

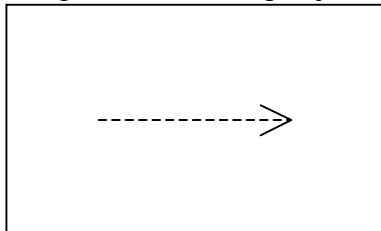
Ways of Going ‘Back’: A Case Study in Spatial Direction¹

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1 Introduction

Suppose the arrow in (1) represents the path of a moving object. How would we describe the direction in which that object is moving?

- (1) The path of a moving object



It depends. For you as a reader the object is going *to the right*, but if you are looking at a map it is going *east*. The object is also going *away from* the left-hand border and going *straight ahead*. Clearly, there are different ways to describe the direction of a moving object, depending on the properties of the moving object or its environment that we base our description on (see, for instance, Talmy 2000).

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Some of these path directions are based on a reference frame, a notion that figures prominently in the study of prepositions like *under*, *behind*, *left of*, *east of*, that express static relations between two objects defined on the basis of a particular axis (e.g. Levinson 1996). Such an axis can be determined by the intrinsic orientation of the reference object (like the front and back of a car), by an observer (like the front and back of a tree from her point of view), or by the environment (like gravitation or the compass).

This paper is about the role that axes play in defining paths of motion. In spite of the rich literature on both domains (axes and paths) there is no explicit account of the relation between them. Almost all of the linguistic and psychological work on reference frames or axes concentrates on their role in determining static, locative relations between two objects (e.g. Levinson 2003, Van der Zee and Slack 2003, Svenonius 2006), but we do not yet have a good idea of how a dynamic path of motion can be based on an axis. I hope to show that it is worthwhile to develop a simple, though explicit, model of how paths can relate to reference frames, because it turns out that the path domain is actually richer than the place domain, both conceptually and lexically. I will demonstrate this by constructing a semantic map (Van der Auwera & Plungian 1998, Haspelmath 2003) that shows the different ways of going ‘back’ in Dutch, as a case study.

The structure of this paper is as follows. In order to get the bigger picture, I start with a general overview of the types of direction of motion that can be distinguished (section 2), then I formulate a simple formal model for axis-based directions (section 3), that I then apply to the different ways of going ‘back’ in Dutch (section 4).

2 Types of Direction

The direction of a path can be distinguished from its *shape* (Talmy 2000, Van der Zee et al. 2010). The shape or curvature of a path is invariant under geometric transformations. A straight, zigzagging, or circular path remains straight, zigzagging, or circular when you rotate it, translate it, or change its size. This is not necessarily true for the direction of a path. The reason is that the direction of a path is not an intrinsic, structural notion (which shape is), but it depends on the frame (in a broad sense) that forms the background of the path. For instance, the upward direction of a path is not a property that is invariant under rotation, because it depends on the gravitational frame.

In this paper I only consider paths of *motion*, although I am well aware of the role of paths in a variety of non-motion configurations, including so-called *fictional motion* (Talmy 2000). I hope that what I have to say here extends to non-motion paths, but it would go beyond this paper to discuss that in any depth.

The first type of path direction that I consider is *absolute direction*, which is determined by an absolute frame of reference, given by a local or global

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environment, e.g. compass points (*go north*), gravitation (*go up*), or the front-back axis inside an object (*go to the back*, in a church, classroom, or bus, Fillmore 1975). As is well known, the same frames can be used to determine places (*the lake north of the village, the painting over the fireplace, the seats in the front of the bus*).

Intrinsic direction is determined by distinct sides of a movable object with canonical orientations, like a human being, animal, or vehicle. We can see them most clearly at work in the horizontal plane (Fillmore 1975):

- (2) a. He walked backwards from the Queen.
- b. Crabs walk sideways.

Again, the same frames are used to determine places (*the noise behind me, the shell beside the crab*).

Relative frames of reference can also form the basis for paths, when a direction is projected from the point of view of an observer:

- (3) I saw the tornado move to the right.

Here the movement of the tornado is described in terms of the right-hand side of the subject of the sentence. This is analogous to the description of places, like *the cow to the left of the tree*.

These three types of direction (that I collectively refer to as *reflexive* direction) are based on three very familiar frames. Much less familiar is the type of direction described in Schmidtke et al. (2003), which I refer to as *phasal direction*. In this case the direction of a path is described in terms of the path of the same object in an earlier 'phase'. Let's assume that the moving object first followed a path p' , which then creates a reference frame for the subsequent path p of the same objects that starts from the end point of p' . If p is going in the same direction as p' , then the object is going *straight ahead*. If p is going in an opposite direction to p' , then its direction is *back*. Intrinsic and phasal direction are clearly distinct although they might be aligned. One can go back backwards (alignment of phasal and intrinsic back), but that is not necessary.

A well-known type of direction is what I will call *modal direction* (borrowing the term *mode* from Kracht 2002). The direction of the path of motion is determined by an object that serves as a landmark or reference point. It can be the starting point or source ('from'), the end point or goal ('to'), or an intermediary point ('via'). This is the kind of directionality that is characteristic for the contrasts that we see in adpositional and case systems (Pantcheva 2011). Each of

these three modes can be combined with each of the three classical frames of reference, as illustrated in the following Dutch examples.²

- (4) *Absolute reference frame*
- | | | |
|----|---|--------|
| a. | De muis kwam van onder de tafel.
The mouse came from under the table | Source |
| b. | De muis rende onder de tafel door.
The mouse ran under the table through | Route |
| c. | De muis kroop onder de tafel.
The mouse crept under the table | Goal |
- (5) *Relative reference frame*
- | | | |
|----|---|--------|
| a. | De kat kwam van achter de boom.
The cat came from behind the tree | Source |
| b. | De kat rende achter de boom langs.
The cat ran behind the tree along | Route |
| c. | De kat sprong achter de boom.
The cat jumped behind the tree. | Goal |
- (6) *Intrinsic reference frame*
- | | | |
|----|---|--------|
| a. | De cameraman kwam van achter de camera.
The cameraman came from behind the camera | Source |
| b. | De cameraman liep achter de camera langs.
The cameraman walked behind the camera along | Route |
| c. | De cameraman stapte achter de camera.
The cameraman stepped behind the camera | Goal |

This is because source, route and goal directions are based on places (like under the table, behind the tree, behind the camera) that are defined on the basis on axes. The direction of the paths of motion in (4)-(6) is independent of the directions of the axes; what counts is what part of the path of motion intersects with the axis.

Much less common is a type of direction that I call *centripetal*, because it involves motion towards an implicit point of view:

- (7) a. A voice came from behind.
 b. The tree was approached from the left.
 c. a northerly wind (i.e. coming from the north)

The path in these examples is aligned with (but opposite to) an axis of the object that is approached. In (7b), for example, the path is not only directed towards the tree (which is like modal direction), but more specifically to the relative left of the tree. There is sometimes a superficial similarity with modal direction structures,

² The advantage of Dutch examples is that they encode the distinctions between the modes more explicitly than English does.

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but the crucial difference is that the object of the preposition can never be made explicit in centripetal direction constructions. Compare the sentences in (8).

- (8) a. The victim was approached from behind.
b. The victim was approached from behind a tree.

(8a) is centripetal direction, (8b) modal direction. (8a) describes the path relative to the victim, (8b) describes the path relative to the tree. The centripetal type of direction can be based on absolute, relative, and intrinsic frames, as shown in (7). (7a) is based on an intrinsic axis, (7b) on a relative axis, (7c) on an absolute axis.

In the last type of direction that I discuss here, the reference frame for one moving object is defined by another moving object (Bogaert et al. 2008). Since two objects move with respect to each other, I call this *reciprocal direction*. There are many different possibilities, only some of which might be expressed in natural language, for instance in the adpositional system of Dutch. The two objects can move towards each other (9a) or maintain a constant relation, with the reference object preceding (9b) or following (9c). The adpositional constituent is indicated with square brackets.

- (9) a. Esau rende [Jakob tegemoet].
Esau ran Jacob to-meet
'Esau ran to meet Jacob.'
b. Laban ging [achter Jakob aan].
Laban went after Jacob on
'Laban went after Jacob.'
c. Lea ging [voor Jakob uit].
Lea went before Jacob out
'Leah went ahead of Jacob.'

At first blush this reciprocal direction is based on the intrinsic axes of the reference object, Jacob. However, it is not so much the intrinsic, body-based axes of Jacob that count, but rather the axes that are defined by his direction of motion. Suppose Tony and Cherie walk away backwards from the queen, then (10) clearly does not mean that Tony is looking at Cherie's back, but that Cherie is preceding Tony.

- (10) Tony liep achter Cherie aan.
Tony walked after Cherie on
'Tony went after Cherie'

We can see a similarity now between phasal direction and reciprocal direction. In both cases the frame of reference is a path of motion. In phasal direction it is an

earlier path of motion of the moving object, in reciprocal direction it is the path of motion of *another* moving object. In other words, in addition to an absolute, intrinsic, and relative frame of reference, we can also recognize a dynamic frame of reference, determined by motion.

The different types of path direction that we have seen in this section can be divided along two dimensions. One dimension concerns the type of axis involved, with a main division between the three traditional, static axes (absolute, intrinsic, relative) and the motion-based, dynamic axis. The other dimension concerns whether there is only one object at stake (which we can call the *figure*, following Talmy 2000) or whether a second object plays a role as the reference object (the *ground*) for the figure. This division corresponds more or less to the grammatical distinction between adverbs and adpositions. Within the second, adpositional group we can distinguish between modal, centripetal, and reciprocal directions. Table (11) gives an overview of these types of direction.

(11) Types of direction

	Only figure	Figure and ground
Static axis	Reflexive direction	Modal and centripetal direction
Dynamic axis	Phasal direction	Reciprocal direction

As we see, one and the same type of axis can figure in different types of direction. In the next section I analyze how this is possible by modeling axes, paths, and directions in a more formal way, with *vectors* as building blocks.

3 Axis-based direction

Building on Zwarts & Winter (2000), Kracht (2002), and Bohnemeyer (2012), I assume that an axis is a function that assigns to an object a free unit vector at a time t .³ For example, there is the **up** function that assigns to every object x at time t a unit vector $\mathbf{up}_t(x)$ that represents the upward direction from x . This is an absolute axis, which means that it is the same for all times and objects. The **up** axis has an opposite axis, that can be defined using the vector inversion operator: $-\mathbf{up}_t(x)$ is the downward direction from x at time t (if we want to assume that the upward direction is primary). Another example of an absolute axis is **north**, which assigns to every object a unit vector pointing north. The **up** and **north** functions are constrained to yield vectors that are perpendicular to each other.

Intrinsic axes differ from absolute axes in being much more variable and partial across objects and times. For instance, we represent the intrinsic front of an

³ A *unit* vector is a vector of length 1. It is used to abstract away from the property of length, because for the representation of axes only the direction of a vector is relevant. A *free* vector is a vector that only represents length and direction and abstracts away from location.

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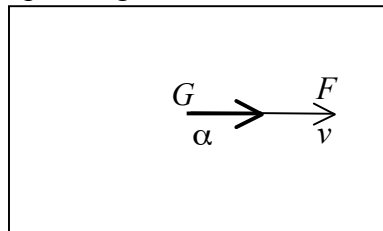
object x at time t through the unit vector $\mathbf{front}_t(x)$. People that face the same direction have the same **front** vector. When they turn around, their **front** vectors change over time. People have an intrinsic **front** and also an intrinsic **top**, but for many objects these functions are not defined, because they lack intrinsic backs or fronts. Because of that, **front** and **top** are partial functions. It is possible to define the **top** function in terms of the **up** function: the top of an object is that side that is usually up. As we already saw with the absolute axis **up**, the inversion operator $-$ can be applied to give us $-\mathbf{front}$ (the back) and $-\mathbf{top}$ (the bottom). For a given object x , **front** and **top** are always perpendicular to each other and to the third intrinsic axis, **right** and its opposite $-\mathbf{right}$.

A relative axis is defined with respect to an observer. For this we need a function with an additional argument: $\mathbf{face}_t(x,o)$ gives a vector that points from x to a person o who is observing x . In other words: $\mathbf{face}_t(x,o) = -\mathbf{front}_t(o)$, but see the next section for a more general formulation. Notice that the relative axis of the observed object, $\mathbf{right}_t(x,o)$, is identical to the intrinsic axis of the observer, $\mathbf{right}_t(o)$.

Although the temporal parameter is important in capturing the variable nature of intrinsic and relative axes, I will omit them in the remainder, thereby abstracting away from the way objects can rotate (leading to the variability of intrinsic axes) or points of view can change (the variability of relative axes).

The unit vectors create a *coordinate system* around an object G that can be used to define locations and directions in terms of G and its axes. To keep things simple, I abstract away from the volume of objects and treat them as points. Suppose that v is an arbitrary (non-zero) vector that is located in such a point-sized object G and pointing in the same direction as an axis α of G , as graphically illustrated in (12). There is then a positive real number s (a *scalar*) such that $v = s\alpha(G)$. For convenience, I write this as $v_{\alpha(G)} = s$.

(12) v pointing in the direction of α



For example, if $\alpha = \mathbf{up}$, then v is an upward pointing vector if and only if $v_{\mathbf{up}(G)} > 0$.⁴

⁴ Obviously, this simplified notion of 'pointing in the same direction' is too strict. We would ultimately also want to count vectors as 'upward' that form a relative small angle with the axis vector **up**. See Zwarts & Winter (2000) for details.

The vector v in (12) can be used to represent the locative relation between object G (functioning as the ground) and another object F (the figure), following Zwarts & Winter (2000). Assume that $\mathbf{place}(G,F)$ represents the located vector pointing from G to F , then (13) formulates the condition for F is in front of G :

$$(13) \mathbf{place}(G,F)_{\mathbf{front}(G)} > 0$$

F is in front of G because the vector pointing from G to F is a positive scalar multiple of the intrinsic frontal axis of G , as illustrated in (12). Replacing **front** with one of the other axial functions that we introduced above allows for the definition of other locative relations:⁵

- (14) a. F is behind G : $\mathbf{place}(G,F)_{\mathbf{front}(G)} > 0$
 b. F is above G : $\mathbf{place}(G,F)_{\mathbf{up}(G)} > 0$
 c. F is in front of G : $\mathbf{place}(G,F)_{\mathbf{face}(G,o)} > 0$

(14a) defines *behind* as the inverse of *in front* by inverting the intrinsic axis of the ground. (14b) gives *above* as an example of a relation based on the absolute axis **up**. (14c) shows that *in front* also has a reading that is based on the relative axis **face**, which is pointing from the ground to the observer.⁶

Now consider what happens when the figure F is *moving* with respect to the ground G . I represent such a path of motion as a continuous function, designated by $\mathbf{path}(G,F)$, from moments of time to vectors pointing from G to F (cf. Zwarts & Winter 2000). It will be useful to restrict such a path to a particular time interval $[t_0, t_1]$. Then we can distinguish the points in (15).

- (15) $\mathbf{path}(G,F)(t_0)$ is the starting point (source) of the path
 $\mathbf{path}(G,F)(t_1)$ is the end point (goal) of the path
 For every t , $t_0 < t < t_1$, $\mathbf{path}(G,F)(t)$ is an intermediate (route) point of the path.

The conditions in (15) define paths with respect to the absolute down axis, assuming that the time interval $[t_0, t_1]$ is the ‘running time’ of the event being described in the sentence.⁷

⁵ Of course, as Herskovits (1986) and much later work has showed, non-geometric factors also have to be taken into account, in addition to these geometric conditions.

⁶ All by itself, this definition is too weak, because it allows F to be ‘behind’ the point of view. I assume that there are pragmatic principles at work that restrict the application of relative *in front* to positions of the figure *between* the ground and the point of view.

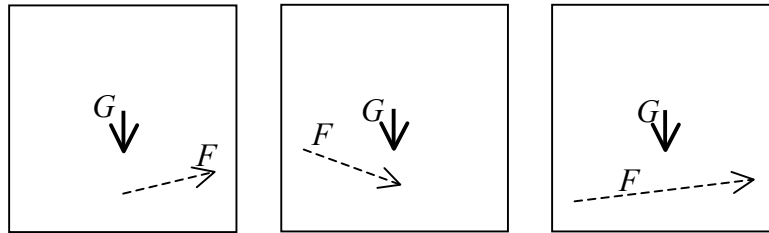
⁷ The examples in (16) are adapted from Jackendoff (1983:163,166). See Zwarts (2005) for more precise definitions of a wide range of path prepositions.

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- (16) a. The mouse ran from under the bed. Source
 $\mathbf{path(b,m)}(t_0)_{\text{-up(b)}} > 0$
- b. The mouse went under the bed. Goal
 $\mathbf{path(b,m)}(t_1)_{\text{-up(b)}} > 0$
- c. The mouse went under the bed. Route
 There is a t , $t_0 < t < t_1$, such that $\mathbf{path(b,m)}(t)_{\text{-up(b)}} > 0$

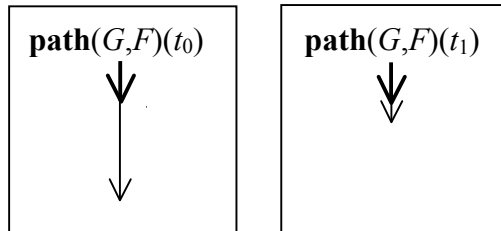
Similar definitions can be given for modal directions with respect to intrinsic or relative directions, as in (5) or (6) above. (17) gives a graphical illustration of the three modes.

- (17) Source, goal, and route paths with respect to an axis



As we can see in (17), with modal motion the path of the figure is ‘orthogonal’ to the axis of the ground. This is different with centripetal motion, which is characterized by a path leading towards the ground *along* a particular axis, as schematically illustrated in (18):

- (18) Initial and final vectors of a centripetal path ‘from below’



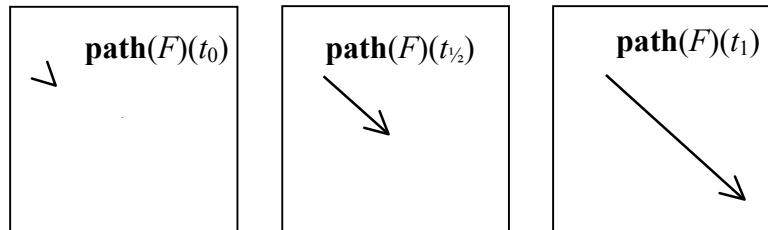
Centripetal motion requires that the final vector is shorter than the initial vector along the relevant axis. This can be represented in the following way for F coming from below with respect to the implicit ground G :

- (19) $\mathbf{path(G,F)}(t_0)_{\text{-up(G)}} > \mathbf{path(G,F)}(t_1)_{\text{-up(G)}} \geq 0$

The initial and final vector both point downward, but the initial vector is longer than the final vector. (19) formulates symbolically what (18) represents geometrically. Centripetal directions can be defined in this way for any type of axis.

All of the path expressions that we have analyzed until now involve a binary path $\mathbf{path}(G,F)$, a dynamic relation holding between a moving figure and a ground. There is also a unary path predicate, $\mathbf{path}(F)$, which applies to a single moving figure F and maps each moment of time t from the interval $[t_0,t_1]$ to a vector pointing from the position that F occupies at t_0 (i.e. $\mathbf{path}(F)(t)$) to the position that it occupies at t . The position $\mathbf{path}(F)(t_0)$ always corresponds to the zero vector. This is graphically illustrated in (20).

(20) ‘Snapshots’ from a unary path over the interval $[t_0,t_1]$



Since the final vector of the path represents the final position of the figure with respect to its starting point, we can represent absolute, intrinsic, and relative motion through a simple condition on the final vector with respect to the relevant axis:

- | | | |
|---------|--|-----------|
| (21) a. | go up
$\mathbf{path}(F)(t_1)_{\mathbf{up}(F)} > 0$ | Absolute |
| b. | go forward
$\mathbf{path}(F)(t_1)_{\mathbf{front}(F)} > 0$ | Intrinsic |
| c. | go to the right
$\mathbf{path}(F)(t_1)_{\mathbf{right}(F,o)} > 0$ | Relative |

Notice that in these cases the figure F moves in the direction of its own axis. Hence the term *reflexive* motion as a cover term for these.

For reciprocal motion it is essential that both figure and ground are moving. Their motions define axes that are used to locate their movements in relation to each other. If $\mathbf{path}(G)$ is the path of an object G in motion, then $\mathbf{dir}(\mathbf{path}(G))$ represents the unit vector that represents the direction in which G is moving.⁸ With this axis we can represent whether F and G move in opposite directions (22a) or in the same direction (22b,c). Moreover, in order to distinguish (22b) from (22c) we need additional locative conditions that represent whether F is behind G or in front of G :

⁸ For motion in a straight line, $\mathbf{dir}(\mathbf{path}(G))$ is that unit vector v such that $\mathbf{path}(G)(t_1)_v > 0$.

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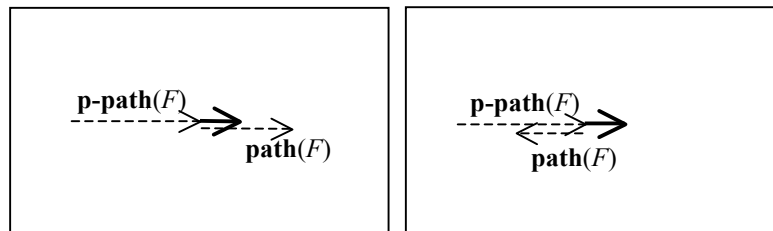
- (22) a. Esau rende [Jakob tegemoet].
 Esau ran Jacob to-meet
 'Esau_F ran to meet Jacob_G.'
 $\mathbf{dir}(\mathbf{path}(F)) = -\mathbf{dir}(\mathbf{path}(G))$
- b. Laban ging [achter Jakob aan].
 Laban went after Jacob on
 'Laban_F went after Jacob_G.'
 $\mathbf{dir}(\mathbf{path}(F)) = \mathbf{dir}(\mathbf{path}(G)) \ \& \ \mathbf{path}(G,F)(t_1) \cdot \mathbf{dir}(\mathbf{path}(G)) > 0$
- c. Lea ging [voor Jakob uit].
 Lea went before Jacob out
 'Leah_F went ahead of Jacob_G.'
 $\mathbf{dir}(\mathbf{path}(F)) = \mathbf{dir}(\mathbf{path}(G)) \ \& \ \mathbf{path}(G,F)(t_1) \cdot \mathbf{dir}(\mathbf{path}(G)) > 0$

Finally, phasal direction involves the comparison of the present path of a figure F with its previous path. If we represent that previous path as $\mathbf{p-path}(F)$, then $\mathbf{dir}(\mathbf{p-path}(F))$ gives us the direction of that previous path in the form of a unit vector. That allows us to formulate phasal directionals like *ahead* and *back* as follows:

- (23) a. go (straight) ahead
 $\mathbf{path}(F)(t_1) \cdot \mathbf{dir}(\mathbf{p-path}(F)) > 0$
- b. go back
 $\mathbf{path}(F)(t_1) \cdot \mathbf{dir}(\mathbf{p-path}(F)) < 0$

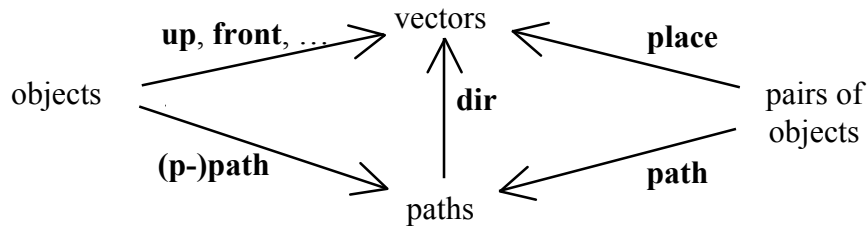
The two figures in (24) illustrate this graphically.

- (24) Going ahead and going back



A variety of functions has been introduced in this section. Figure (25) gives an overview of the different ontological domains (objects, pairs of objects, vectors, and paths) and the mappings between them.

(25) Domains and mappings



Furthermore, the table in (26) summarizes the analyses of the types of direction that we have seen in this section.

(26) Analyses of types of direction

	Only figure	Figure and ground
Static axis	Reflexive $\mathbf{path}(F)(t_1)_{\mathbf{axis}(F)} > 0$	Modal $\mathbf{path}(G,F)(t_1)_{\mathbf{axis}(G)} > 0$ Centripetal $\mathbf{path}(G,F)(t_0)_{\mathbf{axis}(G)} >$ $\mathbf{path}(G,F)(t_1)_{\mathbf{axis}(G)} \geq 0$
Dynamic axis	Phasal $\mathbf{path}(F)(t_1)_{(-)\mathbf{dir}(\mathbf{p-path}(F))} > 0$	Reciprocal $\mathbf{path}(G,F)(t_1)_{(-)\mathbf{dir}(\mathbf{path}(G))} > 0$

One important distinction is whether the axis is based on the figure itself (reflexive and phasal direction) or on the ground (modal, centripetal, and reciprocal direction); the other important distinction is whether the axis is of the traditional, static type (reflexive, modal, centripetal direction) or dynamic (phasal and reciprocal direction). Nevertheless, underlying all these different types of direction is one single ‘calculus’ of directions, (25). This general representation of axes and directions not only reveals the system of directionality, but, as I will show in the next section, it also allows us to compare lexicalization patterns in this domain in a more systematic way.

4 Going ‘back’ in Dutch

Different axes can sometimes be closely related to each other (Clark 1973, Fillmore 1975, Allan 1995). For instance, the intrinsic top side of an object is usually also up in the absolute sense. The intrinsic front of an object is also usually the side that is leading when the object is moving. These relations are important because they help to explain why the same expressions are often used for meanings based on different but related axes. The preposition *above*, for instance, can be used with intrinsic, absolute, or relative frames.

In this paper, I focus on the cluster of axes that are related to the notion ‘back’ (Allan 1995), but I start with the more fundamental opposite notion ‘front’. My

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starting point is the partial function **front** that assigns to an object x a unit vector that indicates where its 'interactive' side is if it has one (e.g. eyes, mouth, reproductive organs for a human being, buttons and screen for certain artefacts, entrance for buildings, etcetera). Some rooms (classrooms, buses, churches) get a front-back axis because of the way they are used by human beings. The front of a classroom is the side that the people that use it are facing. We can postulate a function **CU** (for 'canonical use') that defines an absolute axis on the basis of an intrinsic axis:

- (27) If α is an axis, s a confined space, and x an object in s , then $\mathbf{CU}_s(\alpha)(x)$ is that unit vector v such that for every human being y using s in the canonical way, $\alpha(y) = v$.

The relative front axis is defined on the basis of the intrinsic front axis of the observer by an operation that I call **CE** (for 'canonical encounter', Clark 1973):

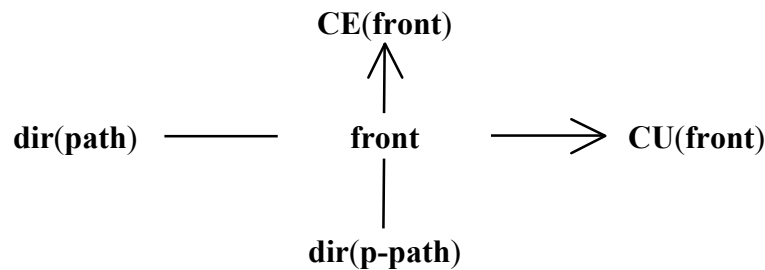
- (28) If α is an axis of an observer o and x an object observed by o , then $\mathbf{CE}_o(\alpha)(x)$ is that unit vector v such that for every object x , v is a reflection of $\alpha(o)$ through the vertical plane between o and x .

Axes are assigned to x by treating x as a person that the observer o is seeing through a mirror, metaphorically speaking. The up-down and left-right axes remain invariant, but the front-back is inverted.

If an object x moves, then this creates a unit vector $\mathbf{dir}(\mathbf{path}(x))$, as we saw. If x has an intrinsic front axis, then often $\mathbf{dir}(\mathbf{path}(x)) = \mathbf{front}(x)$, because the normal way for people to move (but also for animals and vehicles) is with their intrinsic front as the 'leading edge', as Allan (1995) calls it. This establishes a close connection between the motion axis and the intrinsic front axis. If an object x made a previous movement, then we get a unit vector $\mathbf{dir}(\mathbf{p-path}(x))$. In the normal course of events, this axis will again have the same direction as $\mathbf{front}(x)$, i.e. $\mathbf{dir}(\mathbf{p-path}(x)) = \mathbf{front}(x)$. In other words, we are usually facing in the direction of places that we have not been to yet.

Taking all these different axis together, we can construct the diagram in (29) that shows how the intrinsic front axis relates to other, similar axes:

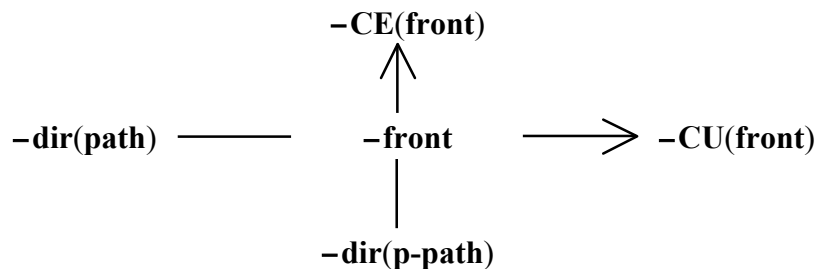
(29) The relations between ‘front’ axes



The arrows correspond to functions that derive axes from the basic **front** axis; the lines correspond to canonical alignments. Remember that **path** represents the path of motion in the *current* phase while **p-path** represent the path of motion in the *previous* phase.

If we apply the inversion operator we get a diagram that represents the different ‘back’ axes and their relations, in (30).

(30) The relations between ‘back’ axes



We can view this diagram as a *semantic map* in the sense of Van der Auwera & Plungian (1998) and Haspelmath (2003), that is, a structure that shows how close certain meanings are to each other and which meanings are more likely to be expressed by the same form. The semantic map approach operates under the assumption that the meanings expressed by one form have to be *contiguous*. In other words, the set of meanings covered by one form has to correspond to a connected subgraph. But even apart from this important constraint, a structure like (30) is useful for studying paradigmatic lexicalization patterns. Let us turn to Dutch now to see how various types of ‘back’ expressions relate to this system of back axes.

Let us start with those types of direction that involve only a moving figure, i.e. what we called the reflexive and phasal direction in the previous section and represented through the general formula $\text{path}(F)(t_1)_{\alpha(F)} > 0$ for a particular axis α . Not all of the back axes in (30) participate in this formula: obviously, α cannot be **-dir(path)** because an object cannot move into a direction opposite to the direction in which it is actually moving. For the remaining four axes we find three different adverbial expressions:

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- (31) a. *achteruit*: a compound of *achter* 'behind' and *uit* 'out'
 b. *naar achteren*: a PP headed by *naar* 'to' with *achter* 'behind' as complement, with an adverbial suffix *-en*
 c. *terug*: a lexicalized PP consisting of the preposition *te* 'to' and the noun *rug* 'back'

The examples in (32) show the primary uses of these expressions:

- (32) a. Alex liep achteruit. $\alpha=-\mathbf{front}$
 Alex walked behind-out
 'Alex walked backwards.'
 b. Alex ging naar achteren. $\alpha=-\mathbf{CE(front)}$
 Alex went to behind-EN
 'Alex went to the back.'
 c. Alex ging terug. $\alpha=-\mathbf{dir(p-path)}$
 Alex went to-back
 'Alex went back.'

With relative back ($\alpha=-\mathbf{CU(front)}$) the situation is not so clear, probably because it is most natural to describe such a situation with the adverb *weg* 'away' instead of one of the 'back' adverbs in (31), but *achteruit* 'backwards' and *naar achter* 'to the back' seem acceptable for this meaning, while *terug* 'back' is definitely not.

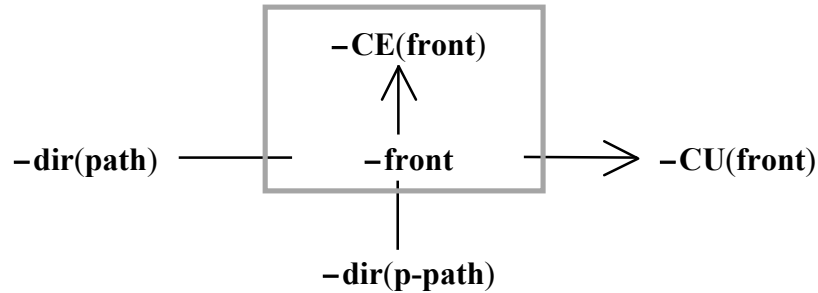
- (33) a. ?De bal rolde achteruit.
 The ball rolled behind-out
 'The ball rolled away from me.'
 b. ?De bal rolde naar achteren.
 The ball rolled to behind-EN
 'The ball rolled away from me.'
 c. #De bal rolde terug.
 The ball rolled to behind-EN / behind-out / away
 'The ball rolled away from me.'

Interestingly, there is some overlap in the use of the words in (31) with the verb *deinzen* 'shrink (back)'. Here all three are possible, describing intrinsic motion.

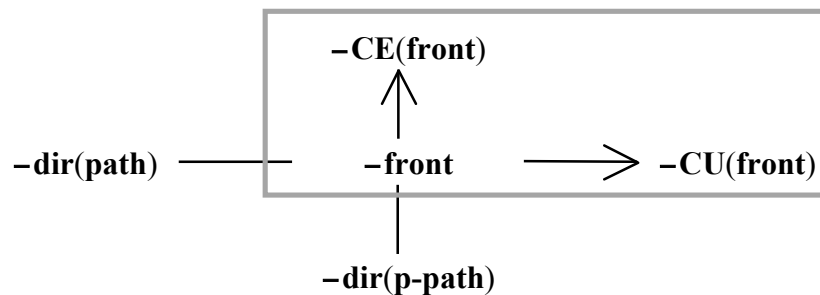
- (34) Ik deinsde achteruit/ naar achteren/ terug van schrik. $\alpha=-\mathbf{front}$
 I shrunk behind-out/to behind-EN/back with fear
 'I backed away with fear.'

These data now suggest that the words in (31) are polysemous, covering regions of the diagram, as shown in (35)-(37).

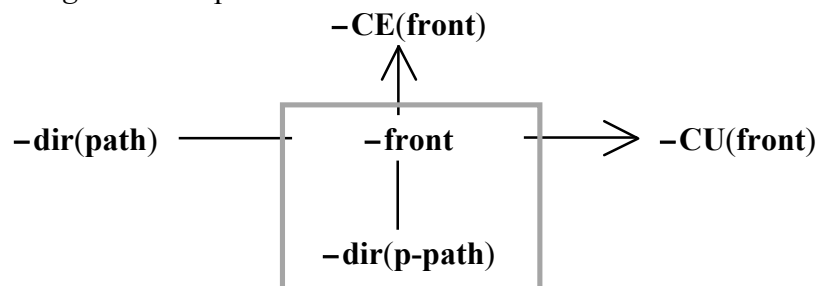
(35) *achteruit* on the map of back axes



(36) *naar achteren* on the map of back axes



(37) *terug* on the map of back axes



Notice that each of the expressions covers a connected portion of the graph, as expected by the contiguity constraint of the semantic map approach. The intrinsic axis **-front** always forms the connecting link within polysemous categories, which is not surprising, given its basic status in this domain.

More important than the contiguity of the path expressions in (31) is the fact that they are sensitive to the distinctions between axes. This is surprising, because most other ‘back’ expressions, namely the ones that involve a ground object, do not show this sensitivity. Static location, modal direction, and centripetal direction always use the same form for all the axes over which they are defined, in Dutch

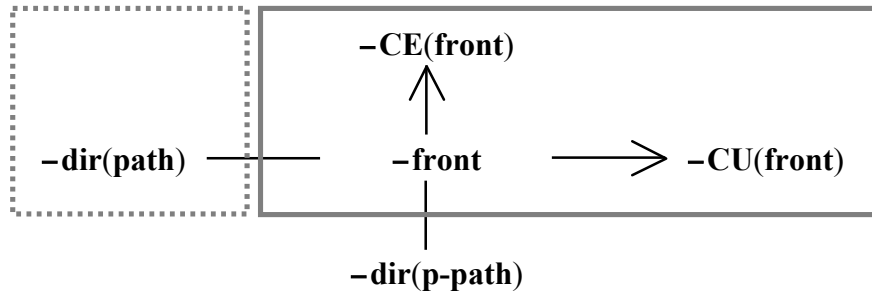
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(with the form *achter*) and English (*behind*). We find lexical differentiation only for reciprocal motion, i.e. for the $-\mathbf{dir}(\mathbf{path}(G))$ axis. In Dutch, there are three different, but equivalent, ways of describing the reciprocal back direction corresponding to $\mathbf{path}(F,G)(t_1)_{\mathbf{dir}(\mathbf{path}(G))} > 0$:⁹

- (38) ‘Laban went after Jacob.’
- a. Laban ging achter Jakob aan.
Laban went after Jacob on
 - b. Laban ging Jakob achterna.
Laban went Jacob behind-after
 - c. Laban ging Jakob na.
Laban went Jacob after

The motion axis $-\mathbf{dir}(\mathbf{path}(G))$ is therefore lexically distinguished from the other axes in Dutch. The same is true for English, which has *after* instead of *behind* here, see (39).

- (39) The division between *after* and *behind*



Notice that the phasal axis $-\mathbf{dir}(\mathbf{p-path}(G))$ does not seem to play a role as an axis for binary paths. The reason might be that it is hard to describe the place or path of a figure *F* in terms of the path of another object *G* in an earlier phase.

5 Conclusion

The domain of direction is much richer than the well-known prepositional source-goal pattern and the intrinsic, relative, and absolute frames of reference, even when we are only looking at English or Dutch. There is a range of different types of direction in those languages that can be analyzed in terms of a small number of basic elements and functions. I zoomed in on the ‘back’ direction, showing that one dimension of this domain consists of a radially organized network of ‘back’ axes and another dimension consists of the different place and path functions that

⁹ Apart from the fact that (38c) is archaic and restricted to certain verbs, no other clear differences suggest themselves between these forms.

operate on these axes. These two dimensions together account for the rich lexical patterns that we find in this domain. It turns out that the language of motion makes distinctions between axes that the language of location does not make, at least in the ‘back’ domain in Dutch. Whether this observation extends to other directions, other conceptual domains, and other languages is a topic for future research, as well as the question what might be functional or other reasons for such an asymmetry between the language of motion and the language of location.

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