Force Antagonism in the Semantics of Movement Verbs

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1. Introduction

1.1 'climb' / German 'steigen'

In the literature (e. g. Levin (1993)):

verbs of directed motion   ↔   verbs of manner of motion

→ Uncertainty: is 'climb' a verb of directed movement (= "going up") or not?

The problem:
'climb' refers to **upward movement** when in isolation, but can be combined with PPs denoting **downward movement**.

The same is true of the German translational equivalent 'steigen':

(1)   a.   Der Luftballon stieg schnell.
           (The balloon was climbing fast (i. e., upward))
      b.   Peter stieg auf den Berg.
           (Peter climbed onto the mountain)
      c.   Peter stieg vom Baum.
           (Peter climbed down from the tree)

Possible analyses:

→ polysemy between a **manner** and a **direction** reading

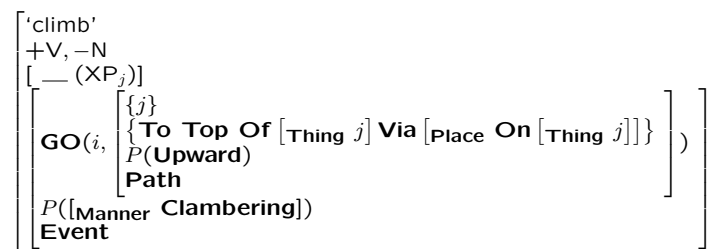→ upward direction as a **default** that may be cancelled: Jackendoff's (1985) *preference rules*.

Jackendoff (1985) assumes a "**switch**" in the lexical entry: 'climb' has a **manner** and a **direction** component, each single component can be lacking, but one has to be present.

Jackendoff's evidence:

(2)   a.   Bill climbed onto the mountain.

[+Clambering, +Upward]

b.   The train climbed onto the mountain.   [+Upward]

c.   Bill climbed down the mountain.   [+Clambering]

d.???The train climbed down the mountain.   [∅]

... In this paper:

- we compare evidence for both climbing verbs German 'steigen' and English 'climb' −

- in order to get insight into a common concept CLIMB.

- We ask which are the relevant **features** of this concept, and how these shall enter a semantic-conceptual model of 'steigen' / 'climb' situations.

Jackendoff proposes the following lexical entry for 'climb':

$$\begin{bmatrix} \text{'climb'} \\ +V, -N \\ [\ \underline{\quad}\ (XP_j)] \\ \begin{bmatrix} \mathbf{GO}(i, \begin{bmatrix} \{j\} \\ \{\mathbf{To\ Top\ Of}\ [_{\mathbf{Thing}}\ j]\ \mathbf{Via}\ [_{\mathbf{Place}}\ \mathbf{On}\ [_{\mathbf{Thing}}\ j]]\} \\ P(\mathbf{Upward}) \\ \mathbf{Path} \end{bmatrix}) \\ P([_{\mathbf{Manner}}\ \mathbf{Clambering}]) \\ \mathbf{Event} \end{bmatrix} \end{bmatrix}$$

$\{\cdot\}\ldots\{\cdot\}$: choice of syntactic options

$P(\cdot)$: Preference Rule Features

1.2 Critical Remarks: Which features?

... 1. Cases with completely unspecified direction

- Paths may be given by source or route prepositions instead of goal prepositions:

(3)   climb out of, along, through, over, across

→ hence, it is not the case that the feature UPWARD is present unless explicitly cancelled.

(4) a. Peter {'steigt' / 'klettert'} auf den Berg.
         Peter is climbing   up the mountain.
     b. Peter {'steigt' / 'klettert'} dem Felsen entlang.
         Peter is climbing   the rock   along.
     c. Peter {'steigt' / 'klettert'} aus   der Tonne /
         Peter is climbing   out-of the bin   /
         in   die Tonne.
         into the bin.

(5) Peter {'steigt' / 'klettert'} in   das Tal   (herunter).
     Peter is climbing   into the valley (down).

... 2. What exactly is the "manner"?

(6) 'clambering' := a movement pattern, support from hands
     and feet

?

How far can this be extended? The applicability of the manner
feature must be very vague. One can hardly say that all cases
that don't fit literally are metaphors (maybe the first sentence
below, but rather not the second):

(7) a. The train climbed up the mountain.
     b. The snake climbed up the tree.

... 3. Data problems

Web search delivers some examples with **non-clambering down-
ward** movement (!), even if they are rare.

(Google hits, raw numbers: ratio 'snake climbed down' / 'snake
climbed' = 22/999)

Examples:

(8) Watching the *sun* also as it *climbed down* the cloudless
     sky, and literally counting the minutes till it should reach
     the horizon, ...
          Haggard, H. Rider (Henry Rider), 1856-1925: The Ivory Child
                          www.gutenberg.org/files/2841/2841.txt

(9)   On the track, eight driving instructors took the *vehicle*
      on to a hump and the next minute, it *climbed down* a
      steep descent.
           http://www.hindu.com/2006/07/25/stories/2006072503480200.htm

(10) By the time the ATC informed them about the altitude
      of the *Boeing*, the plane had *climbed down* to 14496
      feet. And just 26 seconds before disaster, ...
              skyscrapercity.com/archive/index.php/t-143494-p-2.html

(11) Afterwards the *snake climbed down* the crack we climbed
      and my partner actually felt it slither past his hand which
      he had jammed into the crack! ...
              "wfinley", http://www.cascadeclimbers.com/forum/.....

2 An Analysis in Terms of Force Relations

(12)   The Police Report:

YOKOSUKA, Kanagawa — A female U.S. soldier belonging to the Yokosuka base has been arrested for trespassing after she got drunk and *jumped* onto the roof of a local resident's house, police said. The 69-year-old resident called police shortly before 10 p.m. on Saturday. "Someone is on the roof of my home," he told police.

Officers arrived at the man's home in Yokosuka and arrested the 18-year-old sailor, who was heavily drunk.

Police said she first *climbed* onto the roof of a nearby three-story building from an outside stairway. She then *jumped* onto the roof of the 69-year-old man's home.

The sailor, who belongs to the Kitty Hawk, has reportedly admitted to the allegations.

        http://mdn.mainichi-msn.co.jp/national/news/20061218......

2.1 Path Adaptation

A prototypical situation in which an upward clambering movement takes place:

$$\rightarrow$$

Now consider:

(13)   The soldier climbed onto the roof.

→ The path involved in this situation could be represented as:

- We assume **contact** of the climber with the reference object of the preposition (the roof) and any object on the way towards that goal.

→ The **movement path adapts** to the shape of this object because the climber has to find support on every point of her climbing tour.

→ Hence, the path shape of 'climb' is calculated as the **series of those points along the reference object** that offer support. The path therefore results from an iteration of support-situations.

→ There is **force exertion** in vertical direction (against gravity) on every point of the path.

This is definitely possible for the German translation:

(14)   Sie stieg auf das Dach nebenan.
        (She STIEG onto the neighbouring roof)

... English ok.?

2.2 Force Exertion

→ We hypothesise that **the notion of vertical force exertion constitutes the conceptual core of the meaning** of 'climb'; the direction of the movement is not basic but follows from path adaptation.
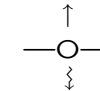
... Prediction:

→ We should be able to refer to a descent to the neighour's roof by the same sentence: →

... Compare the case of 'jump':

- Both 'jump' and 'climb' involve **force exertion** against gravity and against a supporting reference object:

$$\begin{array}{c} \uparrow \\ -\!\!-\!O\!-\!\!- \\ \updownarrow \end{array}$$

- Both verbs generate an **upward movement momentum** from this force.

→

- 'jump', like 'climb', is compatible with upward and downward paths:

  (15)   The soldier jumped onto the roof.

  (**ambiguous!**: UP, if from the ground; DOWN, if from the higher house)

- In both cases, the downward movement can be explained as the **global path** that results if the core situation is augmented by another, non-focused, movement episode

- The global path of the movement is free to have downward orientation as long as in each point, there is **force exertion against gravity**.

- DOWNWARD is then possible because of the **iteration** in the exertion of force.

- This is a marked case because it only works at a granularity level that ignores certain intermediate points in which the force exertion condidition would not be fulfilled (and these portions of the path are what contributes the downward movement)
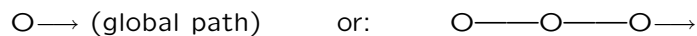
. . . Diagram 'climb':

(iteration of **support episodes** "O"; plus **non-focussed phases** "—" that allow for downward movement):

↑ : momentum
O————————————————O—O—O→ global path, ref.object
↕ : force exertion
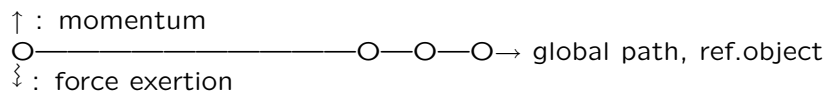
. . . Diagram 'jump':

(force and momentum in "O" as above; plus "**flying phase**" in "—"). The whole thing can also be iterated.

O—→ (global path)   or: O——O——O—→

(→ Of course, there is a difference in climbing vs jumping which lies in the exact ways of force exertion and contact with ground)

2.3 Manner / Movement Shape

Very brief: (cf. Weisgerber (in press, 2007) for more details)

. . . **Inferences** have to be drawn as to which **motion method** is available for the moving entity

. . . The manner features are posited accordingly (humans: clambering; koala bears: slightly different way of clambering; vehicles: running on wheels, etc . . .) . . .

. . . and have to provide the right kind of **force exertion pattern**.

... All this is a matter of **conceptual- and world knowledge**, as given in *Conceptual Knowledge Modules*:

For humans, the conceptual lexicon lists (among others) the 'standardMotionMethod':

(16)

> **Human < Thing.Moving.Animate <**
> **Thing.Moving**:
> ⋮
> standardMotionMethod = ForceInput =
> iterate(pushAgainst(limbs,Surface($\square.y_{\textbf{Thing}}$)))
> ⋮
> clamberMotionMethod = ForceInput =
> iterate(grip(limbs,Surface($\square.y_{\textbf{Thing}}$)))
> ⋮

(Weisgerber (2007, in press))

- "intrinsic upward momentum, freely suspended"

→ continuous and invariable

→ Dense set of Via points on the path

→ **each** point on the path is higher than all preceding ones, i. e. **continuous upward** movement.

This explains why 'the balloon climbs' allows only one type of global path, namely 'direction=upward'.

The special thing about the balloon-examples is perhaps just the strict continuity of the movement.

2.4 Case: 'The balloon climbs'

Very brief:

Different scenario: freely suspended object → different Manner in which force exertion plays itself out. This factor can be read off the object concept.

(17)

> **gas balloon** < movingThing
> TranslationalMotionMethod =
> intrinsic impetus up, freely suspended
> . . .

. . . Prediction:

upward movement may be continuous, downward movement must be stepwise.

Consider again the data from the first section:

(18)   Watching the *sun* also as it *climbed down* the cloudless sky, and literally counting the minutes till it should reach the horizon, . . .

(19)   By the time the ATC informed them about the altitude of the Boeing, the *plane* had *climbed down* to 14496 feet. And just 26 seconds before disaster, . . .

The interpretation of such cases requires a conceptualisation that posits a **series of designated support points** (which are not strictly needed for upward movement).

This seems more plausible than arbitrarily weakening the notion of "clambering by moving hand and feet".

2.5 Section Summary

- We have specified the sense in which 'climb' denotes a 'manner of movement': it describes a **pattern of force exertion along the points of a path**. We thus propose that 'climb' can best be described as an '**antagonistic**' movement verb (rather than a verb of directed movement).

- More specifically, the verb involves **vertical force exertion** that acts against gravity, thus creating a potential for upward movement at each single support point on the path.

- It may be true that the existence of a variant like climbing as of balloons **cannot be predicted**, it has to be stipulated that these types of force exertion and support (via buoyancy) are allowed as well. In this sense, this would be seen as a "**lexicalised variant**".

- However, we point out that there is a **common conceptual core** in all uses of climbing. If additional specifications are fixed for specific context types, this does not disturb this picture.

- Hence, our proposal is **neutral** with respect to the question of **productive inference vs. a lexicalised network** of uses; arguably, a combination of both is usually needed (cf. Jackendoff (2002)).

- The path of the whole event comes about in the course of an **iterated application** of this manner component. Hence, the direction of this global path is in principle independent of the direction of movement that is created by the force exertion.

- The direction and the shape / method of movement are **underspecified**. These latter values are rather inserted and modulated in the course of the interpretation process according to the specific properties contributed by the context.

- In this way, we have dispensed with Jackendoff's use of "clamber" and "upward" as elementary lexical features for 'climb'. His observations about the asymmetry of conditions

on upward and downward movement can be explained from conditions on the force exertion component in different contexts.

3.1 A unified notion of "Force Exertion"?

... Remaining problems with 'climb' and 'steigen'

- Is there really a unified +antagonistic semantics for 'climb' and 'steigen': isn't climbing as of balloons a passive movement?

- The problem with 'climb' replicates with G. 'fliegen' / 'fly': as with 'climb', there are uses in which the moving object appears to be passive:

(20) a. Ein Vogel flog durch das Fenster.
          A bird flew through the window
      b. Das Flugzeug flog durch die Wolken.
          The plane flew through the clouds.
      c. {Ein Stein / Eine Gewehrkugel} flog durch das Fenster.
          A stone / A bullet flew through the window.

... and an answer to Levin and Rappaport Hovav, 1995

Note: English has **pairs** of verbs that are not distinguished in German.

steigen:	climb	rise
schwimmen:	swim	float
schweben:	hover	float (in the air)
springen:	jump (/bounce)	bounce

− Conspicuous gap:

fliegen: only fly

... Alternations

→ Then, we can see that we are dealing with **two kinds of alternations**:

- +/−antagonistic situations with similar movement types, which are distinguished by different verbs in English, though not in German

- force exertion and apparently passive situations, covered by the same verb in both English and German: climbing (extends to things like balloons), flying (extends to things like bullets).

→ Clearly, the movement shape / pattern is not (always) what makes the difference. So if there is a difference in manner, it should lie with **different constellations of force exertion**. One group appears to contain the "**forceful**" verbs (antagonistic), the other the "**passive**" variants.

→ Analysis: While German movement verbs often cover cases with or without force exertion, **English distinguishes** them in ±**antagonistic** variants (with some blurred cases like 'bounce')

Note that the +**antagonistic class** appears to correspond to **Levin's (1993) RUN class** and the −**antagonistic** class to the **ROLL class** of manner of movement verbs. Hence, it seems that the feature ±antagonistic is what triggers unaccusativity effects with these movement verbs (not so much Levin's "internal causation")

In distinction to ROLL verbs, causatives derived from **RUN class** verbs have the following properties:

a. The interpretation is one of **indirect causation**

b. The causative use is only licenced in the presence of a directional PP, or the causative a lexically fixed collocation.

c. German does not allow productive causativisation of the pattern b.

The following examples demonstrate this:

(21) a. The soldiers marched to the tent.
      b. The general marched the soldiers to the tent. [causative + PP]
      c. *The general marched the soldiers.
      d. The general walked the dog / ??the soldiers [isolated exceptions]

German:

(22) a. Die Soldaten marschierten zum Zelt.
      b. *Der General marschierte die Soldaten zum Zelt [no causative at all in German]
      c. *Der General marschierte die Soldaten

... Consequences for 'fly' / 'fliegen': The data

Geuder and Weisgerber (2006) argue that the causativitsation patterns of 'fly' and German 'fliegen' invariably point to a **classification with the RUN class** – (direct causative would have to be similar to the meaning of 'throw').

Their corpus examples show that 'fly' behaves as a RUN verb:

In contrast, German allows causativisation of unaccusative verbs just like English:

(23) a. The cheese rolled to the train station / They rolled the cheese to the train station
      b. Der Käse rollte zum Bahnhof / ok: Sie rollten den Käse zum Bahnhof

- Almost all examples involve a directional complement; e. g.:

(24) hi everyone, need to get a 3rd gen headlight have a hole in ours where **a lorry flew a stone up** and hit us

  www.yotasurf-online.co.uk/public/forums/showthread.php?p=90648

... not: * a lorry flew a stone.

- Almost all examples involve a directional complement;

- The only (idiosyncratic?) exception: toy planes / paper planes (but NOT even arrows)

(25)   It keeps hundreds, if not thousands, of people who can barely *fly a paper dart* rushing to your LHS to buy brightly coloured boxes covered in shrinkwrap and . . .

        `www.wattflyer.com/forums/showthread.php?t=4400`

(26)   Throw a piece of cardboard straight out like you were flying a paper plane. It will almost immediately fly at an upward angle

    `www.yale.edu/ynhti/curriculum/units/1988/6/88.06.02.x.html`

- Almost all examples involve a directional complement;

- The only (idiosyncratic?) exception: toy planes / paper planes (but NOT even arrows);

- German does not allow any of these examples (in the relevant reading):

(27)   *Der Laster flog einen Stein herauf
      (The lorry flew up a stone)

(28)   *Er flog ein Papierflugzeug
      (He flew a paper dart)

We conclude that 'fliegen' / 'fly' as movement verbs **always pattern with the RUN class**, even if they involve 'passive' objects that have been thrown or shot off. (Levin & Rappaport's (1995) criterion of 'internal causation' fails here, since stones, paper darts etc. are clearly unable to act as internal causers of the movement).

The reason must be that this type of movement counts as **antagonistic**.

This can be confirmed from **psychological research on people's intuitions about forces** ('naïve physics'): moving objects are ascribed an intrinsic momentum ('impetus') that counteracts gravity and inertia.

3.2 IMPETUS as a Concept of Intuitive Physics

. . . 'Historical' example: The Cliff and Ball Problem.

(Cf. Closkey (1983), Closkey and Kohl (1983).)

Ground   "Draw the path the ball will follow!"
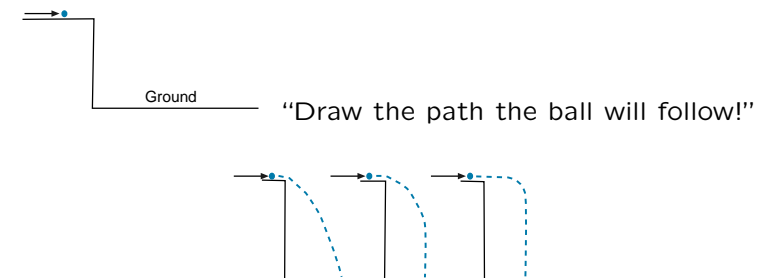
- 74% of the subjects draw a more or less 'parabolic' path (first figure, correct), a significant group draws solutions like in C.

- In **interviews** these subjects explain their solutions as:

  (29)   "continue straight, **then turn** and fall straight down: **gravity 'wins over impetus'**.

- In particular, **impetus** is the concept that underlies **uncontrolled, fast, automatic processing** of movement, while **Newtonian** physics depends on **reasoning** and must be learned.

- Empirical finding: impetus vs. 'correct Newtonian' reasoning is employed in **different kinds of tasks**.

  Unsolved problem: The **role of expert knowledge** in relation to naïve physical reasoning remains unclear.

Kozhevnikov and Hegarty (2001):

→ The implicit concept of impetus has been **learned from observation**. It turns out to be a good **approximation to Newtonian physics** as it appears in our world where friction is omnipresent in motion.

→ it must be the intuitive theory that **underlies the conceptual-semantic representations**.

Idea: an **impetus** internal to the object is responsible for motion.

Kozhevnikov and Hegarty (2001): "This theory, which we will refer to as a *naïve impetus theory*, makes two fundamental assertions about motion.

First, the theory asserts that the act of setting an object in motion imparts to the object an **internal force** or 'impetus' that serves to maintain the motion.

Second, the theory assumes that a moving object's **impetus gradually dissipates** (either spontaneously or as a result of external influences), and as a consequence the object gradually slows down and comes to a stop."

→ Force antagonism of the impetus against surrounding forces like gravitation.

→ A movement impetus can be generated by force exertion or inherited by force transmission.

→ What is behind the feature +antagonistic is an intrinsic impetus that acts against environmental forces like gravity.

'fly / fliegen' denotes a situation type in which a moving object creates its support in the air from a movement impetus. (Note that there is no passive resting position for flying objects, as opposed to swimming ones: when the flying activity ceases, the object falls down).

A movement that is characterised by the interplay of two environmental forces, counts as [−antagonistic]

3.3 'sinken' vs. 'fallen', and the role of the environment

- German 'steigen' and 'sinken' ('climb' / 'rise' vs. 'sink') are usually considered opposites, so should 'sink(en)' also be considered an antagonistic verb?

- Why do we have 'climb up / down', but not 'sink upward'?

Consider the following contrast of both 'fallen' and 'sinken' scenarios in gaseous vs. liquid environment:

(30) a. Ein Buch fiel vom Himmel. (A book fell from the sky)
      b. ???Ein Buch sank vom Himmel. (A book sank from the sky)

      c. Ein Flugzeug fiel vom Himmel. (A plane fell from the sky)
      d. Ein Flugzeug sank in eine tiefere Reisehöhe. (A plane sank to a deeper cruising altitude)

(31) a. Die Schlüssel des Tauchers fiel auf den Meeresgrund. (The scuba diver's keys fell to the ground of the ocean)
      b. ??Die Schlüssel des Tauchers sanken auf den Meeresgrund. (The scuba diver's keys fell to the ground of the ocean)

      c. ???Der Tote fiel zum Meeresgrund. (The dead body fell to the ground of the ocean)
      d. Der Tote sank zum Meeresgrund. (The dead body sank to the ground of the ocean)

- Both 'sinken' and 'fallen' denote downward movement as passive traveling along gravitation.

- In 'fallen' gravitation is the only present force, the motion is fully determined, depending only on the physical makeup of the object.

- In 'sinken', on the other hand, the motion is both passive (traveling with gravitation, i. e. driven by an external force) and active in its being antagonistic: there is one more force involved, which acts against gravitation. This force is brought about by the environment.

→ linguistically, the (conceptually given) **prominence of the intervention of the medium** makes up the difference between falling and sinking scenarios. (On the surface, this difference may appear as 'slow vs. fast downward motion'.)

There is an asymmetry between "passive" upward and "passive" downward movement: climbing as of balloons results from an impetus (as it opposes itself to gravity), sinking does not.

For an upward movement for which gravitation does not play a role, or where gravitation is removed from the focus of the description, the verb 'rise' is used (German also uses 'steigen'):

(32)   The sun was rising

(33)   Smoke was rising from the chimney

(34)   The temperature is rising

(35)   The curtain is rising

4. Conclusion

Considering scenarios of 'climb' / 'steigen', 'fliegen' / 'fly','fallen', vs. 'sinken' vs. 'rise' . . .

. . . we discussed the role of conceptual knowledge, especially of and naïve-physical nature, in semantic encoding of motion verbs.

→ Conceptually, there are **three kinds of motion forces** which are conceptually salient:

– **object-caused**,

– **environment-caused**,

– and **gravitation-caused**.

→ Physically, only the third kind of force causes a completely passive (and thus fully determined) downwards motion.

→ Scenarios with antagonism between external forces in combination with object-internal passivity are possible.

→ In all other cases, (where motion is not completely determined since it is actively influenced by the object), linguistic variation may arise.

The end. THANK YOU.

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Motion Verbs and Force Relations

Note: Please do contact the authors instead of citing these slides directly: there may be changes, improvements, a newer version, or a paper finally! we will send you the newest version in case. Thank you.

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