Manner of Movement and the Conceptualisation of Force

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Overview

• Semantic classification of verbs of movement: „verbs of direction“ vs. „verbs of manner of movement“

• Classification problems arise with certain „verbs of vertical movement“:
  English *climb* ≈ German *steigen*; *sink*, etc.

• Hypothesis: these verbs represent a category of manner that is about force relations in movements.
Overview

• Hypothesis: these verbs represent a category of manner that is about force relations in movements.

• Moreover, the system of lexical semantic contrasts with these verbs shows that the relevant notion of force is the notion of impetus known from psychological work on „naive physics“. 
Part 1: Classifying Movement Verbs
Verb Classification: Direction vs. Manner

The importance of the distinction
Manner of movement / Direction of movement:

- Talmy's (1985) hypothesis of a lexical typology
  [in our own paraphrase:]
  ± manner verbs as the syntactic core of the clause
  ± manner verbs allowed with directional complements;

Presupposes that a clear distinction between manner verbs and verbs of direction can be drawn.
Levin & Rappaport (2007) hypothesise that verb meanings have to be unambiguously categorised as either "manner" or "result" verbs, with "direction" counting as a result-type feature. One of their problem cases: *climb* appears to indicate both upward direction and (sometimes) manner.
Verb Classification: Direction vs. Manner

- The 7 Classes of movement verbs from Levin (1993) largely fall into two groups of manner vs direction:

1. Verbs of directed movement
   - "Verbs of inherently directed motion", 
     arrive, ascend, ?climb, descend, enter, fall, plunge, rise... etc.
   - "Leave Verbs"
   - ? "Chase Verbs",
   - ? "Accompany Verbs"
2. Verbs of manner of movement
   • ROLL-class
     *bounce, drift, drop, float, glide, move, roll, slide, swing*; [AROUND AXIS] *coil, revolve, rotate, spin, turn, twirl*...
   • RUN-class
     *bounce, clamber, climb, crawl, dart, dash, float, fly, gallop, hobble, hurry, jump, leap, limp, meander, roam, roll, run, swim, whiz, zigzag* ...
   • "Verbs of motion using a vehicle"
     *cycle, ski, skate, row, ride*...
   • "Waltz verbs"
Verb Classification: Defining the classes

2. Verbs of manner of movement
   - **ROLL-class**
     ```
bounce, drift, drop, float, glide, move, roll, slide, swing; [AROUND AXIS] coil, revolve, rotate, spin, turn, twirl...
```  
   - **RUN-class**
     ```
bounce, clamber, climb, crawl, dash, float, fly, gallop, hurry, jump, limp, meander, roam, roll, run, swim, whiz, zigzag ...
```  

Levin's classification:
– The **RUN** class contains truly intransitive verbs, often agentive
– The **ROLL** class contains unaccusative verbs
– Some verbs occur in two variants, e.g. *roll*
Verb Classification: Defining the classes

- The verb *roll* occurs as an unaccusative verb (cf. a) or an agentive verb (cf. b.), as evidenced by the different patterns of resultative constructions.

  a. *The curtain rolled [*itself* open].
  b. *The children rolled [the grass flat].*  
  (Levin & Rappaport 1995: 209-10)

- The unaccusative use of *roll* gives rise to a direct causative (comparable to the causative-inchoative alternation):

  *The cheese rolled to the station.
  They rolled the cheese to the station.*
Verb Classification: Defining the classes

• The verb *roll* occurs as an unaccusative verb or an agentive verb.
• The unaccusative use of *roll* gives rise to a direct causative.

• Conclusion:
  – the word meaning of *roll* is neutral wrt. a factor agentivity / control
  – *roll* allows addition of an agentive component without change of manner

• There are other ROLL-type verbs which cannot be agentive (e.g. *drift* [or at least its German counterpart])
Verb Classification: Defining the classes

2. Verbs of manner of movement
   - ROLL-class
     bounce, drift, drop, float, glide, move, roll, slide,
     swing; [AROUND AXIS] coil, revolve, rotate, spin,
     turn, twirl...
   - RUN-class
     bounce, clamber, climb, crawl, dash, float, fly,
     gallop, hurry, jump, limp, meander, roam, roll, run,
     swim, whiz, zigzag ...

In sum,
the ROLL class contains verbs that do not inherently specify a factor which controls the movement.
The RUN class carries a positive specification for an agentive / controlled movement (hence they are not unaccusative and block direct causatives).
Verb Classification: Direction

Verbs of directed movement specify the localisation of a path, and hence can be classified in the same way as directional prepositions.

Applying the typology of path prepositions by Zwarts (2006)
Verb Classification: Direction

Applying the typology of path prepositions by Zwarts (2006)

<table>
<thead>
<tr>
<th>type of path concept</th>
<th>path-P</th>
<th>path-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOAL</td>
<td>location of end•</td>
<td>in(to)</td>
</tr>
<tr>
<td>SOURCE</td>
<td>location of start•</td>
<td>out of</td>
</tr>
<tr>
<td>ROUTE</td>
<td>loc. intermediate</td>
<td>through</td>
</tr>
<tr>
<td>COMPARATIVE</td>
<td>end• closer to reference obj.</td>
<td>toward</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>all •• with same loc. relation</td>
<td>along</td>
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</tbody>
</table>
Applying the typology of path prepositions by Zwarts (2006) — residual types:

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<td>around-and-around</td>
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</tbody>
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Here, the analogy begins to break down: Path shape and periodic movements seem to yield manner of movement concepts.
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Complication: Ambiguity of verbs like *rotate*
- a. movement along a circular trajectory
- b. movement of a thing around its own axis

a. = "translational movement" vs. path component
b. = "internal movement" vs. manner
Verb Classification: Manner

Some types of manner components in Levin's (1993) list:
• Internal movement: roll, [AROUND AXIS]: spin, etc.; swing...
• Path shape: meander, zigzag
• Type of surface contact: slide, bounce (?)...
• Step patterns / posture / affordances of moving entity: run, waltz, gallop, crawl, limp, clamber; ski, cycle...
• Speed and speed-related agency: dash, hurry

Manner components can usually be defined in terms of properties that hold locally, confined to the moving object and/or to subparts of the path.
Verb Classification: Manner

Internal movement as a manner component: The case of roll

• manner: an event of rotation
  – with part structure (subevents): incremental chain defined by increasing angles of rotation.
• translational movement component: mapping (homomorphism) of manner structure onto incremental change of place (but without localisation of path).

Rothstein (2004)
Direction vs. Manner: Classification Problems

- Verbs of "vertical movement"(?): *climb*, *sink*…
  - Are they manner verbs or verbs of directed movement?
  - Can verbs combine a manner and a directed-path component in one lexical entry (contra Levin & Rappaport 2007)?

*climb*
- upward direction?
- manner: "clambering"?

*sink*
- downward direction?
- manner: slowed down (# fall)

Hypothesis: These verbs are about a manner feature "(configuration of) force exertion"
Verb Classification: Direction vs. Manner

A problem:
• *climb* is classified both under the RUN class of manner verbs and under the directed motion class by Levin (1993).
  — Why does *climb* allow downward movements?
  — How is this polysemy motivated?

• More problems: RUN verbs that need not be agentive, like *fly, zigzag*…
  (These cases will turn out to be conceptually similar to *climb*)
Part 2: *Climb* as a manner verb
climb

Jackendoff (1985, 1990) on climb:

One lexical entry that contains both the features "clambering" and "upward", ...but treats them as defaults. One of them can be cancelled (but not both simultaneously):

a. Bill climbed (onto) the mountain. [+Clambering, +Upward]
b. The train climbed up the mountain. [+Upward]
c. Bill climbed down the mountain. [+Clambering]
d. * The train climbed down the mountain. * [--]

Polysemy between two lexical entries:
— a manner variant that is neutral wrt. direction
— a directed motion variant

a. Bill climbed onto the mountain.  [manner]
b. The train climbed up the mountain.  ?
c. Bill climbed down the mountain.  [manner]
d. ? The train climbed down the mountain.  ?
e. The balloon climbed (higher and higher).  [upward]

Problem: What is the manner? When is downward movement possible or impossible?
climb

The manner feature cannot be described as "clambering" (with feet and hands).

• If *climb* denoted the manner "clambering", the following uses could only be covered by the [upward] sense:

  *The train climbed up the mountain.*
  *The snail climbed up the tree.*

• However, climbing as a downward movement of vehicles and animals without feet is possible:

  *On the track, eight driving instructors took the vehicle on to a hump and the next minute, it climbed down a steep descent.*


Generalisation: Downward climbing requires controlled, stepwise descent
The manner feature cannot be described as "clambering" (with feet and hands).

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,…

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!

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
climb

Downward movements that cannot be called "climbing": e.g. dropping

Hypothesis:
– *climb* denotes force exertion against gravity;
– downward movements can only be called "climb" if they betray the presence of an upward force on certain points of the path.
→ Controlled, stepwise descent

Evidence:
1. The shape of the path adapts to points where the ground offers support (if force comes from push-off). Consider the example: "They climbed onto the roof."
"They climbed onto the roof"
"They climbed onto the roof"

- Force
- Gravitation
- Manner component
- Translational movement (independent of manner, direction up or down)
Similar case: "He jumped from the roof"

The verb *jump* denotes *upward* force exertion with push-off against the ground, ...which subsequently causes movement along a trajectory. Again, its direction is independent of the manner.
Variant: "The ballon was climbing"

The verb *climb* also allows scenarios in which a freely suspended object (e.g. a balloon) exerts a continuous upward force (due to buoyancy).

These cases require upward direction of the movement. Downward movement would have to occur intermittently, between supported steps, which is not applicable here.
Hypothesis, refined:
— *climb* denotes a manner feature "force exertion against gravity".
— As with all manner features, this is a condition on subparts of the unfolding event.
— The trajectory of a movement event constitutes an independent tier.
The directionality of the translational movement cannot always be predicted from the manner.
— Corollary: *climb* as a downward movement requires a controlled, stepwise descent.

More empirical evidence for this account:
• *climb* vs. *rise*
• E. *climb* vs. German *steigen*
Part 3: *Climb* and other verbs of vertical movement
climb vs. rise

- **Rise** does not allow downward movement.
- In many cases of upward movement, **climb** and **rise** can be used interchangeably:

  *The submarine rose to the surface.*

  *The submarine climbed to 200 feet, then went into a steep glide which took her down to 380 feet before control was [regained].*
climb vs. rise

With upward direction, climbing situations are a subclass of rise configurations:
a freely moving object moving upward

• Observation 1:
Certain cases of rising could not be expressed by climb:

*We have watched the river rise until it fills the field on the opposite bank...*
http://www.stellabooks.com/articles/day_in_life.php

*The hairs on the back of his neck began to rise*

*The curtain rose.*
• Observation 2: 
*Rise* covers both movement of an object and change of vertical extension. This property is shared by other words that denote upward vectors, e.g. *high* (Zwarts 1997)
climb vs. rise

"The window is two meters high."

Height as extension

Height as position (distance from ground)

Analogously:

"rise" as change of extension: "The hairs on his neck were rising"

"rise" as change of position: "The submarine was rising"
• Conclusion:

*Rise* behaves as a purely directional predicate, the behaviour of *climb* does not align with this semantic type.

— Rather, *climb* is used for situations in which a freely moving thing is perceived as opposing gravity.
climb and its German translations

- The usual German translation for Engl. *climb* is *steigen*.

The range of uses of G. *steigen*, is similar but not identical to *climb*:

```
The goats climbed onto the roof.  
The snail climbed up the tree.  
The train climbed up the mountain.  
The submarine climbed to the surface.  
The balloon climbed higher and higher.
```

Generalisation:

In uses with ground contact, steigen requires use of legs. In uses without contact, no restrictions are effective.
**climb** and its German translations

- **Generalisation:**
  In uses with ground contact, *steigen* requires use of legs. In uses without contact, no such restrictions are effective.

- **Note that G. *steigen* partly covers the English verb to *step* (movement may be horizontal):**

  
  \[
  \begin{align*}
  \text{Er stieg über die Pfütze} & \quad \text{“He stepped over the puddle”} \\
  \text{Er stieg auf die Leiter} & \quad \text{“He stepped up onto the ladder”}
  \end{align*}
  \]

- **The comparison shows again that *climb* does not have a "clambering" component in its lexical meaning, while G. *steigen* combines the meaning of climb with a "stepping" feature.**
• The comparison also shows that German *steigen* should be considered polysemous between a manner and a separate "upward" reading.

**The goats climbed onto the roof.**

**The snail climbed up the tree.**

**The train climbed up the mountain.**

**The submarine climbed to the surface.**

**The balloon climbed higher and higher.**
climb and its German translations

• Note, in contrast, the distribution of G. *klimmen* (not usually considered for translation due to low frequency)

The goats climbed onto the roof.
The snail climbed up the tree.
The train climbed up the mountain.
The submarine climbed to the surface.
The balloon climbed higher and higher.

G. steigen  |  klimmen

ok  |  ok
* steigen  |  ok
* steigen  |  ok
ok  |  ok
ok  |  ok
A note on Polysemy

• If [+contact] and [-contact] uses of *steigen* constitute polysemy, the semantic model in terms of force exertion motivates it.

• There is a common conceptual core, but unpredictable features are added on the way from the core concept to a fully-fledged situation model.

The goats climbed onto the roof.
The snail climbed up the tree.
The train climbed up the mountain.
The submarine climbed to the surface.
The balloon climbed higher and higher.

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<th>klimmen</th>
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</tr>
<tr>
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Polysemy

- If [+contact] and [-contact] uses of *steigen* constitute polysemy, the semantic model in terms of force exertion motivates it.
- There is a common conceptual core, but unpredictable features are added on the way from the core concept to a fully-fledged situation model.
- For *climb*, a "clambering" movement pattern is to be seen as an inference in the course of construction of the situation model.
Polysemy

- A "clambering" movement pattern as an inference: Note that different modes of force generation are possible.

The goats climbed onto the roof.
The snail climbed up the tree.
The train climbed up the mountain.
The submarine climbed to the surface.
The balloon climbed higher and higher.

The 110 pound human projectile climbed to a height of over 100 feet and then fell safely into a net 200 feet away - a record shot!

Part 4: On the conceptualisation of forces
If the conceptual core of *climb* is a constellation of forces (upward against gravity), then it has to be formulated in terms of the way in which humans perceive and conceptualise forces. Psychological investigation of force perception has led to a framework of "naive physics".

Relevant here in particular: the "impetus" model (McCloskey & Kohl 1983)
Impetus

A very basic sketch of the impetus framework

- As long as nothing intervenes,
  - things fall to the ground if not supported (gravitation).
  - moving things come to a stop (inertia).

- If a thing behaves in opposition to these tendencies of gravitation and inertia, this is ascribed to an intrinsic "impetus", which the thing exerts against its environment.

- Impetus, which works against the environmental forces, is "used up" if not renewed.

- Impetus can be self-generated or inherited from outside.
Impetus

- Impetus, which works against the environmental forces, is "used up" if not renewed.
- Impetus can be self-generated or inherited from outside.

Evidence: the ball-and-cliff problem
When a ball is shot from the edge of a cliff, many naive subjects would draw the trajectory as in c).

Intuitively, the ball inherits impetus; when it is used up, gravitation wins and the ball is falling down.
• **Impetus can be inherited:**

*Evidence from the "spiral tube problem"*

The diagram shows a thin curved metal tube. In the diagram you are looking down on the tube. In other words, the tube is lying flat. A metal ball is put into the end of the tube indicated by the arrow and is shot out of the other end of the tube at high speed.

A is the correct answer; but 51% draw sth. like B.
Impetus

• The semantic contrast and classification patterns observed with movement verbs like climb and others betray the conceptualisation in terms of impetus.

• The meaning contrast between climb and rise:
  – rise denotes upward directionality of a movement in various configurations
  – climb is confined to objects that can be bearers of impetus, i.e. independent objects that are moving around freely.
climb vs. rise

"The window is two meters high."

Height as extension

Height as position (distance from ground)

Analogously:

"rise" as change of extension:
"The hairs on his neck were rising"

"rise" as change of position:
"The submarine was rising"
**Impetus**

- The semantic contrast and classification patterns observed with movement verbs like *climb* and others betray the conceptualisation in terms of impetus.

  – *Climb* is applicable to self-generated, but also to ballistic movement, i.e. objects that have been thrown or shot off.

  *The arrow climbed into the sky*

  – *Climb* is a member of a class of verbs that need not be agentive, but block the formation of direct (lexical) causatives.

  *I climbed an arrow into the sky*
2. Verbs of manner of movement
   • ROLL-class
     bounce, drift, drop, float, glide, move, roll, slide, swing; [AROUND AXIS] coil, revolve, rotate, spin, turn, twirl...
   • RUN-class
     bounce, clamber, climb, crawl, dash, float, fly, gallop, hurry, jump, limp, meander, roam, roll, run, swim, whiz, zigzag...

   • The RUN class carries a positive specification for an agentive / controlled movement (hence they are not unaccusative).
   • ROLL verbs may yield (direct) causatives, because the word meaning of *roll* is neutral wrt. a factor agentivity / control; as opposed to the RUN class
Manner: Classification Problems

2. Verbs of manner of movement
   - ROLL-class
     - bounce, drift, drop, float, glide, move, roll, slide, swing; [AROUND AXIS] coil, revolve, rotate, spin, turn, twirl...
   - RUN-class
     - bounce, clamber, climb, crawl, dash, float, fly, gallop, hurry, jump, limp, meander, roam, roll, run, swim, whiz, zigzag ...

Hence: No verb in the RUN class may form a direct causative, only ROLL verbs may. However, RUN verbs appear in situations with external causation:

The projectile climbed to a height of 100 feet.
Shots zigzagged through both sides of the door.
A stone flew through the window.
Impetus

— *Climb* is a member of a class of verbs that block the formation of direct (lexical) causatives, even if they are not agentive or "internally caused".

Consider the case of *fly* (Geuder & Weisgerber 2006):

*A stone flew through the window.*

*A lorry flew a stone up.*

* * A lorry flew a stone.*

In brief, *fly* only yields indirect causatives, the type which also occurs with *RUN* verbs. These causatives

a) ...can be formed regularly only in construction with PP (Levin & Rappaport 1995)

b) ...are possible in English but not in German.
2. Verbs of manner of movement

- **ROLL-class**
  
  *bounce, drift, drop, float, glide, move, roll, slide, swing;* [AROUND AXIS] *coil, revolve, rotate, spin, turn, twirl...*

- **RUN-class**
  
  *bounce, clamber, climb, crawl, dash, float, fly, gallop, hurry, jump, limp, meander, roam, roll, run, swim, whiz, zigzag...*

• Hypothesis: The grouping in Levin's verb classification reflects impetus (not agentivity or ±external causation).

RUN verbs denote movements with impetus.
Impetus

- Another case in point: verbs of rotation
  E. rotate, G. rotieren, sich drehen.
Habel (1999) observes that only the internal movement interpretation of sich drehen allows a direct causative:

The earth rotates (around its own axis).
The earth rotates around the sun.

He rotated the picture.
* They rotated the space probe around Jupiter.

Hypothesis: Change of direction is perceived as an indication of impetus.
Summary
1. *Climb* is a verb of manner of movement that specifies force configurations on a path.

2. The manner component "upward force exertion (against the ground)" implies a direction, but the overall trajectory of the movement is independent of this. Hence this manner of movement may occur on downward paths as well.

3. There is a second variant with continuous exertion of upward force and without ground contact. This is probably an instance of polysemy, but shares the same conceptual core.
4. The relevant notion of force is "impetus".

5. The notion of impetus is what distinguishes *climb* from pure directional verbs.

6. The notion of impetus is what explains the semantic classification of movement verbs, rather than agentivity or internal/external causation.
References


