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arrive, leave, exit, land, take off
- **Orientation Path Expressions**
climb, descend
- **Topo-metric Path Expressions**
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- **Topo-metric orientation Expressions**
just below, just above

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Path information is encoded in matrix verb, while adjuncts specify manner of motion

Modern Greek, Spanish, Japanese, Turkish, Hindi

Defining Motion (Talmy 1985)

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- (58) a. The *event* or situation involved in the change of location ;
b. The object (construed as a point or region) that is undergoing movement (the *figure*);
c. The region (or *path*) traversed through the motion;
d. A distinguished point or region of the path (the *ground*);

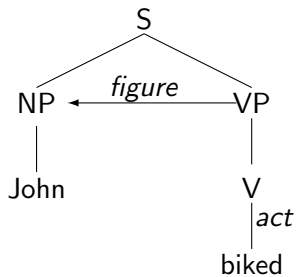
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- (59) a. The *event* or situation involved in the change of location ;
b. The object (construed as a point or region) that is undergoing movement (the *figure*);
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d. A distinguished point or region of the path (the *ground*);
e. The *manner* in which the change of location is carried out;

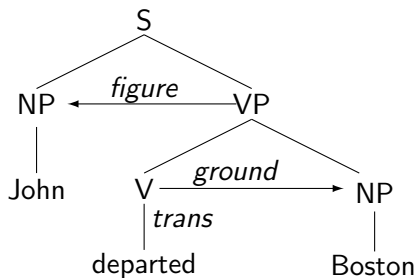
Defining Motion (Talmy 1985)

- (60) a. The *event* or situation involved in the change of location ;
b. The object (construed as a point or region) that is undergoing movement (the *figure*);
c. The region (or *path*) traversed through the motion;
d. A distinguished point or region of the path (the *ground*);
e. The *manner* in which the change of location is carried out;
f. The *medium* through which the motion takes place.

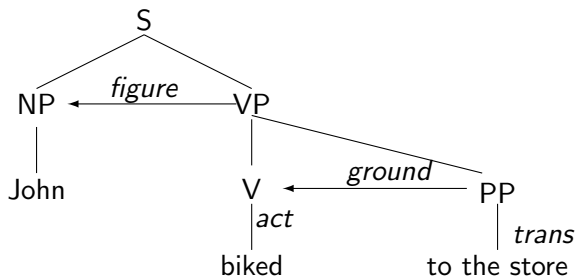
Manner Predicates



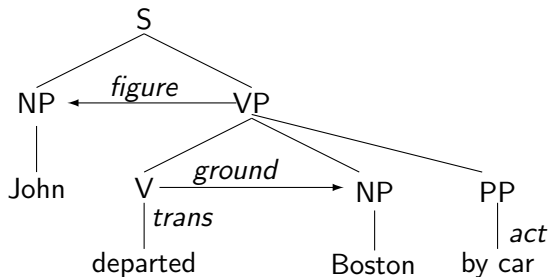
Path Predicates



Manner with Path Adjunction



Path with Manner Adjunction



(61) a. Isabel climbed for 15 minutes.

Path+manner Predicates (Talmy 2000) 1/2

- (63) a. Isabel climbed for 15 minutes.
b. Nicholas fell 100 meters.

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- (67) a. Isabel climbed for 15 minutes.
b. Nicholas fell 100 meters.
- (68) a. There is an action (*e*) bringing about an iterated non-distinguished change of location;
b. The figure undergoes this non-distinguished change of location;

Path+manner Predicates (Talmy 2000) 1/2

- (69) a. Isabel climbed for 15 minutes.
b. Nicholas fell 100 meters.
- (70) a. There is an action (*e*) bringing about an iterated non-distinguished change of location;
b. The figure undergoes this non-distinguished change of location;
c. The figure creates (leaves) a path by virtue of the motion.

Path+manner Predicates (Talmy 2000) 1/2

- (71) a. Isabel climbed for 15 minutes.
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- (72) a. There is an action (*e*) bringing about an iterated non-distinguished change of location;
b. The figure undergoes this non-distinguished change of location;
c. The figure creates (leaves) a path by virtue of the motion.
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- (73) a. Isabel climbed for 15 minutes.
b. Nicholas fell 100 meters.
- (74) a. There is an action (e) bringing about an iterated non-distinguished change of location;
b. The figure undergoes this non-distinguished change of location;
c. The figure creates (leaves) a path by virtue of the motion.
d. The action (e) is performed in a certain manner.
e. The path is oriented in an identified or distinguished way.

Path+manner Predicates (Talmy 2000) 2/2

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John climbed to the summit.

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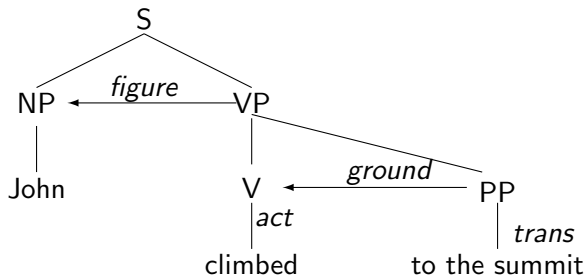
(79) **Manner of motion verb with path adjunct;**

John climbed to the summit.

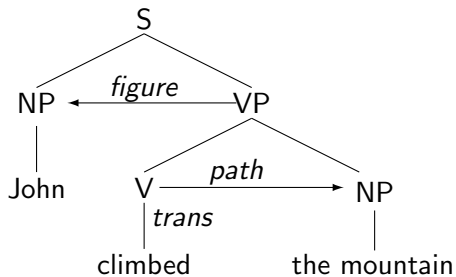
(80) **Manner of motion verb with path argument;**

John climbed the mountain.

With Path Adjunct



With Path Argument



Dynamic Interval Temporal Logic

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- **Path** verbs designate a distinguished value in the change of location, from one state to another.

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- **Path** verbs designate a distinguished value in the change of location, from one state to another.
The change in value is **tested**.
- **Manner of motion** verbs iterate a change in location from state to state.
The value is **assigned** and reassigned.

$$(81) \quad \boxed{\text{loc}(z) = x}_{e_1} \xrightarrow{\nu} \boxed{\text{loc}(z) = y}_{e_2}$$

$x \neq y?$
↖

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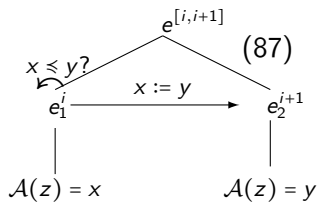
When this test references the ordinal values on a scale, \mathcal{C} , this becomes a *directed ν -transition* ($\vec{\nu}$), e.g., $x \leq y$, $x \geq y$.

$$(85) \quad \boxed{\overset{x \neq y?}{\curvearrowright} \text{loc}(z) = x}_{e_1} \xrightarrow{\nu} \boxed{\text{loc}(z) = y}_{e_2}$$

When this test references the ordinal values on a scale, \mathcal{C} , this becomes a *directed ν -transition* ($\vec{\nu}$), e.g., $x \leq y$, $x \geq y$.

$$(86) \quad \vec{\nu} =_{df} \overset{\mathcal{C}^?}{\curvearrowright} e_i \xrightarrow{\nu} e_{i+1}$$

Directed Motion



Change and Directed Motion

- Manner-of-motion verbs introduce an **assignment** of a location value:

loc(x) := y; y := z

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- Path verbs introduce a pair of **tests**:

$\neg\phi? \dots \phi?$

Change and the Trail it Leaves

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- For motion, this trail is the created object of the path p which the mover travels on;
- For creation predicates, this trail is the created object brought about by order-preserving transformations as executed in the directed process above.

Motion Leaving a Trail

(88) MOTION LEAVING A TRAIL:

a. Assign a value, y , to the location of the moving object, x .

$loc(x) := y$

Motion Leaving a Trail

(89) MOTION LEAVING A TRAIL:

a. Assign a value, y , to the location of the moving object, x .

$loc(x) := y$

b. Name this value b (this will be the beginning of the movement);

$b := y$

Motion Leaving a Trail

(90) MOTION LEAVING A TRAIL:

a. Assign a value, y , to the location of the moving object, x .

$loc(x) := y$

b. Name this value b (this will be the beginning of the movement);

$b := y$

c. Initiate a path p that is a list, starting at b ;

$p := (b)$

Motion Leaving a Trail

(91) MOTION LEAVING A TRAIL:

- a. Assign a value, y , to the location of the moving object, x .

$loc(x) := y$

- b. Name this value b (this will be the beginning of the movement);

$b := y$

- c. Initiate a path p that is a list, starting at b ;

$p := (b)$

- d. Then, reassign the value of y to z , where $y \neq z$

$y := z, y \neq z$

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- a. Assign a value, y , to the location of the moving object, x .

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- b. Name this value b (this will be the beginning of the movement);

$b := y$

- c. Initiate a path p that is a list, starting at b ;

$p := (b)$

- d. Then, reassign the value of y to z , where $y \neq z$

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- e. Add the reassigned value of y to path p ;

Motion Leaving a Trail

(93) MOTION LEAVING A TRAIL:

a. Assign a value, y , to the location of the moving object, x .

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$b := y$

c. Initiate a path p that is a list, starting at b ;

$p := (b)$

d. Then, reassign the value of y to z , where $y \neq z$

$y := z, y \neq z$

e. Add the reassigned value of y to path p ;

$p := (p, z)$

f. Kleene iterate steps (d) and (e).

Quantifying the Resulting Trail

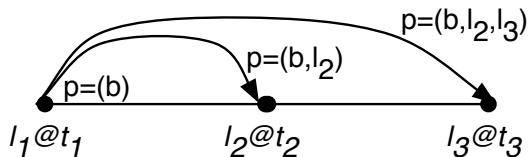


Figure: Directed Motion leaving a Trail

Quantifying the Resulting Trail

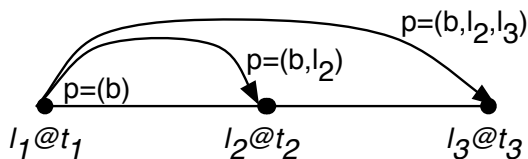


Figure: Directed Motion leaving a Trail

(95) a. The ball rolled 20 feet.

$$\exists p \exists x [[roll(x, p) \wedge ball(x) \wedge length(p) = [20, foot]]]$$

Quantifying the Resulting Trail

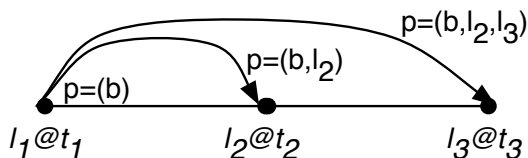


Figure: Directed Motion leaving a Trail

(96) a. The ball rolled 20 feet.

$$\exists p \exists x [[roll(x, p) \wedge ball(x) \wedge length(p) = [20, foot]]]$$

b. John biked for 5 miles.

$$\exists p [[bike(j, p) \wedge length(p) = [5, mile]]]$$