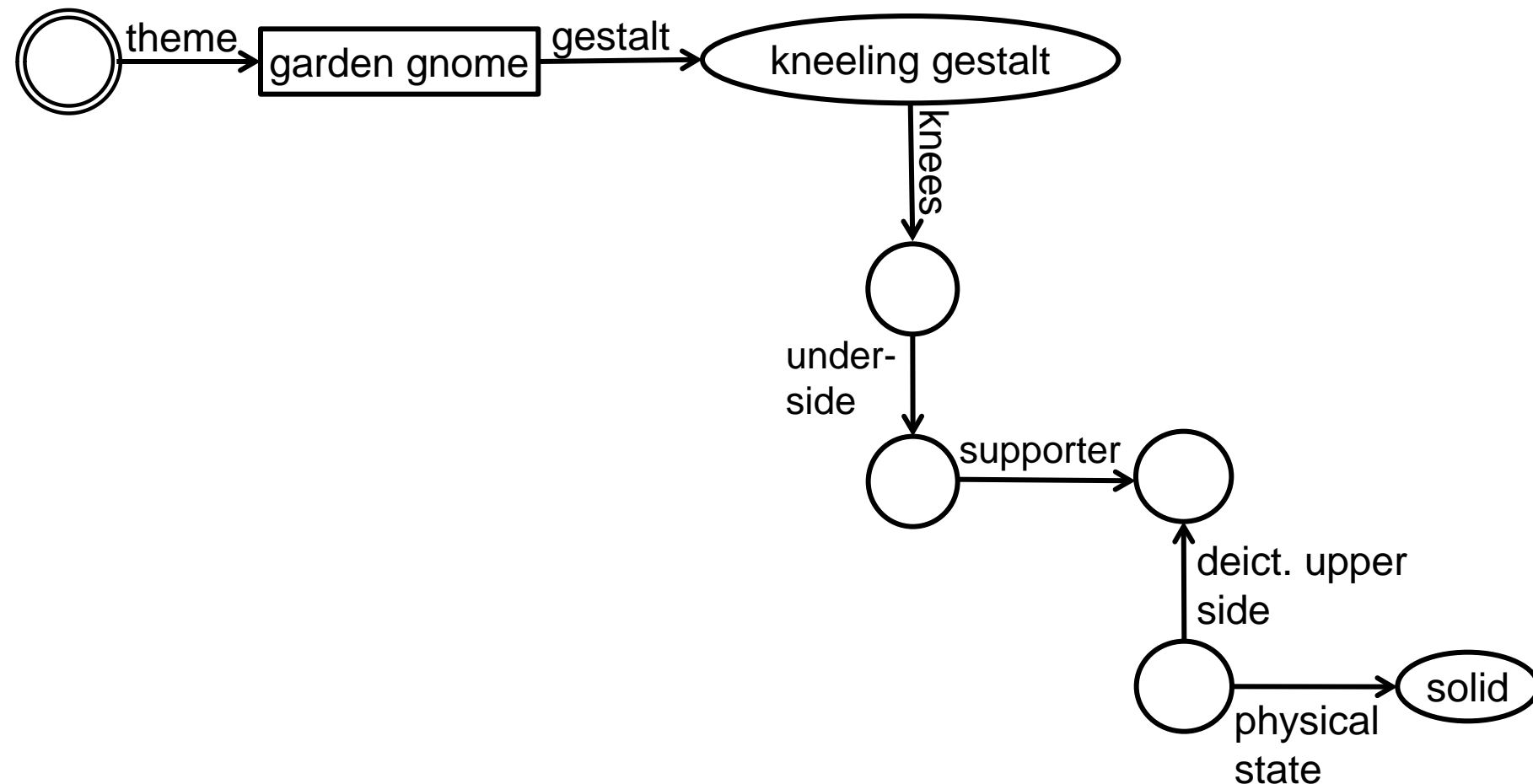
# Der Gartenzwerge kniet.

'The garden gnome is kneeling.'

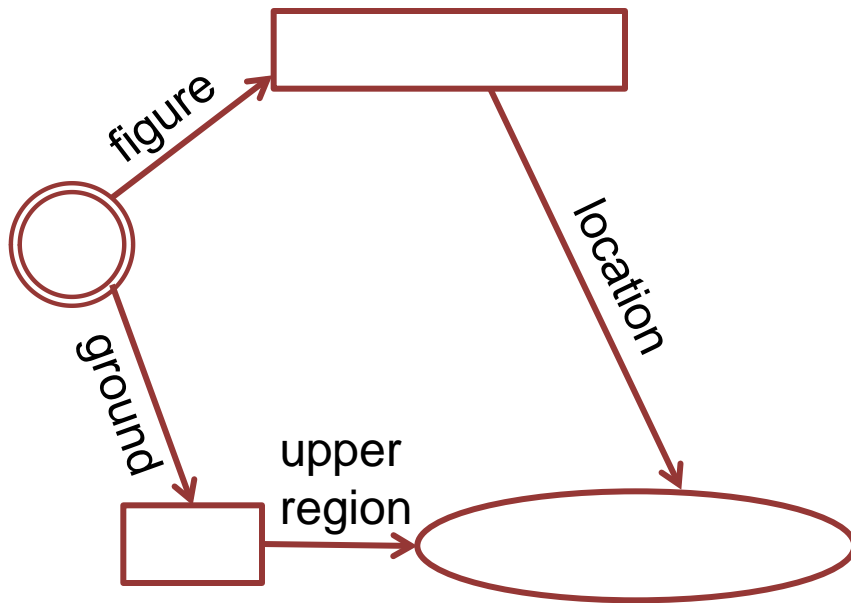


a. *knien* 'kneel':  $\lambda P\lambda x$  [KNEEL(x) & P(x)]

b.  $\text{Int}(\text{KNEEL}(x)) = \exists y$  [support<sub>f</sub>(d-us(y), knee(x))]



# *sein / sich befinden* 'be / be located'

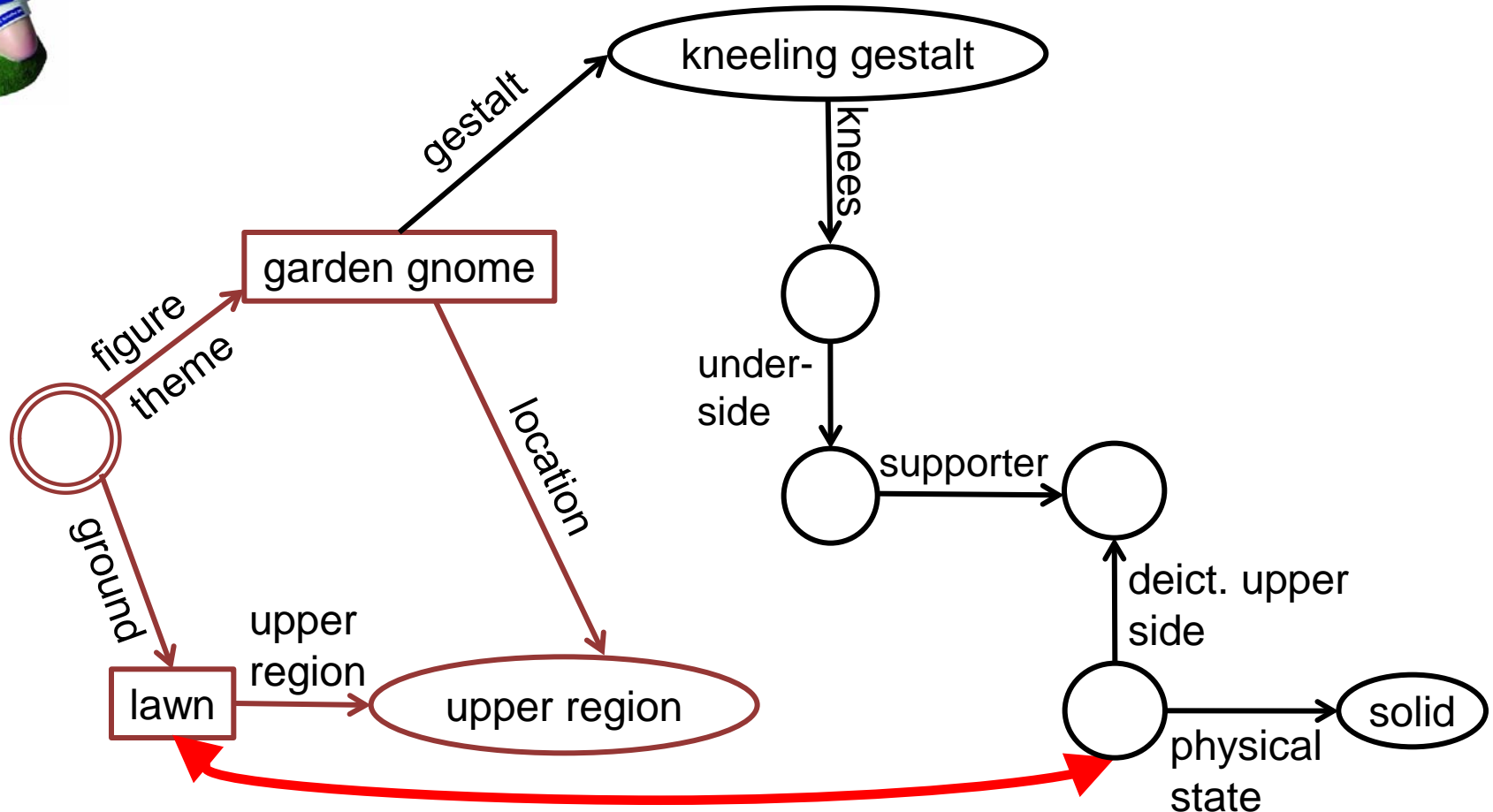


# Der Gartenzwerge kniet auf der Wiese.

'The garden gnome is kneeling on the lawn.'



- a. *knien* 'kneel':  $\lambda P \lambda x [KNEEL(x) \ \& \ P(x)]$
- b.  $\text{Int}(KNEEL(x)) = \exists y [\text{support}_f(\text{d-us}(y), \text{knee}(x))]$
- c. *auf* 'on': [-DIR]:  $\lambda y \lambda x [\text{LOC}(x, \text{UPPER\_REGION}(y)) \ \& \ \text{CONTACT}(x,y)]$

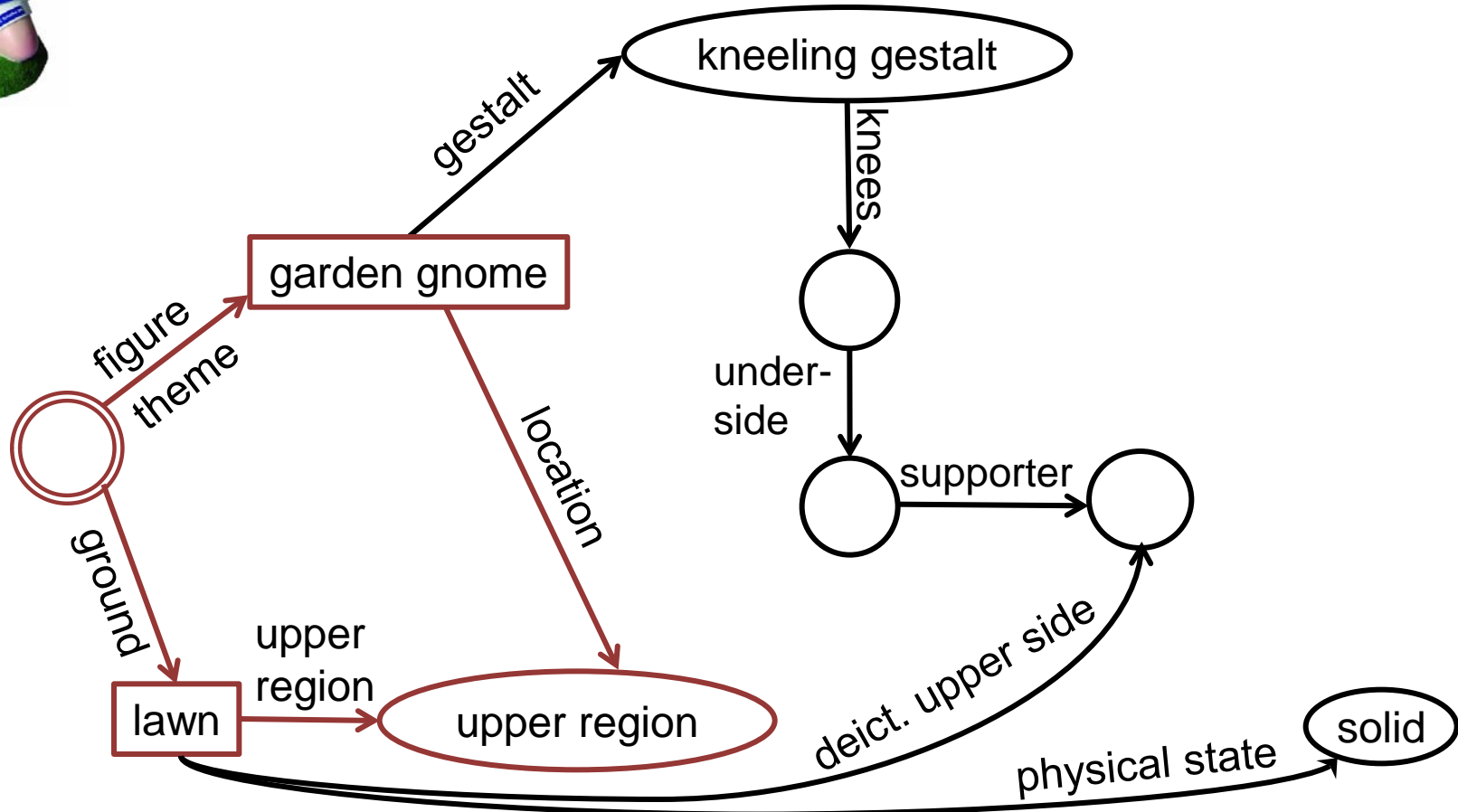


# Der Gartenzwerg kniet auf der Wiese.

'The garden gnome is kneeling on the lawn.'

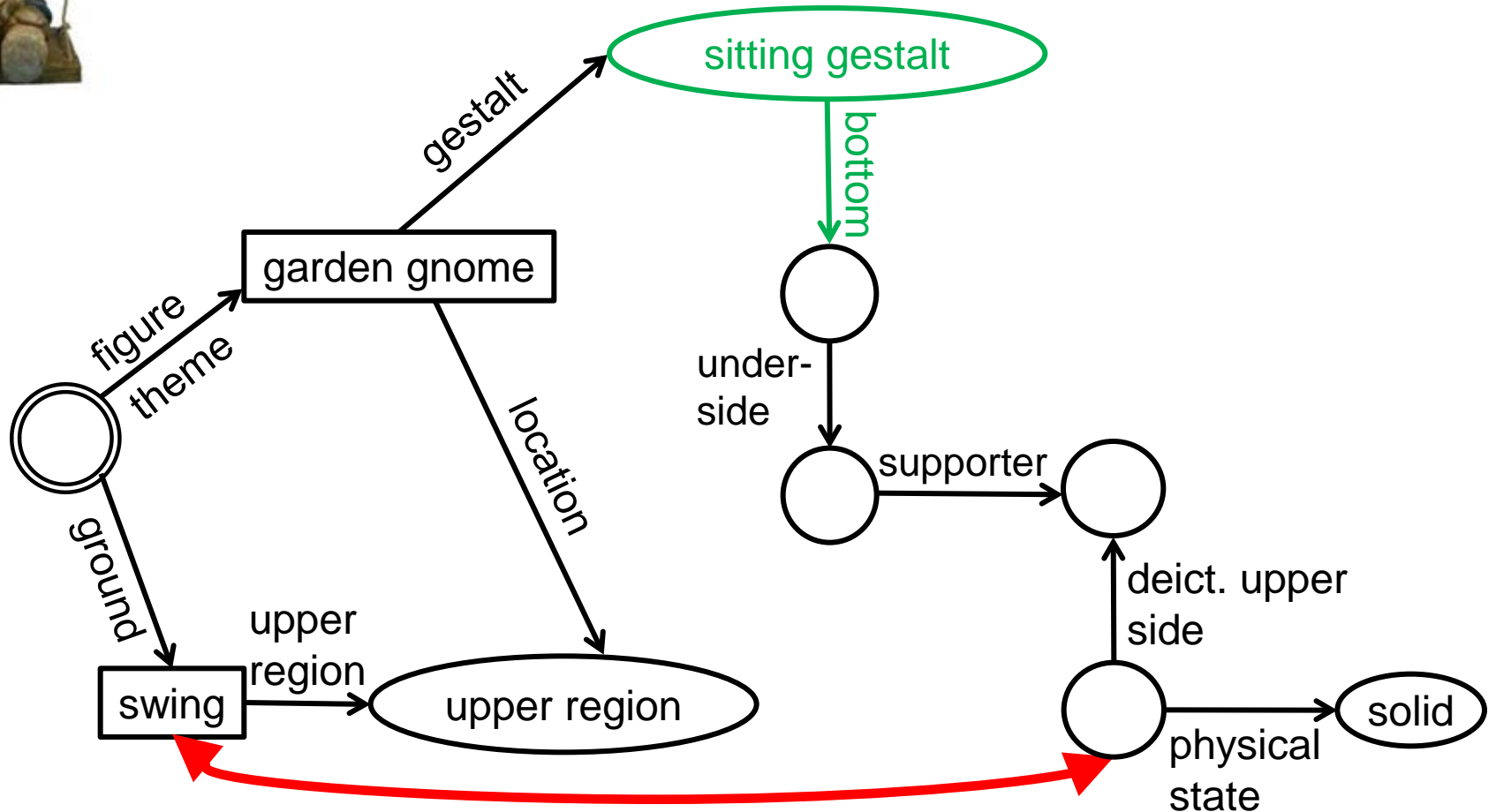


- a. *knien* 'kneel':  $\lambda P \lambda x [KNEEL(x) \ \& \ P(x)]$
- b.  $\text{Int}(KNEEL(x)) = \exists y [\text{support}_f(\text{d-us}(y), \text{knee}(x))]$
- c. *auf* 'on': [-DIR]:  $\lambda y \lambda x [\text{LOC}(x, \text{UPPER\_REGION}(y)) \ \& \ \text{CONTACT}(x,y)]$

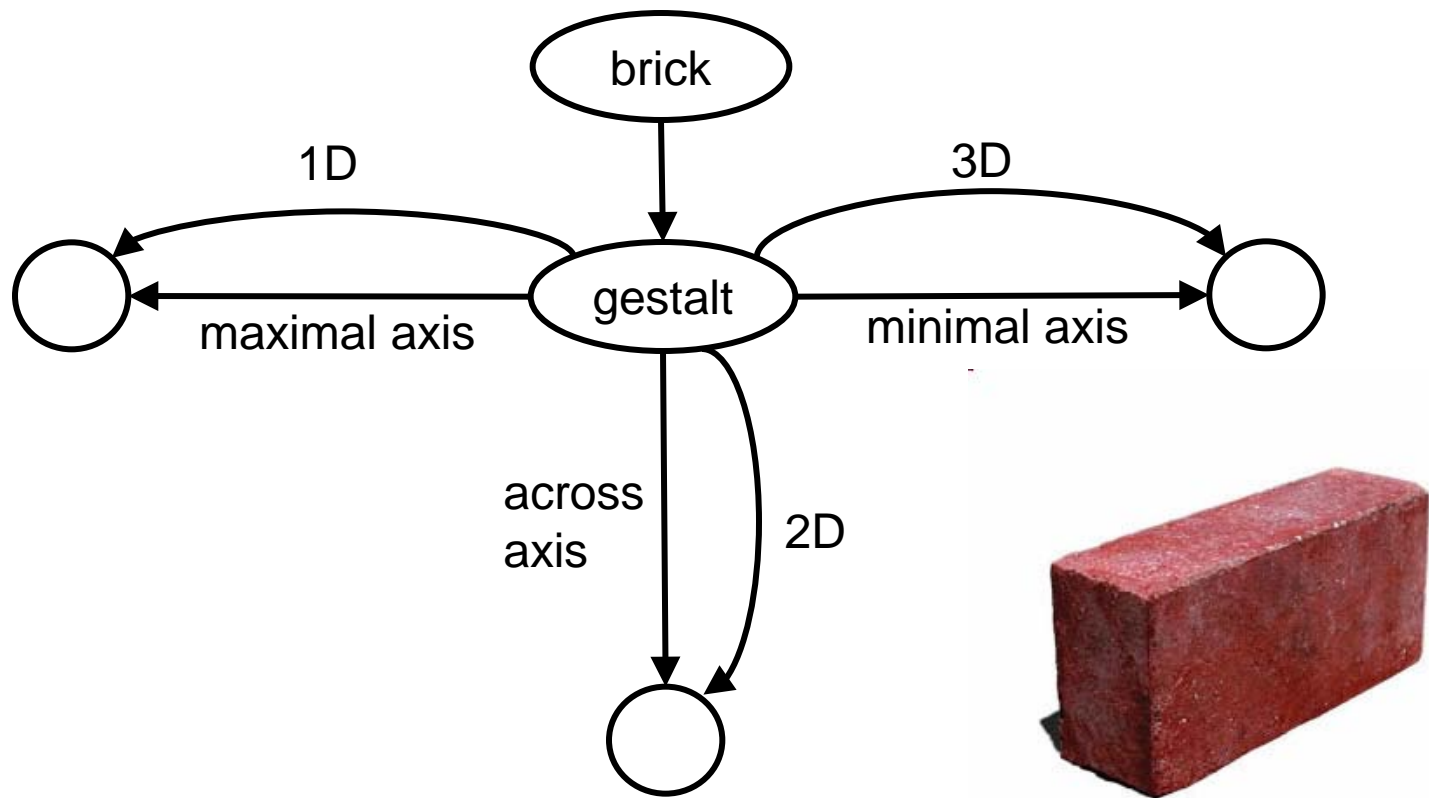




Der Gartenzweig sitzt auf der Schaukel.  
'The garden gnome is sitting on the swing.'



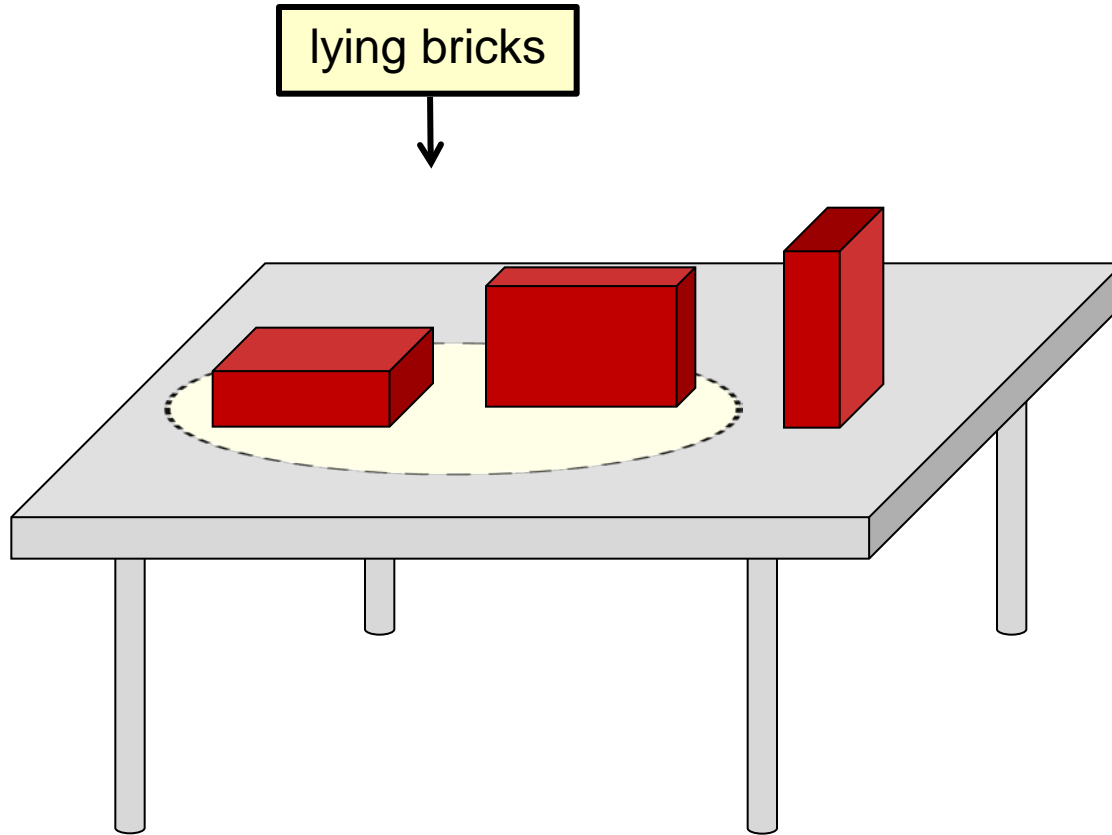
# Object schema of *Ziegelstein* 'brick'



1D	2D	3D
Max	Across	Min

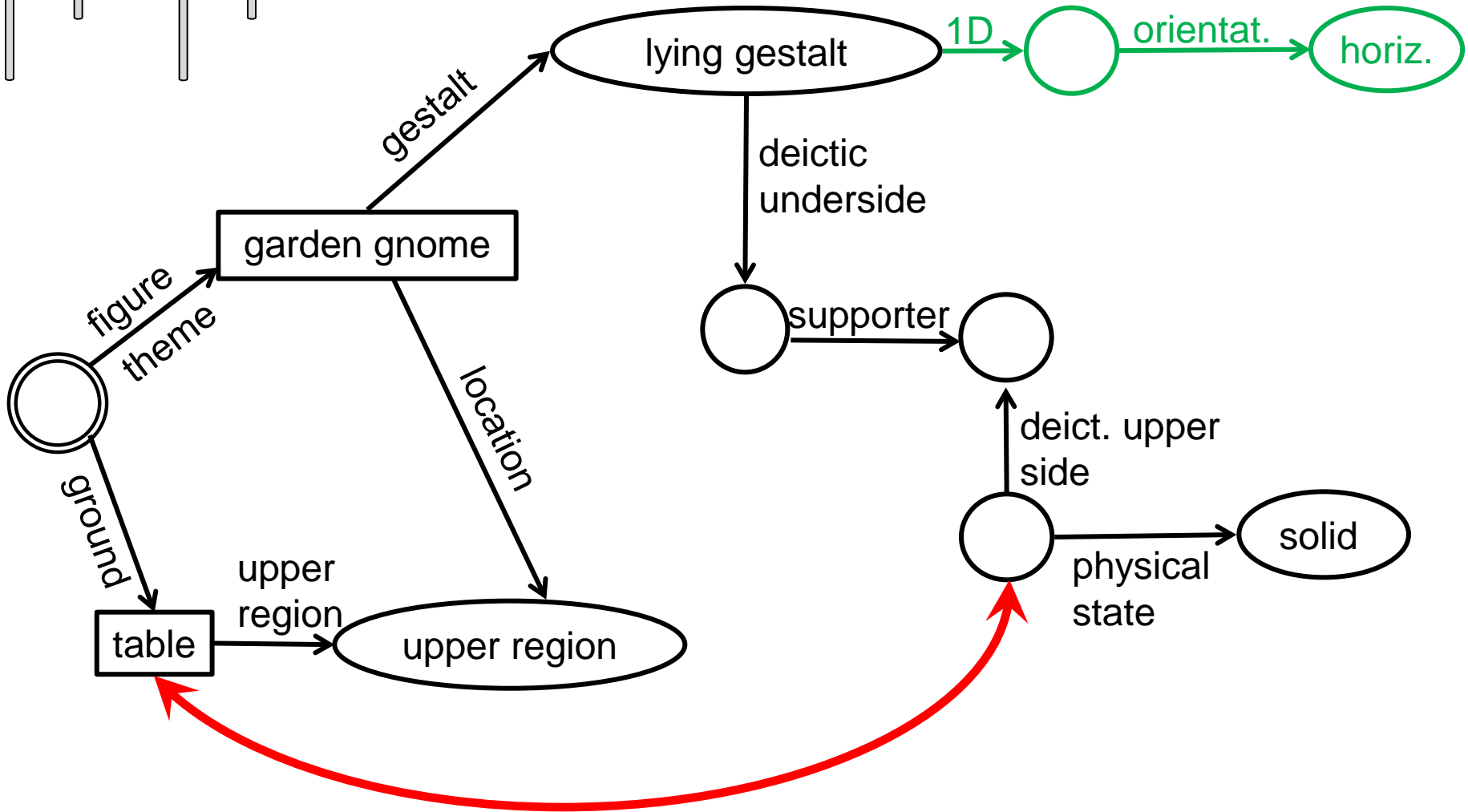
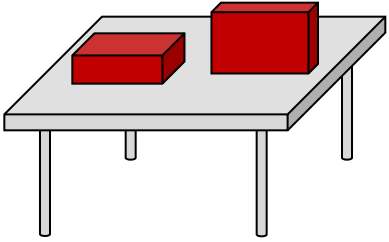
salience/prominence of axes: 1D > 2D > 3D

*Der Ziegelstein liegt auf dem Tisch.*  
'The brick is lying on the table.'

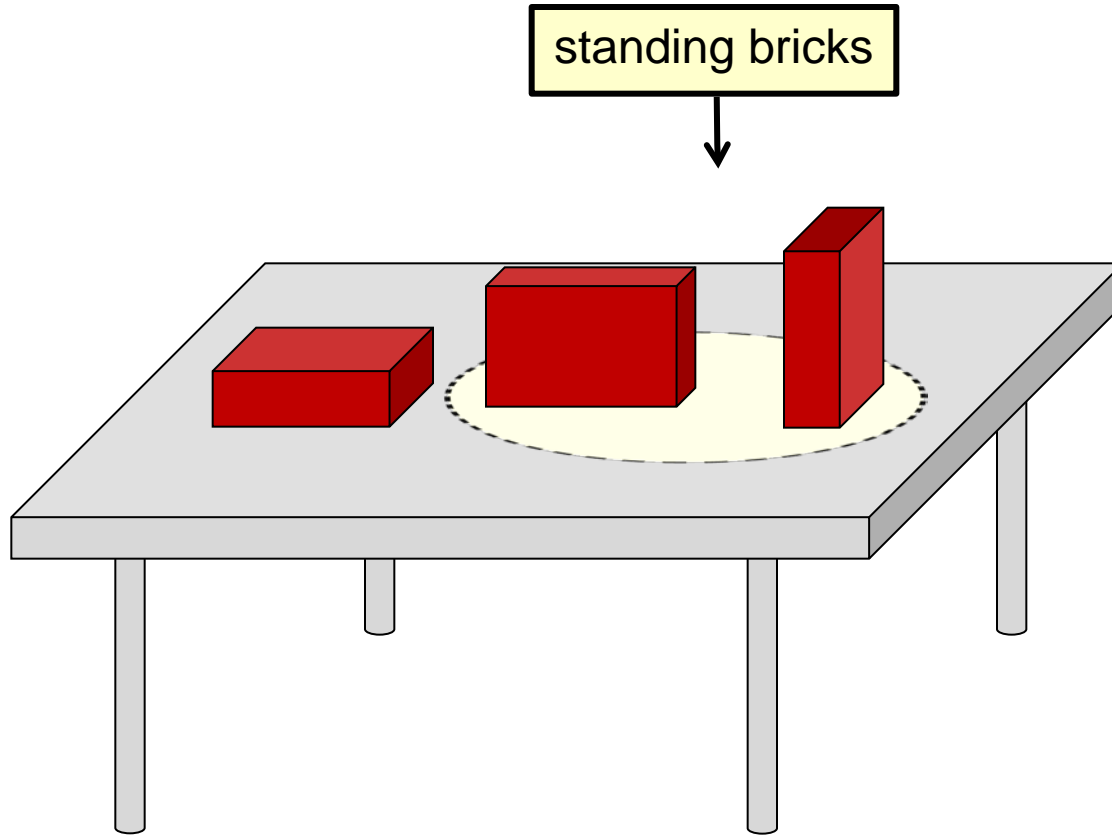


*liegen* 'lie': maximal axis (1D) = horizontal

*Der Ziegelstein liegt auf dem Tisch.*  
'The brick is lying on the table.'



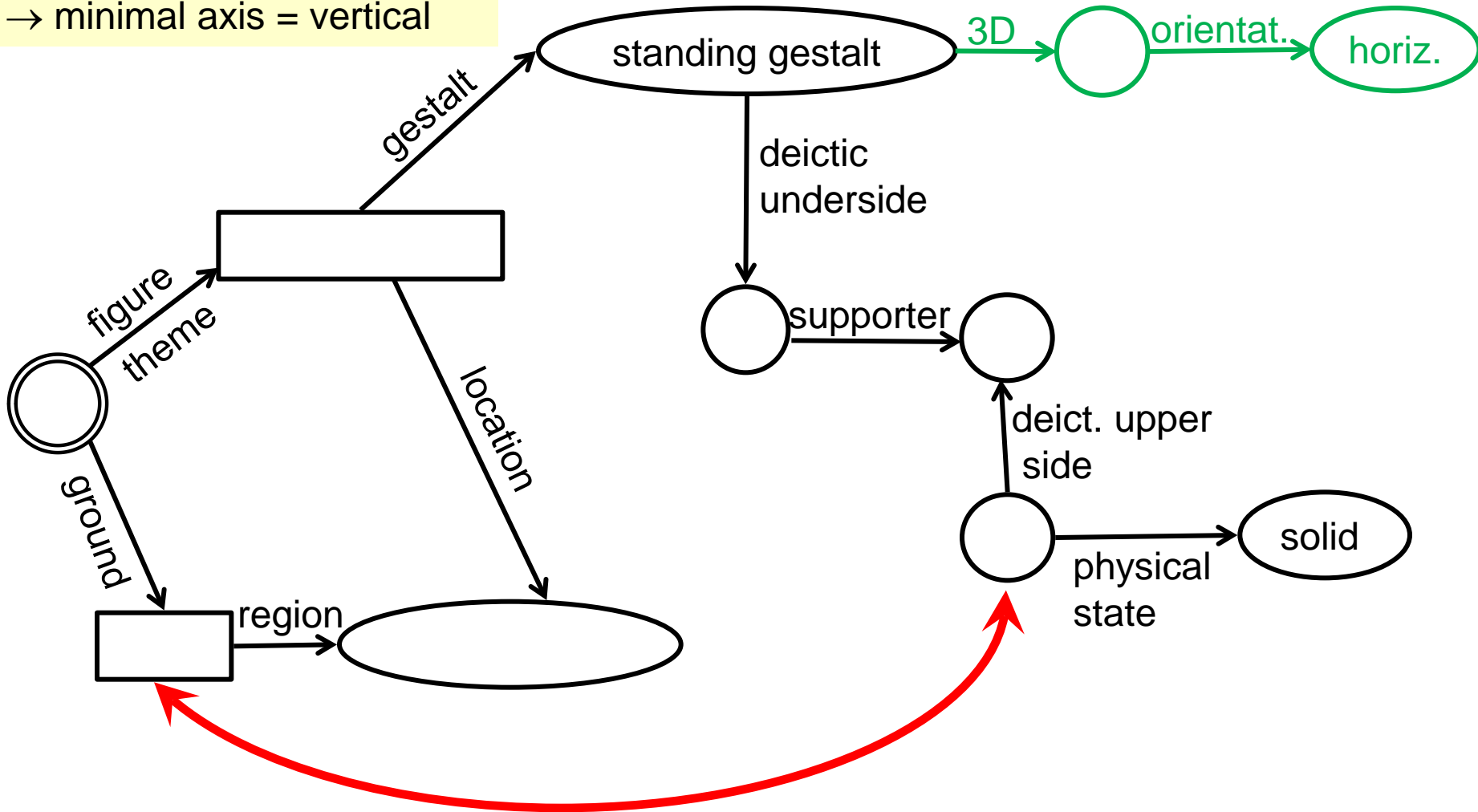
*Der Ziegelstein steht auf dem Tisch.*  
'The brick is standing on the table.'



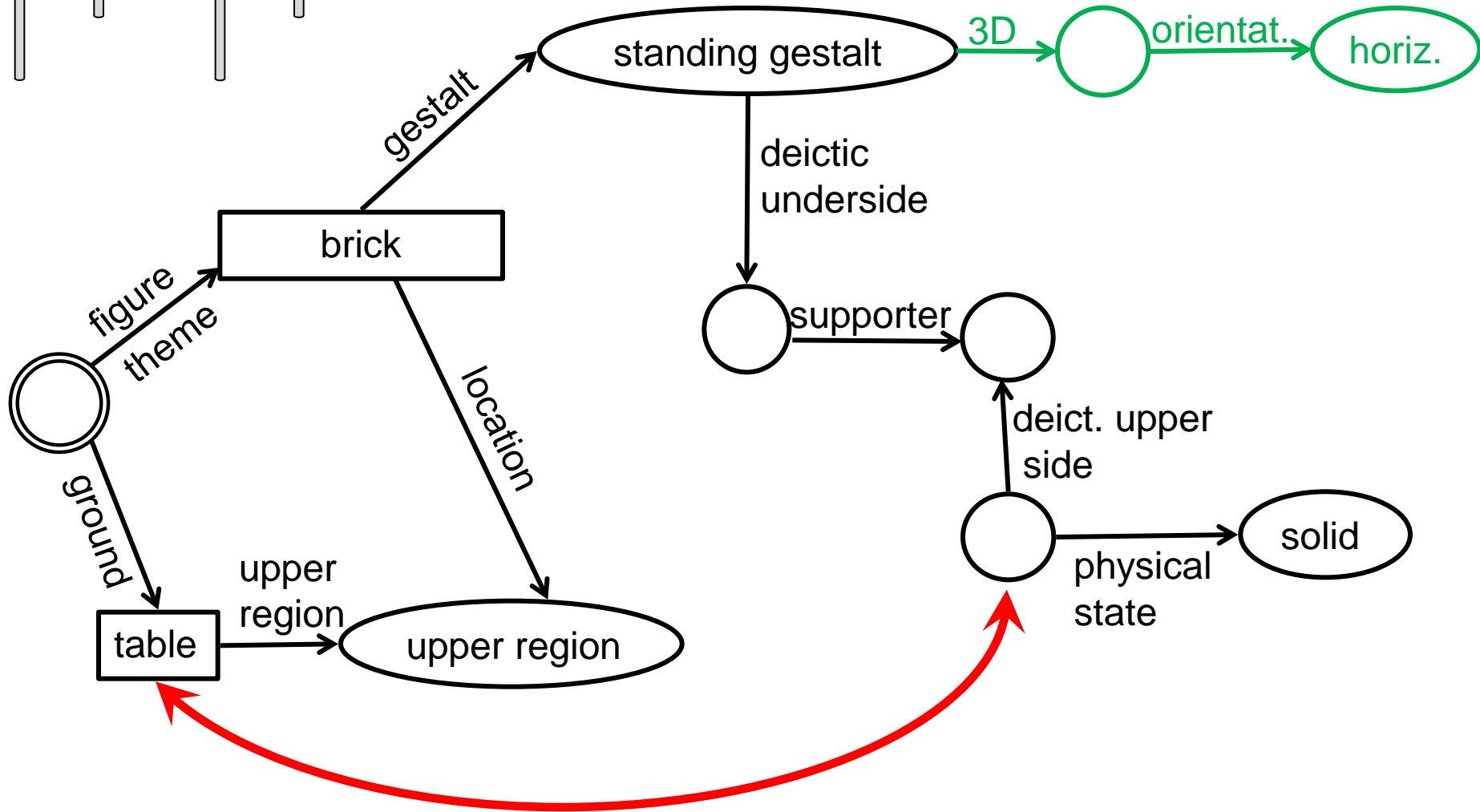
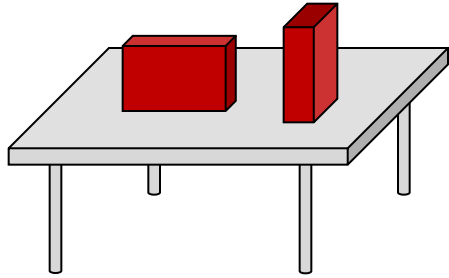
*stehen* 'stand': minimal axis  $\neq$  vertical

# stehen 'stand': option 1

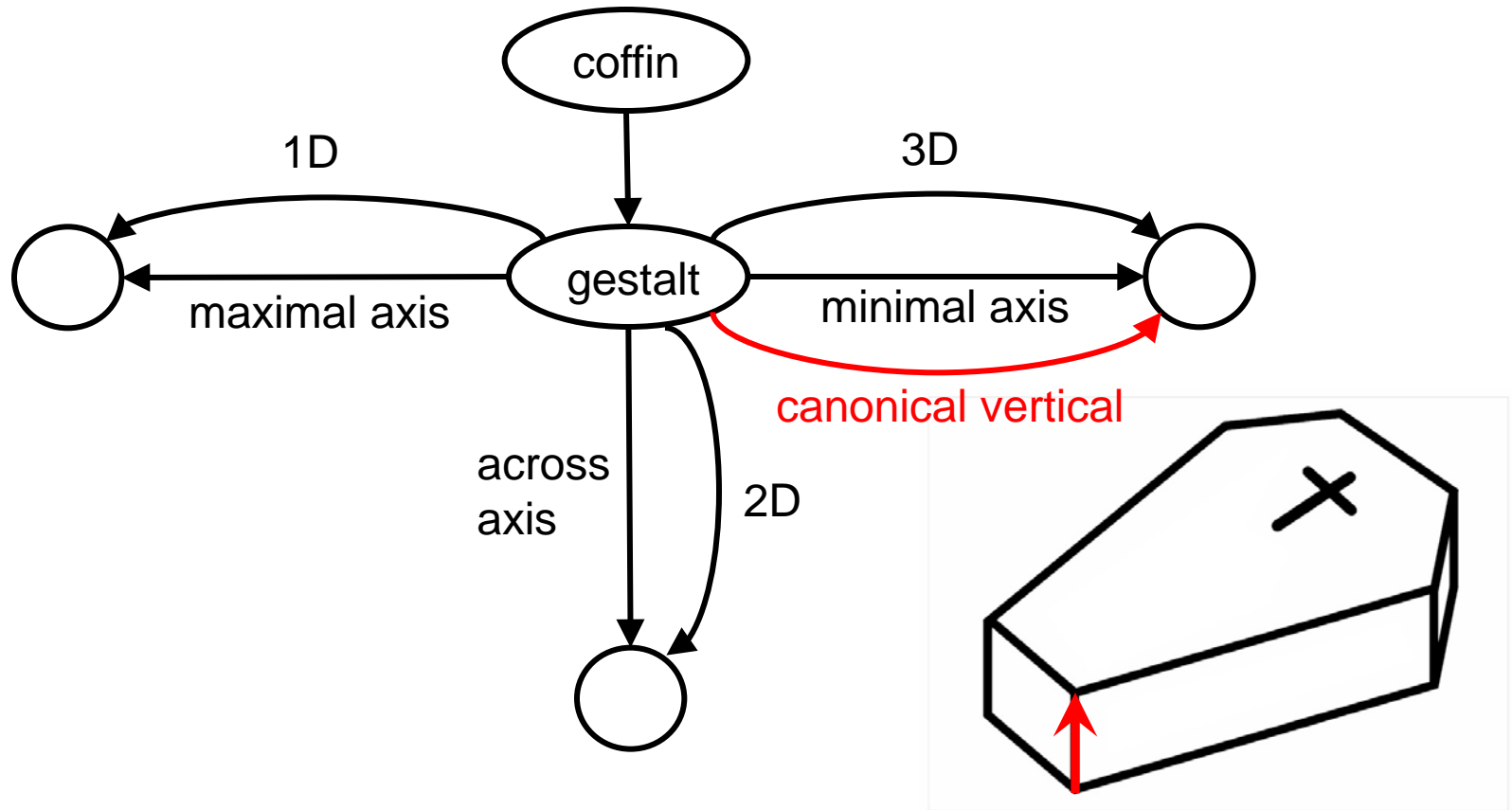
option 1:  
minimal axis (3D)  $\neq$  vertical  
 $\rightarrow$  minimal axis = vertical



*Der Ziegelstein steht auf dem Tisch.*  
'The brick is standing on the table.'



# Object schema of *Sarg* 'coffin'

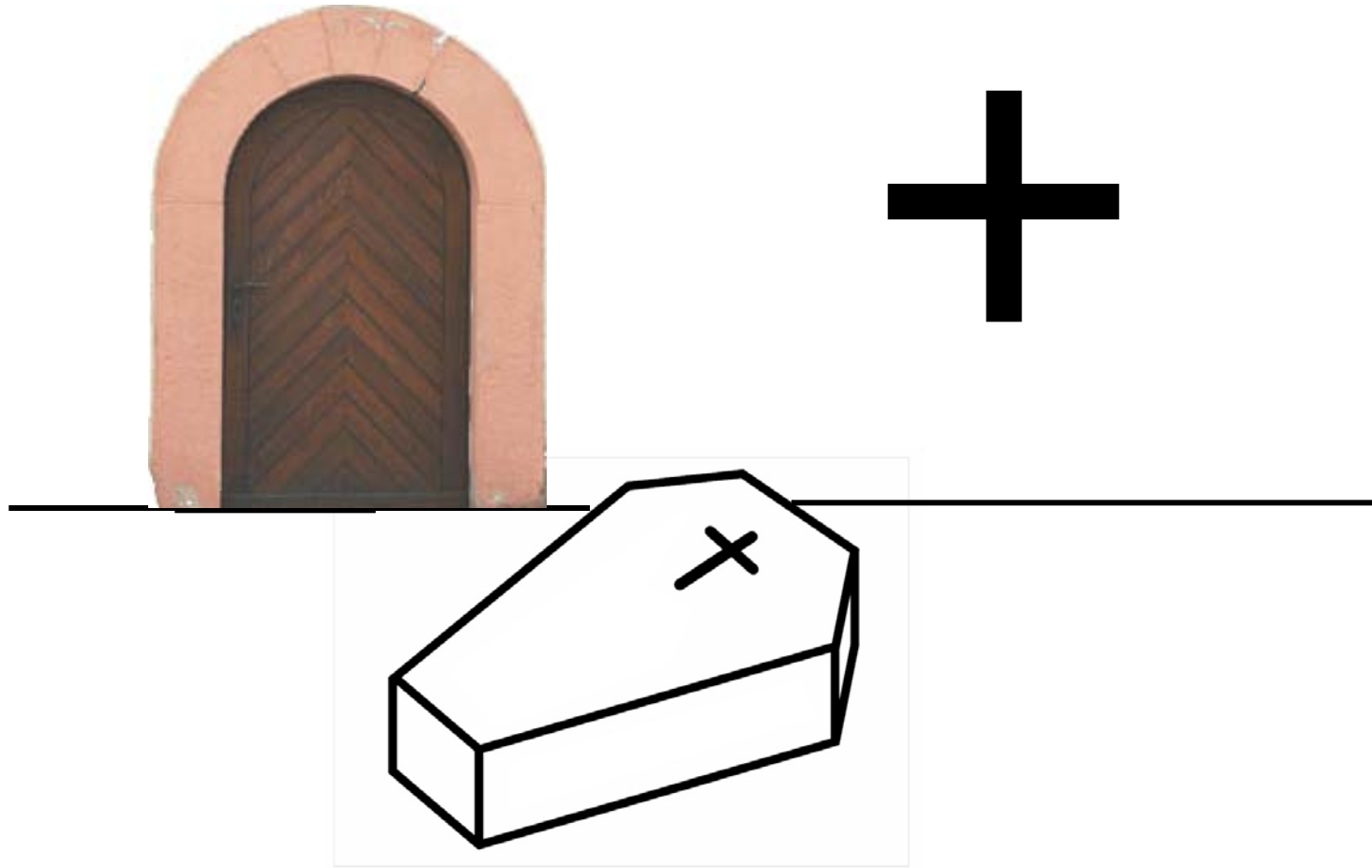


saliency/prominency of axis: 1D > 2D > 3D



*Der Sarg steht in der Kapelle.*

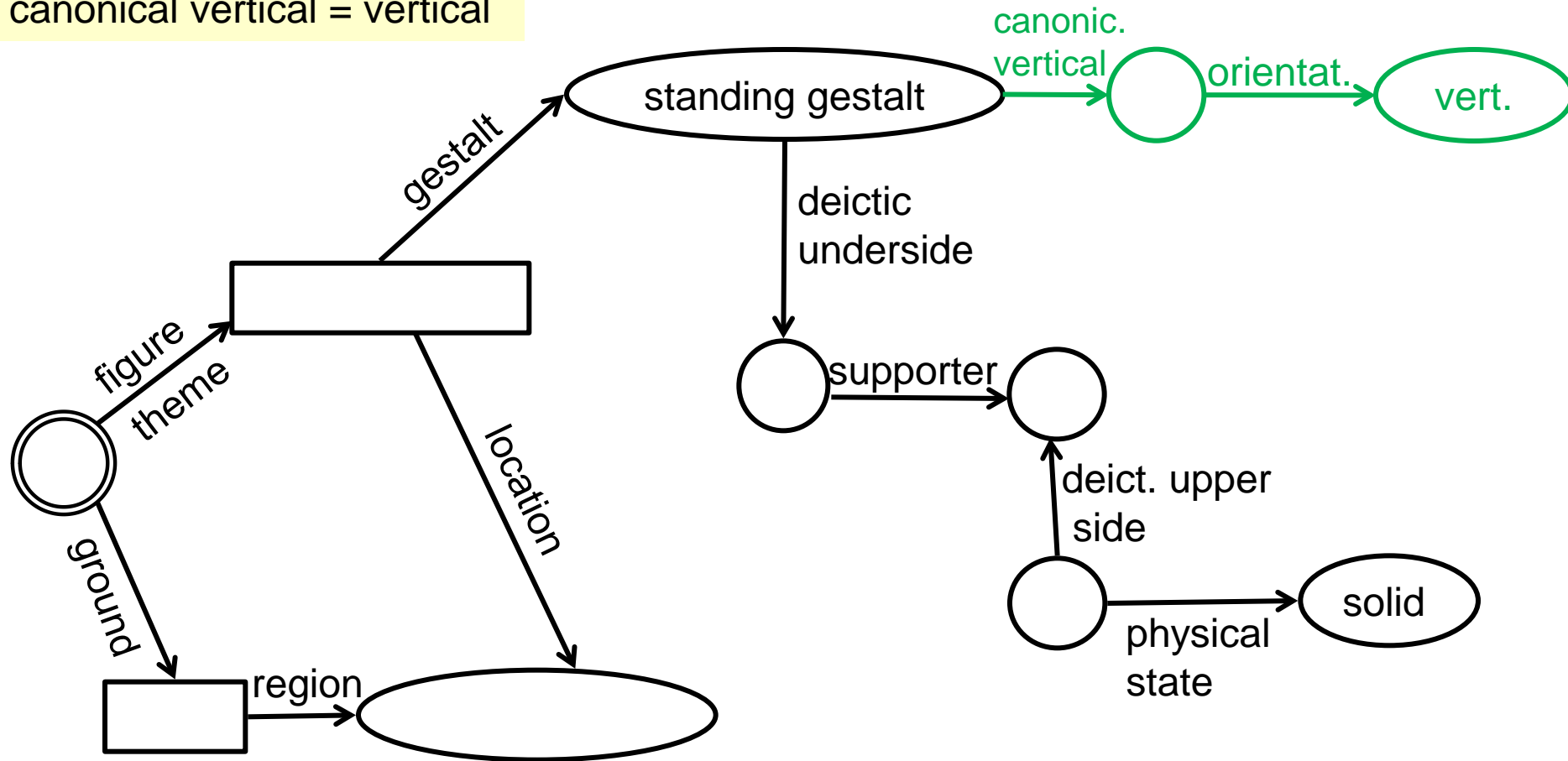
lit.: 'The coffin is standing in the chapel.'



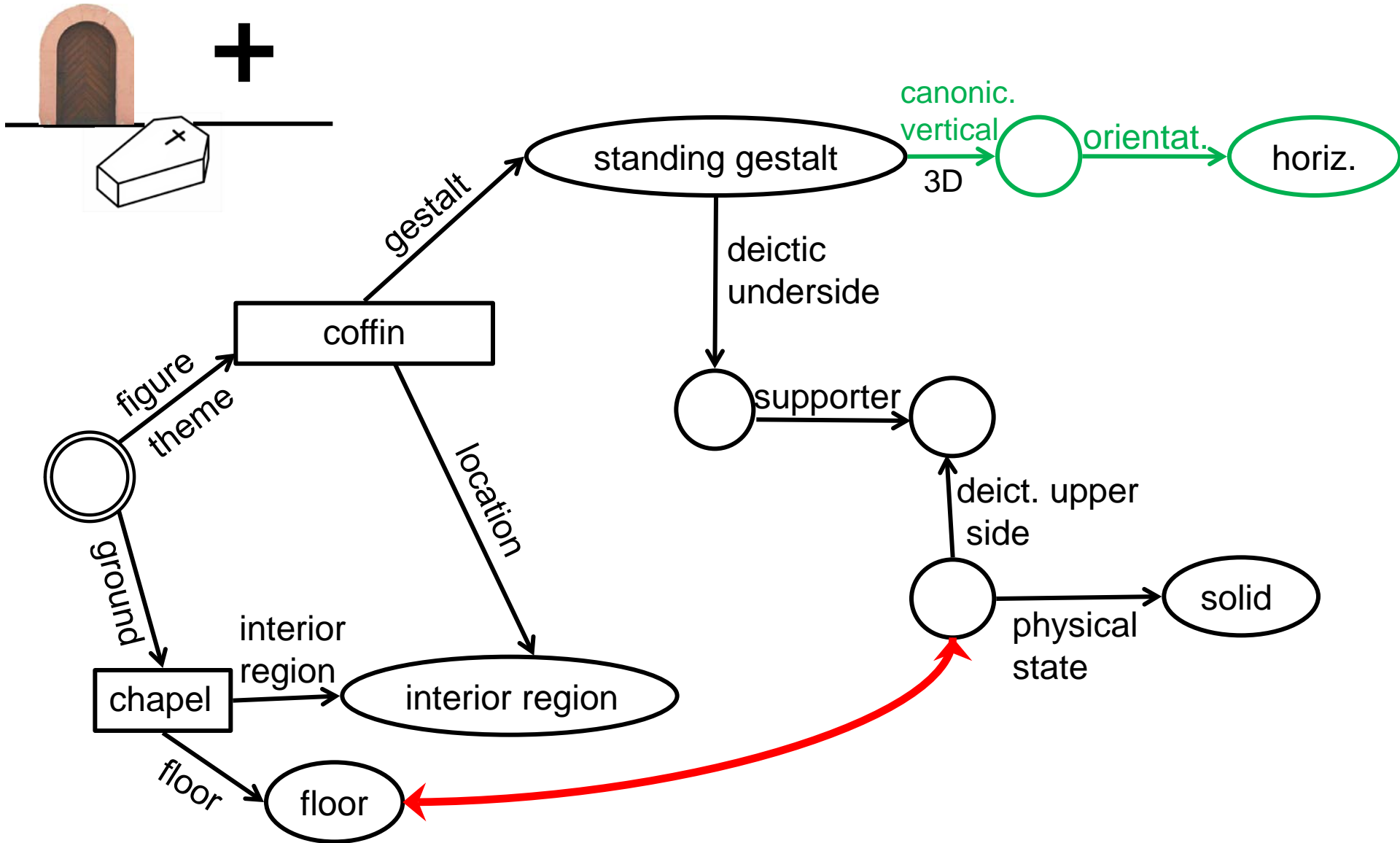
canonical vertical = vertical

# stehen 'stand': option 2

option 1:  
canonical vertical = vertical



*Der Sarg steht in der Kapelle.*  
'The coffin is standing in the chapel.'



# Advantages of a frame analysis of PVs

- All the elements necessary for the analysis of PVs (support, object axes, ...) are captured by frame representations
  - no extra-representational format
- The combinatorics of a PV and the elements co-occurring with it is captured technically by the unification of the frames of the parts.

# Advantages of a frame analysis of PVs

- The representation format allows for easy access to the relevant object properties
- Frame representations show a flexible degree of complexity (zooming in and out by expanding/not expanding nodes)