Dynamic Event Types in Frame Semantics: The Representation of Change in FAMEu

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Abstract

This paper outlines an approach to representing concepts for dynamic situations in a frame-semantic format, using the example of motion verbs and their directional complements. It has been noted in recent research that traditional frames do not properly represent concepts that involve an element of change. A key ingredient of the present proposal is the notion of a phase array from phase-theoretical semantics as an additional frame attribute. A phase array serves to represent the internal temporal set-up of the situation described by a motion expression, as it is determined by the aspectual class of the verb and its projections. The components of the phase array are in turn interpreted using notions from dynamic logic. In this way, the frame receives a dynamic foundation which reflects different kinds of changes expressed by motion verbs and their directional complements. Building on that, a basic type system for motion verbs is introduced, augmented with some further differentiations of types of manner of motion. The paper is rounded off with three brief case studies from typologically diverse languages, namely Russian, French and Korean.

1 The problem: How to represent dynamic meaning elements in frames?

This paper deals with the representation of dynamic elements in the meanings of verbs and their projections in a frame-semantic format, using the example of motion verbs and their directional complements.** It has been noted by Löbner (2011b, 2015, 2017, 2021), Naumann (2013), Naumann and Petersen (2015), and Naumann et al. (2018) and others that standard frames in both the Fillmore (e.g., 1976, 1985) and the Barsalou (1992) tradition represent objects and events as static entities, i.e. they do not properly represent concepts that involve an element of change. Frames in their classic form are static representations of dynamic concepts that do not adequately bring out changes in the properties of objects over time.

Aside from comparatively few stative verbs, the vast majority of verbs is dynamic, i.e. their meaning involves some notion of change. Changes may occur over an extended period of time, like in *screw in the bulb*, or they may be (conceived of as) instantaneous, like in *switch off the light.* Changes may involve opposite states, as in the above examples, or they may consist in a homogeneous development of an object's property, where different stages blend into each other, like in *spread* (e.g., *The fog spread over the scenery.*). And they can consist in a monotonic series of discernible repetitions of some event, as in *swing*, *oscillate*, *jitter* and the like.

Distinctions like the above have been studied extensively under the heading of Aspectual Class (AC), and I will likewise present an account of AC and AC composition in 2.2 below. This specific approach to AC, which extends and slightly modifies the approach

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set forth in Herweg (2014), plays a crucial role in the core part of the present study in that it will provide the anchor for the propounded augmenting of frame representations with a dynamic component.

I will develop the layout of dynamic frame representations with the example of motion verbs, for two reasons: First, motion verbs may well be considered as prototypical exemplars of dynamic verbs, which moreover exhibit all of the differentiations within the field of dynamic meanings outlined above. Second, the present study is part of a broader research project which addresses the specifics of AC assignment in the generation of motion event representations under the perspective of both theoretical linguistics and psycholinguistics (cf. Gerwien and von Stutterheim, 2016).

Building on the basic outline of dynamic frame representations I will introduce a first tier of meaning representations for motion verbs that defines three different, though interrelated concepts of motion, cast in a basic type system for motion verbs. The three motion concepts differ in terms of the extent to which they incorporate the properties of path-generation and directedness. I will proceed by sketching a second tier of verbal meaning representations, again cast in a system of verbal types, that shall serve as a point of departure for a formal semantic theory of more fine-grained manner distinctions among motion verbs. I will conclude the study with three brief case studies from typologically diverse languages, namely Russian, French and Korean. In these case studies, the two tiers of verbal types will be applied in order to carve out some crucial differences between motion expressions in these languages. The observations will finally lead to the hypothesis of a correlation between the path-generating capacity of motion verbs and their AC properties.

2 FAMEu in a nutshell

2.1 The locomotion frame

The representational background for the following considerations is provided by a basic *locomotion* frame within the format of FAMEu (short for "A Frame-semantic Account of Motion Expressions with Underspecification"). This frame is designed to represent crucial elements of the meanings of intransitive motion verbs and their directional complements and modifiers in typologically diverse languages. In the following I will just provide a quick rundown of its components; for more detailed explanations the reader is referred to Herweg (2020).

FAMEu frames are formally represented as typed attribute-value matrices (cf. Carpenter, 1992) on typed feature structures; for an application to frames see Petersen (2015), first published in 2007.[1] The types of FAMEu frames form a type hierarchy. Subtypes below the general *locomotion* type represent (the meanings of) increasingly specific motion verbs. The FIGURE of the *locomotion* frame is the moving entity [cf.][]Talmy.1983. Following a proposal by Gerwien.2016, the figure's motion is delineated on two separate layers, which capture distinct conceptual dimensions of motion events: a MANNER layer, which represents specific manners of motion (such as walking, running, dashing, limping, strolling, etc.) and a PATH layer. The PATH attribute covers different conceptual aspects of paths, represented under two main attributes, ROUTE and P_DIM. ROUTE stands for the path as an object with an internal mereological structure, namely its initial, intermediate and final segments (attributes INIT, INTER and FIN). These path segments may be further specified by directional complements such as 'source', 'route' and 'goal' PPs, which specify a local relation (L_REL) of the moving entity relatively to a GROUND (Talmy, 1983) object. The P_DIM attribute covers several types of dimensional properties of paths, namely their direction in three-dimensional space (attribute DIR), the gestalt/form properties of the pure spatial trace of a path (SHAPE), their velocity and throughput (VEL) and their spatial extent (EXTENT).

In addition to the two fundamental conceptual layers in the representation of motion events, MANNER and PATH, the basic *locomotion* frame includes an attribute EVENT_PROPERTIES for, basically perspective-related, characteristics of event descriptions such as the deictic center (ORIGO), the relative placement of the event in time (TENSE), the high-level perspective or "viewpoint" cf. Smith, 1991 from which the event is presented with regard to its internal structure (ASPECT), and, pivotal for the topic of the present study, a Phase Array (PHASE_ARRAY; henceforth short: PA). A PA is the formal device employed in FAMEu to represent the AC properties of individual linguistic items, such as verbs and prepositions, as well as the AC composition of complex units (cf. Herweg, 2014). Phases in Phase-theoretical Semantics (cf. Herweg, 1990, 1991a, 1991b, 2014; Löbner, 1988, 1989, 1990, 2011a) are segments of a

[1] Attributes in frames are written in upper case and values in lower case letters; types of values and frames are written in italics.

		Sentence AC: BOUNDED		
AC Contribution				
[BD: ingressive]	*in w*	< α: ∅,	μ: ~in_w ,	ω: in_w >
[underspecified]	*durch p*	< α: \durch_p,	μ: durch_p,	ω: \durch_p >
[underspecified]	*rennen*	< α: \rennen,	μ: rennen,	ω: \rennen>

Figure 1: *AC composition for sentence (1) using the phase array account*

scale, i.e., convex partitions of any set with a linear ordering, which are characterized by the fact that a certain (simple or complex) predication holds for them. As an example, a phase can be formed by a period of time at which a certain state holds. So, *Pelle is tired* describes the state of someone by the name of Pelle being tired: 'tired(pelle)'. Here, 'tired' is the PREDICATE applied to the argument 'pelle', and 'tired(pelle)' forms – in the nomenclature of the present study – the PREDICATION that holds for a certain period of time, which, as a whole, forms a phase of the state in question. PAs in turn are abstract tripartite structures $\langle\alpha,\ \mu,\ \omega\rangle$ consisting of an initial phase α, an intermediate phase μ, and a final phase ω, represented in FAMEu by the attributes Pα, Pμ and Pω, whose values are linked (via co-indexing) with the values of the corresponding INIT, INTER and FIN attributes of the ROUTE complex.

We will see an example of AC composition in the FAMEu locomotion frame in figure 2 below.

2.2 Aspectual Class composition with Phase Arrays

The mechanism of AC composition utilized in FAMEu is briefly illustrated in figure 1 for the sample sentence (1); for further details the reader is referred to Herweg.2014.

(1) *Pelle rannte durch den Park in den Wald.*
'Pelle ran through the park into the forest'

In figure 1, '$\alpha : P$', '$\mu : P$' and '$\omega : P$' – where 'P' is a variable for predications – mean that the (situation described by the) predication P holds for the entire phase α, μ and ω, resp. '$\alpha : \sim P$' etc. means that the contrary negation of the predication P holds for the phase (cf. below, 4.1, postulate (D1.b)), and '$\alpha : \backslash P$' etc. means that it is underspecified whether the positive P or its negation $\sim P$ holds for the phase in question, or if the expression does not even refer to that phase at all (expressed by $\emptyset$). 'rennen' represents the predication which states that the figure, i.e. the referent of the subject NP, is engaged in an activity of running. 'durch_p' and 'in_w' are simplified representations of the predications corresponding to the spatial relations designated by *durch* 'through' and *in* 'in(to)' applied to the figure f and the ground objects p (for *Park*) and w (for *Wald*), resp. 'BD' is short for 'bounding'.

Motion verbs and their directional complements are likewise assigned an AC, which is either bounding, nonbounding, or underspecified.[2] Like most German intransitive motion verbs, the AC of *rennen* 'run' is underspecified,[3] as is the AC of the directional preposition *durch* 'through'. This classification is corroborated by the fact that the verb and the preposition accept the criterial contexts for nonbounding expressions, i.e. durational adverbials like *zwei Stunden lang* 'for two hours', as well as those for bounding expressions, i.e. time-span adverbials like *in zwei Stunden* '(with)in two hours' and temporal count adverbials like *zweimal* 'twice', without restriction. The AC of the preposition *in* 'into' is bounding, more specifically ingressive. The α segment in the PA associated with *in* is marked by $\emptyset$, which indicates that this preposition blanks out this phase and contributes only to the specification of μ and ω.[4] The

[2] I prefer to use the terms 'bounding' and 'nonbounding', rather than the more common terms 'bounded' and 'unbounded' - which I used in previous work (e.g., Gerwien and Herweg, 2017; Herweg, 2014), too -, in order to highlight the fact that we are not dealing with properties of situations, but rather with properties of predications about situations. I particularly wish to avoid any connotation that the described situation itself may be temporally unlimited, as the term 'unbounded' may suggest (cf. a similar point made in Kallmeyer et al. (2016) in favour of their use of the term 'nonbounded').

[3] To my knowledge, Maienborn (1990) was the first who argued that the AC of the majority of German intransitive motion verbs is underspecified. Maienborn considers only a handful of intransitive motion verbs in German to be nonbounding (atelic in her terminology). I will discuss these verbs in 6 below.

[4] The concept of blanking out particular phases in a PA, as indicated '$\emptyset$', will be revisited in the analysis of atelic motion verbs in 6.

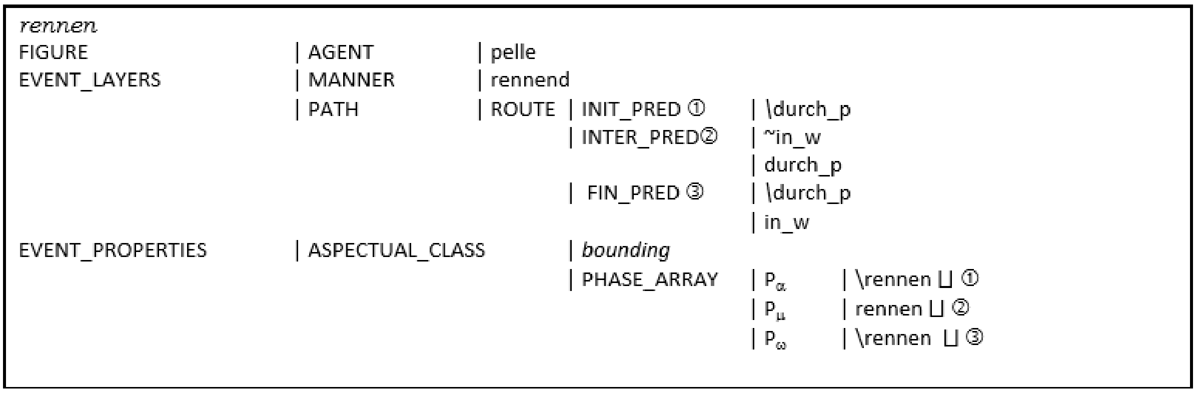

Figure 2: *AC composition for sentence (1) in the locomotion frame*

VP *durch den Park rennen* 'run through the park' is underspecified; only the addition of a bounding PP – in (1) *in den Wald* 'into the forest' – produces a bounding AC for the entire clause. The PAs that represent the AC contribution of the individual items are combined via unification. The relevant parts of the resulting frame is shown in figure 2.

In this frame, the PA contributions of the verb's directional arguments are encoded as values of the attributes INIT_PRED, INTER_PRED and FIN_PRED. These supplementary attributes are used here as abbreviations for more elaborate attribute-value structures which would represent in full detail the local relations and the ground objects introduced by the respective directional argument phrases. They serve to collect and consolidate the information about the figure's respective spatial relation with regard to the ground into a single compact predication about the route segment in question which can be conflated with the relevant predications provided by the verb. The type *verb_pa* abbreviates the contribution of the verb to the PA, and '*verb_pa* ⊔ ⓘ' (where 'ⓘ' is a numbered index) means that the PA contribution of the verb is merged with the PA contribution of its directional arguments, whose representations under the PATH | ROUTE attribute are linked to the PHASE_ARRAY attribute via co-indexing.

To this FAMEu representation, which may be viewed as the result of semantic construction in the terms of Pinkal (1999) and others, additional mechanisms of semantic resolution (again in the terms of Pinkal, 1999) are applied, among them the following:

- Some of the predications would be adjusted with an appropriate logic which covers mutual incompatibilities. As an example, 'in' would resolve the underspecified '\durch' to '∼durch' under the PATH | ROUTE | FIN attribute sequence in the frame in figure 2. This dependency between values of different frame attributes will be captured in FAMEu by a so-called dependency constraint.[5]

- The predication that the verb contributes to the PA is deliberately left underspecified at the initial and final segments P_α and P_ω, represented by '\' in the sample frame. This allows for some vagueness with regard to the question whether or not the specific manner of motion is (already or still) executed in the outer phases and at the transition between phases. In the case of evidence for a negative or positive predication of the manner of motion at P_α or P_ω, this would again be realized by a dependency constraint.

- Also the aspect of the sentence is not yet fully determined at the stage of semantic construction and can only be resolved on the basis of additional contextual information. Although the viewpoint aspect (which is not explicitly shown in the partial sample frame) will presumably resolve to perfective in the majority of cases, there may still be contexts where it resolves to imperfective. Consider, e.g., *Pelle rannte (gerade) durch den Park in den Wald, als ein lauter Pfiff ihn plötzlich anhalten ließ.* 'Pelle was (just) running through the park into the forest when a loud whistle made him suddenly stop', where the subordinate clause triggers an imperfective interpretation of the main clause, which is consequently rendered in English in the progressive form.

I will leave it at this brief sketch of some of the mechanisms of semantic resolution, the details of

[5] Dependency constraints in FAMEu are very much inspired by Barsalou (1992)'s notion of contextual constraints, which represent dependencies between different aspects of a situation, i.e., between different attributes or values in a frame.

which still have to be worked out.

3 Two recent frame-theoretic approaches to the representation of change

As mentioned in the introductory remarks, frames in their classic form are static representations of dynamic concepts that fail to properly capture changes in the properties of events and objects over time. This gap has been addressed in two major strategies to model dynamic concepts in frames. These strategies were first introduced in Löbner (2015, 2017) and Naumann (2013), resp., and recently elaborated in Löbner (2021) and Naumann et al. (2018).

Löbner (2015, 2017) represents the time-dependency of attributes such as "size", whose values change in time, directly in frames, namely by means of additional frame elements. For this purpose he introduces a multitude of additional attributes and values, such as times before, at and after an event, as well as comparators for attribute values such as equality, scalar and mereological orderings, topological relations, etc.

As an example, consider the dynamic verb *grow*. On Löbner's account, this verb denotes an event such that the size of the theme referent at TA, i.e. the time immediately after the time of the event TE, is greater than the size of the theme object at TB, the time immediately before TE. The dynamic element in the meaning of *grow* is thus represented as a simple change of state, i.e. it is reduced to a punctual transition.[6] The extended incremental process of growing is not in the scope of Löbner's analysis. He indicates, however, that this could be captured by imposing a monotonicity condition on a temporally extended event time TE in terms of the values of the SIZE attribute, such that its value monotonically increases during TE.

The graphics in figure 3 from Löbner (2015) illustrates his frame-theoretic account of dynamic meaning elements in terms of their direct representation by means of dedicated additional frame elements; *m* and *mi* are the temporal relations 'meet' and 'meet-inverse' from Allen (1984), which represent adjacent precedence and succession of times, resp.; the comparison value "2" expresses that the value [7] on the size scale applicable to the object [5] at time [4] is greater than the size value [6] of [5] at time [3].

As an alternative to this frame-internal representation of change, which employs additional dedicated attributes and values such as Löbern's times ("TE", "TB", "TA"), comparators ("©$_{\text{size}}$") and comparison values ("2"), Naumann (2013) claims that the standard format of frames itself is used only for static concepts. Dynamic concepts are conceived of as procedures operating on static frames. On this account, a theory of frames hence consists of a space of static frames and a set of dynamic operations in that space.

As an example, the dynamic dimension of *become dry* is captured by an update construction which operates on two frames, one representing the precondition in which the dryness value of the theme referent is not zero and one representing the postcondition in which this value is zero. The dynamic element in the meaning of *become dry* is thus again represented as a simple change of state, i.e. as a one-time transition. The process of drying is represented as an iteration of changes of states from a precondition as above to a postcondition in which the dryness value is lower than the one in the precondition.

The graphics from Naumann (2013) in figure 4 illustrate his approach to representing dynamic meaning elements in an extended theory of frames that employs update operations on static frames; "e_a" and "e_b" represent the left and right boundary of the event e, resp.; "Tr" is an attribute for thematic roles – instantiated as the theme ("THEME") in the case of *become dry* - and "Prop" is an attribute for the relevant property that changes, i.e. the theme referent's state of dryness. "PRE" and "POST" represent the pre- and postcondition of the update operation; "v" and "v' " are the values of the property in question, i.e. the values ¬0 and 0 in the case under consideration, and 'v*' is the value specified in the precondition of the update construction as 'v* ≠ 0', against which v is checked in the application of the update. The update frame on the left hand side of figure 4 models the dimension that is subject to the update, and the update construction on the right hand side maps a frame and the update model to a new frame.

The "dynamic frames" described in Naumann et al. (2018) are conceptually close to Naumann (2013)'s update frames, but differ in some technical details. They involve two "zooming" operations that expand the compact, holistic frame representation of a dynamic event and its thematic roles into frame rep-

[6] Note that punctuality in Löbner's sense does not impose any conditions on the time that the transition in fact occupies. The transition itself can be continuous and temporally extended, or it can be instantaneous without any significant temporal extension. The opposition between punctuality and non-punctuality rather highlights different ways in which transitions may be conceptualized, namley without or with emphasis on their - possibly complex - internal temporal structure. I will use a cognate notion in my definition of pointlike or atomic times in section 4.1, (D2.a).

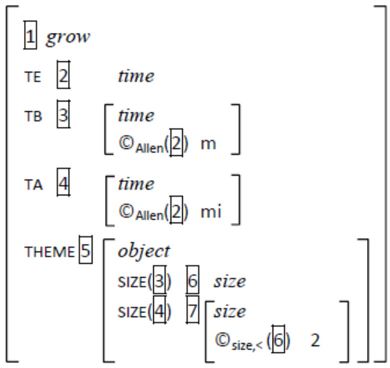

Figure 3: *Löbner's frame representation of verbs of punctual change [source: Löbner (2015: 4)]*

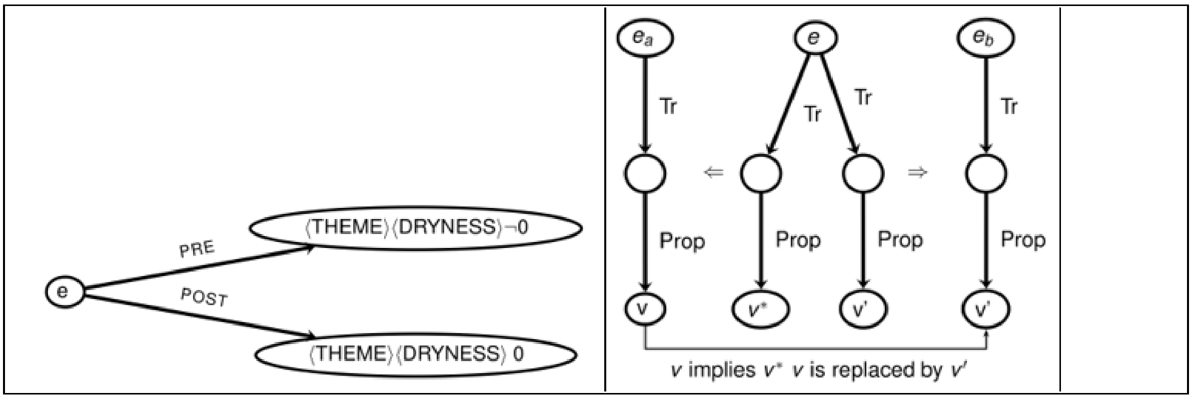

Figure 4: *Naumann's update frame with values (left) and update construction (right) [source: Naumann (2013: 9)]*

resentations of its subevents and their temporal sequence and assign the dynamic attribute expressed by the verb in question to these subevents. The individual sub-frames record the attribute's values (such as levels of dryness, position, height for verbs like *to dry*, *to move* and *to rise*, resp.) as these evolve in the course of the complex dynamic event.

In a recent synopsis of frame-related research in his academic setting,[7] Löbner (2021) refers to the dynamic frames of Naumann et al. (2018) as "hyperframes". Hyperframes are second order frame structures that are formed by first-order frames and relations between them. Basic first order frames like the one in figure 3 remain restricted to punctual event verbs (in the sense described above).

4 The representation of change in FAMEu

4.1 The dynamic foundation of phase arrays

The account of dynamic concepts in frames advocated in the study at hand shares some basic ideas with both Löbner and Naumann but differs from these approaches in important respects. Like Löbner, it makes use of an additional representational device in frames, namely Phase Arrays (PAs; cf. 2.2). Like Naumann, it employs notions from dynamic logic, namely update functions, here called "programs", following the nomenclature of Dynamic Logic (cf. Harel et al., 2000). However, unlike Löbner, who has not yet provided an elaborate theory of complex change occurring over an extended period of time, the present account covers both instanteneous and ongoing change in a unified format.[8] And unlike

[7] Collaborative Research Centre SFB 991 *The Structure of Representations in Language, Cognition, and Science*, Heinrich-Heine-Universität Düsseldorf, Germany.

[8] It should certainly be noted that the present account focusses for the time being on one domain only, while Löbner obviously right from the start is aimed at a general solution that covers a broader range of phenomena. It should nevertheless generally be possible to translate the principles of the present approach to other domains as well.

Naumann, updates are not defined as operations on frames, external to the frames themselves, but are part of the interpretation of frame elements, in particular the interpretation of the predications that serve as values of the PA attribute, via a mapping to expressions of a well-defined formal language based on Dynamic Logic. Note that an interpretation of this kind is needed anyway if the frame langugage is to be more than uninterpreted "markerese" in the sense of Lewis (1970).

To recapitulate: The basic *locomotion* frame introduced in Section 2 includes a Phase Array (PA) as the formal device to represent the AC properties of individual linguistic items, such as verbs and prepositions, as well as the AC composition of complex units.

In order to model dynamic concepts in frames, the approach advocated here ties the representation of change to the conceptual interpretation of the PHASE_ARRAY attribute of the *locomotion* frame, as well as other relevant frames such as *cause_motion* (for *push* etc.) and *cause_change_position* (for *put* etc.). The segments of the PHASE_ARRAY attribute can be related to manifold and potentially multilayered conceptual dimensions such as time, changing positions in space, developmental stages of processes and events and the involved incremental and decremental objects, etc., which yield the dynamic elements of the represented concepts.[9]

For the conceptual interpretation of the PA attribute in our present domain of application, we first assume a function τ which assigns periods of time to entities from different domains. As an example, $\tau(e)$ is the time of occurrence of the event e. For the temporal correlates of abstract PA-elements α, μ, ω we stipulate the condition in (D1.a), where '$t_1 \mathbin{@\!<} t_2$' means that t_1 is adjacent-before t_2, i.e. t_1 is before t_2 and t_1 and t_2 are separated by a pointlike (atomic) period at most (cf. Herweg, 1990, 1991b), as defined in (D2); '$<$' is the precedence relation and '$\subset$' is the proper part-of relation between periods of time. Moreover, postulate (D1.b) determines that the negation operator '$\sim$' for predications over phases expresses contrary negation, as opposed to contradictory or complementary negation, for which standard propositional negation '$\neg$' is used. 'Φ' is a variable that ranges over phases α, μ, ω.

(D1) (a) [Adjacency] For all phase arrays $\langle\alpha,\mu,\omega\rangle$:

$$\tau(\alpha) \mathbin{@\!<} \tau(\mu) \mathbin{@\!<} \tau(\omega)$$

(b) [Contrariety] For all phases Φ and predications P over phases:

$$\neg\exists\Phi(\Phi : \mathrm{P} \wedge \Phi : \sim\mathrm{P})$$

(D2) (a) [Conceptually Pointlike (Atomic) Period] A period of time t is conceptualized as pointlike or atomic (PT(t)) if it is not assigned an internal structure in the form of proper sub-periods:
For all periods t:

$$\mathrm{PT}(t) =_{\mathrm{df}} \forall t'(t' \subset t \rightarrow t' = t)$$

(b) [Temporal Adjacency]
A period of time t_1 is adjacent-before a period of time t_2 ($t_1 \mathbin{@\!<} t_2$) if t_1 is before t_2 and the two periods are separated by a pointlike (atomic) period at most, i.e. by a period that is not assigned any internal structure:
For all periods t_1, t_2:

$$t_1 \mathbin{@\!<} t_2 =_{\mathrm{df}} t_1 < t_2 \wedge \forall t_3(t_1 < t_3 \wedge t_3 < t_2 \rightarrow \mathrm{PT}(t_3))$$

As an illustration, $\tau(\mu)$ and $\tau(\omega)$ are separated by the time of an instantaneous ingressive event, i.e. an event that occupies a conceptually atomic period of time, in the case of a transition from a state $\sim S$ to a state S ($\langle\alpha : \backslash S\ ,\ \mu : \sim S\ ,\ \omega : S\rangle$), like in *enter the room*. The notion of an instantaneous transition, defined in terms of 'PT' and '@<', will below (4.4) be utilized in the dynamic interpretation of egressive and ingressive directional prepositions (i.e., 'source' and 'goal' prepositions, resp.). The notion of contrariety of phase predications, which allows for phases where neither the positive predication P nor its contrary $\sim P$ holds, will prove beneficial in the dynamic foundation of basic motion predicates in 4.3. It also plays an important role for fine-grained semantic distinctions among various subtypes of state predicates (cf. Egg and Herweg, 1994).[10]

[9] In addition to these inherently dynamic concepts, phases can also represent static orderings like scales for size, length, age and price, to which scalar adjectives refer, and even arbitrary orders of objects, like in Löbner (1990)'s analysis of logical quantifiers. For an overview of areas of application for the notion of phases see Löbner (2011a).

[10] Egg and Herweg (1994) defined eight linguistically significant subtypes of state predicates. This classification goes beyond Carlson (1977)'s influential twofold distinction between individual level and stage level predicates (ILP vs. SLP), which appear only as the terminal points in this more fine-grained classification. The eight subtypes are beneficial in order to

4.2 DITL-based definitions for the interpretation of the locomotion frame

In FAMEu, the dynamic dimension of frames is implemented in the interpretation of PAs in terms of a dynamic temporal logic which is vitally inspired by Dynamic Interval Temporal Logic (DITL) as developed in Pustejovsky and Moszkowicz (2011) and Mani and Pustejovsky (2012). The FAMEu approach borrows extensively from DITL, but also expands and alters it where necessary, according to the requirements of the present subject of research. In this type of logic, an update program is a (one- or multi-place) sequence of transitions from one state to another state, where a state is a set of propositions with assignments of values to variables at a specific time index (Pustejovsky and Moszkowicz, 2011: 9).

In order to model the dynamic nature of basic concepts of our *locomotion* frame, we use a DITL-style program for reassingments of locations (regions) l to objects f – the Moving Entity or Figure – over the course of time. We first introduce a localization function `loc`, which assigns locations `l` to the figure `f` at times `t`, which are part ($\subseteq$) of the union ($\cup$) of the times associated with the PA in question.[11]

(D3) $\texttt{loc(f,t) = l}$, with $\texttt{t} \subseteq \tau(\alpha) \cup \tau(\mu) \cup \tau(\omega)$

While DITL employs a discrete model of time with a series of successive points in time, the present account models progression over time by a series of forward-overlapping periods of time, using Allen's 'overlap' relation as defined in Allen (1984). '$t_1 \circ t_2$' means that t_1 starts before t_2 starts and ends before t_2 ends.

We now define an adjusted DITL-style update program for a basic `move` predicate, which assigns changing locations to f, as in (D4). '[$s \Rightarrow s'$]' represents a transition between states s, s'; '$^+$' is Kleene iteration with at least one iteration:

account for a whole variety of linguistic phenomena over and above the ILP/SLP distinction, such as semantic compatibility of predicates with particular temporal connectives and aspectual adverbials (consider, e.g., the contrasts in *as soon as he was old/*young* vs. *as long as he was *old/young* and in *to be already old/*young* vs. *to be still *old/young*), as well as constraints on the progressive and specific effects of interpretation.

[11] Expressions of dynamic logic are written in monospace font. Note that I am using a simplified compact notation for transitions between states '[s ⇒ s']', just like Mani and Pustejovsky (2012), who frequently use a box notation for illustration. For the full definitions of the syntax and semantics of DITL formula the reader is referred to Mani and Pustejovsky (2012, 91 ff.).

(D4) $\texttt{move(f,t)} =_{\text{df}}$
$$[\texttt{loc(f,t)} = \texttt{l}_1 \Rightarrow \texttt{loc(f,t}_2\texttt{)} = \texttt{l}_2, \; \texttt{t}_1 \circ \texttt{t}_2 \;,\; \texttt{l}_1 \neq \texttt{l}_2]^+ \quad \text{for } \texttt{t}_1, \texttt{t}_2 \subset \texttt{t}$$

As DITL predicates are defined as update programs, we can directly name them "programs".

Next is an enriched program for motion which incrementally creates a path; the path p is a list of locations $\langle \texttt{l}_i, \texttt{l}_j, \dots \rangle$ that is dynamically expanded (cf. Mani and Pustejovsky, 2012 98 on 'motion leaving a trail'):

(D5) $\texttt{move\_p(f,t)} =_{\text{df}}$
$$[\texttt{loc(f,t}_1\texttt{)} = \texttt{l}_1 \;,\; \texttt{p} = \langle \texttt{l}_1 \rangle \Rightarrow \texttt{loc(f,t}_2\texttt{)} = \texttt{l}_2 \;,\; \texttt{p} = \langle \texttt{l}_1, \texttt{l}_2 \rangle \;, \; \texttt{t}_1 \circ \texttt{t}_2 \;,\; \texttt{l}_1 \neq \texttt{l}_2]^+ \quad \text{for } \texttt{t}_1, \texttt{t}_2 \subset \texttt{t}$$

The explicit introduction of an incrementally created path p into the interpretation by `move_p` is corroborated by the fact that this path is accessible for modification by a measure phrase: *He walked 10 miles*, *Er lief 10 km*.

The distinction between the basic `move` predicate and the extended `move_p` predicate serves to capture the following differentiation of conceptual characteristics of the involved spatial entities: The application of the `move` program simply yields an unordered set of regions occupied by the figure f in the course of the motion. Any ordering of the elements of that set, which is material to a path, is not intrinsic to the `move` predicate itself. It rather has to — and can, if desired — be specifically construed by means of resorting to the order of the times at which the respective regions are occupied by f during the motion. By contrast, the application of the `move_p` program explicitly produces a sequence of regions occupied by the moving entity f, i.e. a set of regions for which the internal order of its elements is essential. Consequently, unlike `move`, no separate construal of an ordering of regions, and hence of a path, is required in the case of `move_p`.

I will discuss several instances of path-generating and non-path-generating verbal predicates from different languages in the case studies in 6.

To conclude the introduction of the core components of the dynamic model employed here, the translation of the DITL representation of directed motion looks as follows ('_pd' is short for "path-generating and directed"):

(D6) $\texttt{move\_pd(f,t)} =_{\text{df}}$
$$[\texttt{loc(f,t}_1\texttt{)} = \texttt{l}_1 \ , \ \texttt{l}_1 = \texttt{b} \ , \ \texttt{p} = \langle \texttt{b} \rangle \\ \Rightarrow \texttt{loc(f,t}_2\texttt{)} = \texttt{l}_2 \ , \ \texttt{p} = \langle \texttt{b}, \texttt{l}_2 \rangle \ , \\ \texttt{t}_1 \circ \texttt{t}_2 \ , \ \texttt{l}_1 \neq \texttt{l}_2 \ , \\ \texttt{d(b,l}_1\texttt{)} < \texttt{d(b,l}_2\texttt{)}]^+ \quad \text{for } \texttt{t}_1, \texttt{t}_2 \subset \texttt{t}$$

Directedness of motion is represented by postulating that the distance d between the start location b of the motion and the subsequent locations of the figure f continually increases as the motion is executed.

4.3 The interpretation of verbs for homogeneous motion processes

The predications which represent motion verbs in the *locomotion* frame and appear as values under the three components of the PHASE_ARRAY attribute, can be defined as specific instances of the general FAMEu predicates 'move', 'move_p' and 'move_pd', which in turn are defined with the help of the dynamic logic programs `move`, `move_p` and `move_pd` from 4.2. The first FAMEu motion predicate, 'move', is defined as follows with the help of the program `move`. Φ is again a variable that ranges over phases α, μ, ω:

(D7) $\Phi : \text{move}(f) =_{\text{df}} \texttt{move(f,t)}$ for all $t \subseteq \tau(\Phi)$

This general motion predicate is hence defined in our frame-theoretical language as a predicate that designates processes of homogeneous changes of location. As it is defined in terms of a DITL program, which in turn is assigned its dynamic DITL semantics, we can thus say that the FAMEu predicate is interpreted as a DITL-style update program.

Note that the condition '$t_1, t_2 \subset t$' in definition (D4), 4.2, effectively constrains the execution of the `move` program to the phase Φ: The program can only be executed at a time t_1 as long as there is a new forward-overlapping period t_2 in Φ. Thus, the execution of the `move` program terminates with the end of phase Φ (see below, 4.4, for the dynamic interpretation of changes of state).

As '$\sim$' is defined as the contrary negation on predications P (see 4.1, (D1.b)), '$\Phi : \sim\text{move}(f)$' states that there is no execution of the `move` program at any part of Φ:

(D8) $\Phi : \sim\text{move}(f) =_{\text{df}} \neg\texttt{move(f,t)}$ for all $t \subseteq \tau(\Phi)$

In FAMEu frames, '$\Phi : \text{move}(f)$' and '$\Phi : \sim\text{move}(f)$' are abbreviated as values of the relevant PA attribute, namely as the verbal predications 'move' and '$\sim$move', plus the underspecified predication '\move', like in the general scheme in figure 5. Note that, for the sake of illustration, the positive, negative and underspecified predication are randomly assigned to the three phases:

This basic motion predicate will play a crucial role in 6 in the analysis of French and Korean manner-of-motion verbs as well as in the analysis of Russian indeterminate and German nonbounding (atelic) manner-of-motion verbs.

A (logically) stronger verbal predicate 'move_p', which will be used to represent motion verbs such as *walk, run* etc., adds the element of incremental path generation over the period of time for which the predicate in question holds; it is defined using the DITL program `move_p` as follows:

(D9) $\Phi : \text{move\_p}(f) =_{\text{df}} \texttt{move\_p(f,t)}$ for all $t \subseteq \tau(\Phi)$

We determine that, if the start of the motion (t_1 in the definition (D5) of move_p in terms of an update program in 4.2) is specified, it is within phase α, and if the end of the motion is specified, it is within phase ω. This postulate serves to properly link the motion described by the verb and its different PP arguments to PA segments. It also accounts for the fact that in nonbounding contexts the start and end points of the motion are blanked out and hence are not specified (more on nonbounding motion expressions in 6).

Note that the postulate does not categorically preclude any elongated motion which continues beyond ω or even starts prior to α. The relevant parts of this motion would, however, not be linked to the verbal predication that is associated with the PA in question. It would have to be introduced by another verbal predication—a different verb or a different occurrence of the same verb, like in a (possibly eliptical) coordination—, which in turn would be linked to an additional execution of a `move_p` program. This account effectively excludes concatenations of coequal source and goal PPs like in examples (2) and favours constructions like in (3):

(2) (a) **He galloped onto the meadow into the forest.*
(b) **He galloped out of the stables off the meadow.*

(3) (a) *He galloped onto the meadow and (further) into the forest.*

locomotion				
EVENT_PROPERTIES	ASPECTUAL_CLASS			
		PHASE_ARRAY	P_α	~move
			P_μ	move
			P_ω	\move

Figure 5: *Positive, negative, and underspecified verbal predications in the locomotion frame*

(b) *He galloped onto the meadow and trotted into the forest.*

(c) *He galloped onto the meadow and (further) off the meadow.*

(d) *He galloped onto the meadow and trotted off the meadow.*

In DITL, directed motion is built into the meaning representations of motion verbs in general. In contrast to DITL, we rather restrict directedness in FAMEu to specific verbs (*come, approach, ...*) or delegate it to other elements of the sentence, such as specific prepositions (*walk towards ...*) and modifiers *(straight on* etc.).[12]

The corresponding verbal predicate 'move_pd' in FAMEu is defined in the obvious way as follows:

(D10) $\Phi : \text{move\_pd}(f) =_{\text{df}}$ $\texttt{move\_pd(f,t)}$ for all $t \subseteq \tau(\Phi)$

The negations of 'move_p' and 'move_pd' are defined along the lines of (D8) in the obvious way:

(D11) $\Phi : \sim\text{move\_p}(f) =_{\text{df}} \neg\texttt{move\_p(f,t)}$ for all $t \subseteq \tau(\Phi)$

(D12) $\Phi : \sim\text{move\_pd}(f) =_{\text{df}} \neg\texttt{move\_pd(f,t)}$ for all $t \subseteq \tau(\Phi)$

It follows from the definitions of the corresponding programs in 4.2 that the FAMEu predication 'move_pd(f)' entails 'move_p(f)' and 'move_p(f)' entails 'move(f)'. Thus, 'move_p(f)' is underspecified with regard to directedness and 'move(f)' is underspecified with regard to path-generation and directedness.

4.4 Change-of-state events

The previous sections focussed on the dynamic interpretation of motion predications that designate steady processes of continuous changes of location, as represented by verbs like *walk*, *run* etc. Sub-events of an extended motion which consist in changes between opposite states with regard to the location of the figure on a path are typically specified by directional complements of the verb, such as ingressive and egressive prepositions like *into* and *out of.*

The FAMEu *locomotion* frame explicitly accounts for the fact that, in addition to motion verbs, their directional PP complements contribute to the specification of both the path and the internal temporal structure of the described event. Since the meaning of directional prepositions is in general systematically linked to the meaning of static locative prepositions, I will first introduce some basic concepts which serve to capture the semantics of the latter.

Locative prepositional predicates are defined as static relations between a figure f and a region prep*. This region prep* is determined relatively to a ground object g and is specific for the preposition in question (cf. Wunderlich and Herweg, 1991). Locative *in* is accordingly defined as in (15), making use of a 'loc' relation as used in DITL; 'in*(g)' designates (on a simplified account which suffices for the purpose of the present study) the region that is conceptualized as the interior of g in the relevant situation and $\sqsubseteq$ is the spatial part-of relation:

(D13) $\Phi : \text{in}(f, g) =_{\text{df}} \text{loc}(f, t) \sqsubseteq \text{in}^*(g)$ for all $t \sqsubseteq \tau(\Phi)$

In a similar vein, locative *on* is defined by means of a predication 'on*(g)' that designates the region that is conceptualized as the upper surface of g in the relevant situation.

In FAMEu frames, 'Φ : in(f, g)' is abbreviated by the prepositional predication 'in_g' and its corresponding negative and underspecified predications '∼in_g' and '\in_g', which appear as values of the relevant attributes, as in the scheme in figure 6. (Note that the specific assignments of positive, negative and underspecified predications to the attributes INIT, INTER and FIN is again chosen randomly and only serves to illustrate the general approach.)

Source and goal prepositions such as directional *aus/out of* and *in/into* are represented in PAs with

[12] Additional research is needed to determine if some manner of motion verbs (like *roll*, which is used in DITL in order to justify the general directedness constraint) have a stronger inclination towards a directed interpretation than others (like *walk, stroll, stray*).

```
locomotion
EVENT_LAYERS    | PATH   | ROUTE  | INIT_PRED     | in_g
                                  | INTER_PRED    |~in_g
                                  | FIN_PRED      |\in_g
                                                            |
```

Figure 6: *Positive, negative and underspecified prepositional predications in the locomotion frame*

the help of the static locative relation 'in' and its negation as changes of states $\langle\alpha : \text{in}\ ,\ \mu : \sim\!\text{in}\rangle$ and $\langle\mu : \sim\!\text{in}\ ,\ \omega : \text{in}\rangle$, resp. They hence express egressive and ingressive changes of states, resp. The corresponding egressive and ingressive event type predicates can be defined in phase-theoretical terms as follows, where 's' is a predication that designates a state, i.e. a situation that is characterized by the fact that a certain predication holds in it:

(D14) (a) $\lambda e\ \text{EGR}(s)(e) =_{\text{df}}$
$\lambda e \exists\alpha\exists\mu(\langle\alpha : s, \mu : \sim\! s\rangle \wedge$
$\tau(\alpha) < \tau(e) < \tau(\mu))$

(b) $\lambda e\ \text{INGR}(s)(e) =_{\text{df}}$
$\lambda e \exists\mu\exists\omega(\langle\mu : \sim\! s, \omega : s\rangle \wedge$
$\tau(\mu) < \tau(e) < \tau(\omega))$

Since phases α, μ and ω of a PA can be separated only by a pointlike time, as determined in 4.1, postulate (D1.a), it follows from (D14) that egressive and ingressive events are (conceptualized as) instantaneous changes of state.

We thus have pairs of contrasting states in adjacent phases, which are characterized by static predications with opposite polarity. In order to achieve a dynamic interpretation as change-of-state events, we define egressive and ingressive events in terms of an update program as follows, first using the example of the PA representations of *out of* and *into*, resp.:[13]

(D15) (a) For all PA-constellations $\langle\alpha : \text{in}\ , \mu : \sim\!\text{in}\rangle$, there is an event e of type EGR(in), defined by the following program:

$$\begin{aligned}&\text{EGR(in)}(e) =_{\text{df}}\\ &\quad[\texttt{loc}(\texttt{f}, \tau(\alpha)) \subseteq \text{in}^*(g)\\ &\quad\Rightarrow \texttt{loc}(\texttt{f}, \tau(\mu)) \not\subseteq \text{in}^*(g)\ ,\\ &\quad\tau(\alpha) < \tau(e) < \tau(\mu)]\end{aligned}$$

(b) For all PA-constellations $\langle\mu : \sim\!\text{in}\ , \omega : \text{in}\rangle$, there is an event e of type INGR(in), defined by the following program:

$$\begin{aligned}&\text{INGR(in)}(e) =_{\text{df}}\\ &\quad[\texttt{loc}(\texttt{f}, \tau(\mu)) \not\subseteq \text{in}^*(g)\\ &\quad\Rightarrow \texttt{loc}(\texttt{f}, \tau(\omega)) \subseteq \text{in}^*(g)\ ,\\ &\quad\tau(\mu) < \tau(e) < \tau(\omega)]\end{aligned}$$

The dynamic interpretation of egressive and ingressive directional PPs is thus defined in terms of an atomic program that consists in a one-time update of the localization of the figure f with regard to a spatial region which is determined in relation to a ground g. Again, the transition event e is an instantaneous change-of-state, as per 4.1, postulate (D1.a).

This account of PPs that designate a change of state carries over to contrary predications in adjacent phases in general, such as the opposition between 'move' and '∼move', i.e. when a motion stops, or contrasts expressed by more specific verbal predicates. The definitions in (D15) can be generalized to a definition of a comprehensive change-of-state event type COS(Σ). The dynamic interpretation of COS(Σ) in (D16) is again related to pairs of state predications with opposite polarity, represented as 'Σ' and 'Σ−'. Σ and Σ− can each be instantiated by positive and negative predications, as long as these contrast in

[13] Mani and Pustejovsky (2012) and Pustejovsky and Moszkowicz (2011) chose a different approach to the dynamic interpretation of source and goal specifications. In addition to update programs, they use a second kind of program, namely tests. On their account, the interpretation of *travel to Boston* involves a test after each update of the location of the moving entity whether or not the location denoted by *Boston* has been reached. The motion is further executed as long as this is not the case and terminates when the destination is reached. This is of course an ingenious approach which could well be adopted for FAMEu frames. In the present study, however, I prefer a uniform account in terms of transitions between pairs of neighbouring states, because this account maps quite directly the character of phase arrays to a dynamic setting, as becomes particularly obvious in the definition of a generalized change-of-state event type COS(Σ) in (18). From a high-level point of view, the phase-based account can by all means be placed in the tradition of the general account of duality groups developed in Löbner (1990, 2011a) in terms of transitions in the polarity of predicates on a scale that underlies a phase. Note, however, that Löbner also uses the notion of a 'check' in an explicitly procedural account of phase quantification.

polarity (i.e. s vs. $\sim s$ or $\sim s$ vs. s). 'Φ_1' and 'Φ_2' represent any two adjacent phases in a PA.[14]

(D16) For all PA-constellations $\langle \Phi_1 : \Sigma\ ,\ \Phi_2 : \Sigma- \rangle$ such that Σ and $\Sigma-$ have opposite polarity and $\tau(\Phi_1)$ @< $\tau(\Phi_2)$, there is an event e of type COS(Σ), defined by the following program:

$$\mathrm{COS}(\Sigma)(e) =_{\mathrm{df}} [\Sigma \Rightarrow \Sigma-\ ,\ \tau(\Phi_1) < \tau(e) < \tau(\Phi_2)]$$

4.5 Path prepositions

Prepositions like *durch/through* and *über/over, across*, which are usually called 'path' prepositions, are defined (in their strictly motion-related meanings, disregarding uses like *Blick durch das Fenster, Through the looking glass* etc.) as follows; p is the path incrementally created by the motion that the verbal predicate designates ('$\sqsubseteq$' is again the spatial part-of relation, here applied to paths):[15]

(D17) Φ : durch$(f, g) =_{\mathrm{df}}$
there is a path p' in Φ such that $p' \sqsubseteq p$, whose part elements (regions) are spatially included in the specific region in*(g) of g, i.e. $p' \sqsubseteq$ in*(g), and f is moving on p' (in the above sense of 'move_p').

(D18) Φ : über$(f, g) =_{\mathrm{df}}$
there is a path p' in Φ such that $p' \sqsubseteq p$, whose part elements (regions) are spatially included in the specific region on*(g) of g, i.e. $p' \sqsubseteq$ on*(g), and f is moving on p' (in the above sense of 'move_p').

The corresponding frame elements, i.e. the values of the relevant attributes under the ROUTE attribute, are again abbreviated as 'durch', '∼durch', '\durch'; 'über', '∼über', '\über', etc.

Since the above definitions only require that there is a path segment p', such that p'$\sqsubseteq p$, in Φ, but do not require that p extends through the entire phase Φ (although this is not at all excluded), the account allows for multiple path specifications like in *He walked through the historic center past the congress centre across the bridge.*

[14] Note again that the adjacency requirement for the two phases brings it about that the time of the intervening change-of-state event is conceptualized as being pointlike (cf. 4.1, postulate (D1.a)).

[15] The definitions deliberately deal with the German prepositions and do not necessarily capture the exact meanings of similar prepositions in other languanges.

5 Towards a type system for motion verbs

5.1 Basic motion types

FAMEu predications like 'move', 'move_p', 'move_pd', as well as 'in', 'durch', 'über' and others used in the *locomotion* frame, can be treated as sets of events, processes and states – or short: as sets of situations –, namely as sets of the situations they designate. This allows us to define a system of types that correspond to FAMEu predications, where, from an extensional point of view, the denotation of each type is a set of situations.

Having a type system at our disposal is of great practical value: It can be used for cross-linguistic comparison, as in 6 below, as well as for type assignments to values of individual attributes, to partial frame structures and even entire frames (we already used the type *locomotion* for our sample frame).

Based on the definitions in 4, we can readily introduce a couple of basic FAMEu types in the motion domain, namely *move*, *move_p* and *move_pd*, which are defined as sets of situations of unqualified general motion, motion involving the incremental generation of a path, and directed path-generating motion, resp. Note that, as per the definitions in 4, *move_pd* is a subtype of *move_p*, which in turn is a subtype of *move*. More specific types, which correspond to particular verb meanings, can be introduced as subtypes of these general types, e.g. *walk* and *run* as subtypes of *move_p*, and *approach* and *come* as subtypes of *move_pd*.[16]

What is more, since types are sets of situations, we can define a negation '$\overline{}$' for types T, so that '$\overline{T}$' denotes the complement of the set corresponding to T in the domain of situations. With the full set-theoretic equipment at hand, we can, e.g., introduce complex types of the form $A\ \&\ \overline{B}$, which denotes the intersection of the sets A and $\overline{B}$.

Simple and complex types will be an important ingredient of the cross-linguistic considerations in 6. They will be crucial for the classification of motion verbs with regard to the significance that the notion of a path has in their semantics. With the type system at hand, we can differentiate between verbs which introduce a directed path into the meaning representation (type *move_pd*) and verbs which only introduce an unspecific path (type *move_p*), as

[16] In addition, various subtypes of *move_pd* could be defined, such as *move_pdv*, *move_pdh* and *move_pdl* for directed vertical, horizontal and lateral motion, resp., namely by means of additional constraints on the orientation of the directed path in three-dimensional space. However, the details have to be deferred to later work.

well as verbs whose semantics is silent about a path (type *move*), and even verbs that decidedly deny the existence of a path in their semantic representation (type *move* & $\overline{move\_p}$).

It is worth emphasizing that a particular type assignment to a verb does not involve any claim about the (non-)existence of a physical path in real-world motion events. It is rather a claim about the verb's contribution to the construal of a conceptual representation of a motion event solely by virtue of its lexical meaning.

5.2 Elements of a Theory of Manner: A Second Tier of Verbal Types

A second tier of verbal types on top of the types described in § 5.1 shall serve as the point of departure for a closer look into the internal structure of motion processes on our path to a more elaborate representation of manners of motion. As a first step in this direction, we introduce two basic tier 2 types that allow to differentiate between verbs which express a homogeneous flow of motion with no discernible parts (for *glide, sail* etc.), on the one hand, and verbs which express a motion that is composed of a sequence of segments of the same type, such as a homogeneous sequence of steps (*walk, march* and the like) or strokes (*row, scull*), on the other hand.[17] This first distinction among different sorts of manner of motion, which is depicted in figure 7 and which we will get back to in our more elaborate type system below, will be captured by the verbal types 'Cumulative Iteration of Atoms' (*cia*) and '(Non-Segmented) Homogeneous Process' (*hom*).

In order to introduce the verbal types *cia* and *hom*, we need the preparatory definitions in (D19). In these definitions, '$\boxed{m}$' is the 'meet' relation from Allen (1984), i.e. the relation of seamless precedence between periods of time (cf. 3 above) – *nota bene*: in contrast to '@<' (cf. 4.1 above) –; '$\sqsubseteq$' is the mereological (possibly improper) and '$\sqsubset$' the mereological proper part-of relation between two events, and '$\oplus$' forms the mereological sum of two events.[18]

(D19) (a) Cumulative event type predicates:

$$\mathrm{CUM}(E) =_{\mathrm{df}} \forall e_1 \forall e_2 \left(E(e_1) \wedge E(e_2) \wedge \tau(e_1) \boxed{m} \tau(e_2) \implies E(e_1 \oplus e_2)\right)$$

(b) Atomic event type predicates:

$$\mathrm{AT}(E) =_{\mathrm{df}} \forall e_1 \left(E(e_1) \implies \neg\exists e_2 \left(e_2 \sqsubset e_1 \wedge E(e_2)\right)\right)$$

(c) Homogeneous event type predicates:

$$\mathrm{HOM}(E) =_{\mathrm{df}} \forall e_1 \forall e_2 \left(E(e_1) \wedge e_2 \sqsubseteq e_1 \implies E(e_2)\right)$$

(d) Iterative event type predicates:
For all event type predicates E, E' such that $E \neq E'$:

$$\mathrm{ITER}(E) =_{\mathrm{df}} \forall e_1 \left(E(e_1) \Rightarrow \exists e_2 \exists e_3 \left(E'(e_2) \wedge E'(e_3) \wedge e_2 \sqsubset e_1 \wedge e_3 \sqsubset e_1 \wedge \tau(e_2) \boxed{m} \tau(e_3)\right)\right)$$

With the definitions in (D19) we can now define the verbal types 'Cumulative Iteration of Atoms' (*cia*) and '(Non-Segmented) Homogeneous Process' (*hom*) as follows:

(D20) (a) [Definition *cia*]
A verb is of type *cia* if the verbal event-type predicate E is cumulative (CUM) and iterative (ITER) and the iteration is composed of atomic (AT) event types E'.

(b) [Definition *hom*]
A verb is of type *hom* if the verbal event-type predicate E is homogeneous (HOM).

An additional type for cumulative event types in general will prove to be useful for further verb classifications. It is defined in the obvious way:

(D21) [Definition *cum*]
A verb is a type *cum* if the verbal event-type predicate E is cumulative (CUM).

[17] Cf. the concepts proposed in Gamerschlag et al. (2014) in order to describe two different readings of German *steigen* ('rise' vs. 'climb'); cf. below.

[18] The underlying formal theory of times and events is to be considered as a conceptual theory of times and events, not an ontological theory. This means that an atomic event, as defined in (D19.b), may well have a factual internal structure, but this is suppressed in the conceptual representation of the event (cf. Herweg, 1990, 1991a, as well as Löbner's notion of punctuality explained above, section 3). Note furthermore that the condition '$\tau(e2) \boxed{m} \tau(e3)$' in (D19.d) implies that there is at least one iteration of events of type E'. It remains to be checked if this condition is too strong, since one could argue that one could climb a chair (German: *auf einen Stuhl steigen*) with just one single step.

Figure 7: *Graphical illustration of the verbal types cia and hom*

As a first step towards a more elaborate theory of manner, motion verbs can be classified as sub-types of the general types composed of

- the basic tier of types *move, move_p* and *move_pd*, which represent continuous change of location with or without a direction; and

- a second tier of types *cia* and *hom*, which represent evenly segmented and unsegmented cumulative event types, resp., plus the type *cum* for general cumulative event types.

In conjunction, these two tiers of verbal types serve as the starting point to establish a type system for motion verbs. With the elements introduced so far, an initial version of the type system looks as depicted in figure 8. Vertical (including descending) lines represent a supertype-subtype hierarchy with inheritance. Non-connected types are hierarchically unrelated.

As basic types *T1* and *T2* can be conjoined to form complex types *T1 & T2* – where, from an extensional point of view, '&' forms the intersection of two sets – we can classify *walk* and *row* as subtypes of the complex type *move_p & cia*, *glide* and *sail* as sub-types of type *move_p & hom*, and *rise* as a sub-type of *move_pd & hom*. The types *steigen_mm* and *steigen_dir* distinguish two different senses of the German motion verb *steigen* (cf. Gamerschlag et al., 2014), which are typically rendered as *climb* vs. *rise* in English; Firstly, the pure manner-of-motion sense like in *Er steigt auf den Hügel* (literally 'he climbs onto the hill'), which in the FAMEu type system forms a subtype of *move_p & cia*, and secondly, the directional sense like in *Der Ballon steigt (höher und höher)* 'the balloon rises (higher and higher)', which is of type *move_pd & hom*.

This basic system will by and by be expanded as we discuss motion verbs from typologically diverse languages in the ensuing sections.

6 Case studies: The FAMEu type system applied to verbs from typologically diverse language

6.1 Russian and German nonbounding manner-of-motion verbs

Zinova and Osswald (2014) discuss a specific group of Russian imperfective motion verbs which exist in two forms, namely a determinate one, which expresses (uni-)directional motion, and an indeterminate one, which expresses non-directional or multi-directional motion; cf. the pairs of verbs in (4):

(4) (a) determinate: (uni-)directional
  i. лете́ть 'fly' (one direction)
  ii. идти́ 'go' (one direction)
 (b) indeterminate: non- or multi-directional
  i. лета́ть 'fly' (non/multi-directional)
  ii. ходи́ть 'go' (non/multi-directional)

Zinova & Osswald reflect this distinction in their frame-semantic account in terms of the attributes assigned to the verbs: determinate motion verbs have both a 'path' and a 'trace' attribute, while indeterminate motion verbs possess only a 'trace' attribute.[19]

In the FAMEu *locomotion* frame, the distinction between a 'path' and a 'trace' attribute corresponds by and large to the distinction between the ROUTE and the SHAPE attribute (cf. Herweg, 2020). In terms of the FAMEu type system, the opposition between determinate and indeterminate verbs, as conceived of by Zinova & Osswald, can be considered as one between verbs that designate a path-generating motion, i.e. verbs of type *move_p*, and verbs that do not, on their own, designate a motion that necessarily creates a path, i.e. verbs of type *move*. In order to

[19] Zinova and Osswald (2014) deal only with the non-/multi-directional readings of indeterminate verbs and do not provide explicit analyses of their uses in habitual or generic contexts. I will likewise focus exclusively on the non-/multi-directional readings and delegate habitual/generic uses to a general account of habituality and genericity.

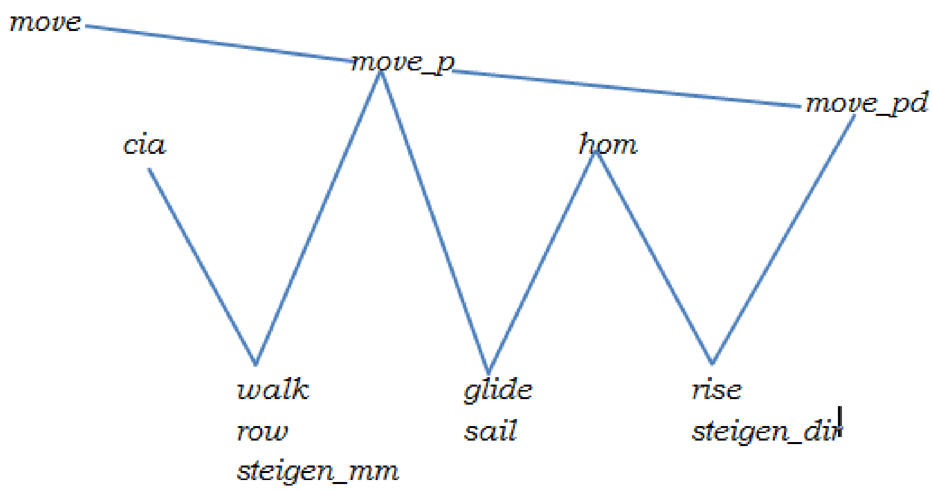

Figure 8: *Initial version of the FAMEu verbal type system*

effectively exclude any path-generating potential for indeterminate verbs, their type attribution can even be strengthened to *move* & $\overline{move\_p}$ (which *a fortiori* means they are also of the non-directed type $\overline{move\_pd}$. As regards determinate verbs, I would rather refrain from strengthening their type to *move_pd*, because the type of verbs which designate path-generating and directed motion should be confined to verbs like *come*, *approach* and *rise*, which clearly express an increasing distance between the start location and subsequent positions of the figure on the designated path (see 4.2 and 4.3 above).

Russian indeterminate motion verbs bear a certain resemblance to a group of six motion verbs in German which Maienborn (1990) identified as nonbounding (atelic in her terminology), rather than underspecified verbs, namely *stromern* ('roam'), *streunen* ('stray'), *schweifen* ('ramble'), *streifen* ('wander'), *streichen* ('prowl') and *wandeln* ('stroll'). The classification as nonbounding is indeed corroborated by the fact that these verbs reject bounding contexts and can only be embedded in nonbounding or underspecified contexts, as is shown in (5) for *stromern* 'roam' (the other verbs mentioned above exhibit the same behaviour).

(5) *Pelle stromerte...*
'Pelle roamed...'

(a) *zwei Stunden lang durch den Wald.*
'for two hours through the forest'

(b) **innerhalb von zwei Stunden durch den Wald.*
'within two hours through the forest'

(c) **aus dem Haus in den Garten.*
'out of the house into the garden'

Like Russian indeterminate verbs, these nonbounding German motion verbs convey the idea of a non- or multi-directed motion, which suggests the assignment of type *move* or even *move* & $\overline{move\_p}$. As regards their path-generating potential, it can be observed that the verbs in question apparently do not easily go together with measure phrases like *zwei Kilometer (weit)* '(for) two kilometers', at least by contrast with standard underspecified motion verbs such as *gehen, laufen, rennen* 'go, walk, run' and the like; cf. (6):

(6) *Er ging / lief / rannte / ?stromerte / ?streunte / ??schweifte / ??streifte / ??strich / ?wandelte zwei Kilometer.*
'He went / walked / ran / roamed / strayed / rambled / wandered / prowled / strolled two kilometers.'

A measure phrase like *zwei Kilometer* 'two kilometers' specifies the extent of a path which, although it is not overtly expressed, must nevertheless be assumed as an element of the semantic representation; otherwise it would be hard to explain how the measure phrase could be interpreted at all. Thus, the observations in (6) indeed justify that *gehen, laufen, rennen* 'go/walk/run' etc. are assigned the type *move_p*, whereas there is good reason to assume that German atelic motion verb are of type *move* and moreover at least lean towards the type $\overline{move\_p}$. However, (5.a) clearly shows that the verbs in question allow directional complements that refer to the intermediate segment of the ROUTE attribute, i.e. atelic or underspecified complements, without reservation. We thus have to concede that we may need a further differentiation of the notion of path-generation which takes into account the extent to which a verb makes use of the components of a fullfledged path concept. We cannot settle this topic in the present study (see, however, my proposal in Herweg, 2020, sec. 4.2.4) and thus indicate the relation of German atelic motion verbs to the $\overline{move\_p}$ type only by a dotted line in figure 9, steering clear of taking a definite stance on the subject here.

Resuming the considerations in 4.2 on the dynamic logic programs `move` and `move_p`, as defined in (D4) and (D5), resp., we can attribute the different behaviour of *move* and *move_p* predicates in (6) to the specific status of the spatial entities introduced by the verbal predicates: On the one hand, a *move_p* predicate generates a path on its own terms and hence can be combined without reservation with phrases that express a measure on paths. On the other hand, according to 4.2, (D4), a *move* predicate only generates an unordered set of regions which the moving entity occupies in the course of its motion. Thus, in order to be able to interpret such a verb in combination with a measure phrase on paths, an external ordering has to be imposed on this set of regions. As outlined in 4.2, this ordering has to be derived from the times associated with the different locations of the moving entity. This need for a separate construal of a sequence of regions may account for the restricted – and potentially graded (cf. the suggested assessments in (6)) – acceptablity of measure phrases on paths in the context of a *move* predicate.

Russian determinate and indeterminate motion verbs and German atelic motion verbs thus fit into the FAMEu type system as shown in figure 9.[20] The pair лете́ть/лета́ть 'fly' is assigned the type *hom*, whereas the pair идти́/ходи́ть is assigned the type *cia*. Figure 9 also displays, under type *move_p*, the German underspecified motion verbs which were contrasted with atelic verbs in (6) above. It is not so evident how the German atelic motion verbs are related to the type *cia*. On the one hand, one may argue that activities of straying, strolling etc. usually involve a step-by-step progression in space. On the other hand, the conceptual salience of this feature of the activity may well be considered rather low, if not degraded to zero, which may even place them in the range of the type *hom*. So I rather leave these verbs unspecified for the types *cia*/*hom* in the classification shown in figure 9.

As regards the PA associated with atelic motion verbs in particular, and nonbounding expressions in general, we assign to them the following PA; as explained in 2, 'Ø' indicates that the verb explicitly declines any reference to the respective phases:[21]

(D22) Phase array for atelic verbal predications P:
$\langle \alpha : \emptyset \ , \ \mu : P \ , \ \omega : \emptyset \rangle$

This PA serves to represent what it means that a nonbounding expression is a predication about the intermediate phase μ of a PA only and blanks out the PA's initial and final phases α and ω. In reality a state or process designated by a nonbounding predication will in general be preceded and followed by the contrary state or process, and there will be events of the state or process setting in or coming to an end. However, the nonbounding predication on its own does not introduce any such contrasts as part of its lexical content. If such a contrast is introduced, this has to be done externally to the predication itself. As an example, verbs like *begin, start, stop* and *cease* establish an ingressive or egressive PA, resp., into which the PA of a nonbounding verb can be embedded, if it appears as an argument of these aspectual operators. Similarly, the PA of a nonbounding verb can be embedded into a more complex phase structure introduced by adverbial aspectual operators like *already* and *still*, which establish a contrast between neighbouring phases with regard to their argument predication (cf. Löbner, 1989, 2011a). The predication itself, however, contributes only the intermediate phase μ to the representation.

We finally state that a motion verb, as the head of a motion expression, accepts a directional complement that designates a change of state between α and μ or μ and ω only if the predication that corresponds to the verb provides the phase impacted by the state of change – α, ω, or both – via its own PA, i.e. α and/or ω must not be blanked out by 'Ø'. This stipulation effectively rules out any combination of

[20] It should be pointed out that assigning German atelic and Russian indeterminate motion verbs close-by positions in the FAMEu type system developed so far does not mean that these verbs are necessarily akin in all relevant semantic respects. There are for sure traceable semantic differences whose elaboration requires additional representational instruments beyond the scope of the present study.

[21] This PA bears a resemblance to the 1-state lexical contents in Klein (1994), just as the egressive and ingressive PAs in the present approach and Klein's 2-state lexical contents. As a matter of fact, the phase-theoretical account shares some fundamental assumptions with Klein's original theory and its further development in terms of argument-time structures in Klein (2000). There are, however, obvious differences, like the further differentiation into a variety of AC distinctions, including expressly underspecified predications, as well as the integrated handling of verbal and prepositional predications and the application of the complete PA inventory to the latter.

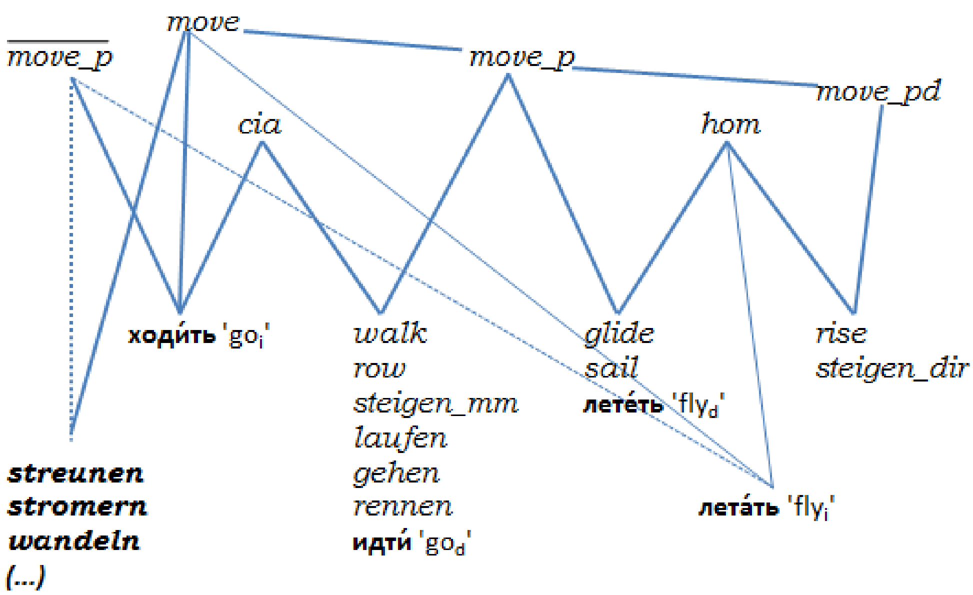

Figure 9: *The FAMEu type system with German and Russian nonbounding motion verbs (in boldface)*

an atelic motion verb with an egressive or ingressive PP like in (5.c) above.

6.2 French manner-of-motion verbs

6.2.1 Combinatorial constraints on French manner-of-motion verbs

A well-known and much debated observation about manner-of-motion verbs (MoMVs) in Romance (and other) languages is that Romance MoMVs, in particular those with rich manner content, do not combine well with 'goal' PPs which express the crossing of a boundary, i.e. ingressive PPs in the terminology of the study at hand, like equivalents of Engl. *into*. Rather, the manner of motion is expressed by a verbal gérondif which is adjoined to a path verb that expresses a change of state. Hence, (7.a), cited in Beavers et al. (2009, pp. 3, 14), is the preferred way in French to express that someone went into a house in a particular manner, whereas (7.b) is odd:

(7) (a) *Je suis entré dans la maison en boitant.*
[I am entered in the house in limping]
'I entered the house limping'

(b) **/??Je suis boité dans la maison.*
[I am limped in the house]
'I limped into the house'

This is a palpable contrast to languages like German and English, where no such constraints exist. In general, Romance MoMVs only accept 'goal' PPs which do not express the crossing of a boundary, which means that they only combine felicitously with general delimiters in the terms of Beavers et al. (2009). Only highly general MoMVs, i.e. verbs with low specific manner content, allow PPs which express boundary crossing.[22] Similar phenomena can be observed in Japanese and Korean (cf. Beavers et al., 2009). The following is an example, again taken from Beavers et al. (2009, p. 15), of a French MoMV in combination with the general delimiter *jusque'à*:

(8) *La cire coule jusqu'au bord de la table.*
[the wax flowed until.to.the edge of the table]
'The wax flowed to the edge of the table.'

Real language production data elicited in psycholinguistic experiments add to this picture: As von Stutterheim and Gerwien report (p.c., August 2016; cf. von Stutterheim et al., 2020), production data from ongoing experiments show that French native speakers (a) in general do not combine MoMVs with directional PPs other than *jusqu'à* and (b) do

[22] There are of course good reasons to put this characteristic trait into the broader context of the position of Romance languages in the typological classification devised by Talmy (1991), where they are treated as path-dominant or verb-framed languages, as opposed to languages like English, German and Russian, which are classified as manner-dominant or satellite-framed; cf. the overview of Talmy's original classification, as well as of extensions and revisions thereof, in Fortis (2010); see also the detailed discussion of French and of Talmy's classification thereof in Pourcel and Kopecka (2005). However, at this point, I will not at all elaborate on this typological classification itself, but will rather examine some characteristic semantic properties of the relevant linguistic items themselves, i.e. Romance MoMVs and general delimiters, using the example of French.

not add additional path segments to sentences involving a MoMV and *jusqu'à*, even if the scene they were asked to verbalize would support a description with multiple path-segments. This rules out scene descriptions like the following:

(9) *??/*Il marche jusqu'à l'escalier et dans la bibliothèque.*

On the basis of these observations, von Stutterheim and Gerwien (p.c., August 2016; cf. von Stutterheim et al., 2020) hypothesize that (a) French MoMVs do not express directed motion, but just an activity of moving without any inherent directedness and without any reference to a path; and (b), in combination with a MoMV, the P *jusqu'à* has a primarily temporal meaning, referring to a temporal reference point which is either explicitly mentioned (as in *marcher jusqu'à 5 heures du matin*) or is derived from an object that serves as a spatial reference in an activity of moving (as in *marcher jusqu'à l'escalier*). *Il marche jusqu'à l'escalier* thus means that the agent has the property to be engaged in an activity of walking and that this property holds up to the time when s/he is located next to the stairs. In combination with MoMVs, phrases like *jusqu'à l'escalier* define a right boundary to the temporal evolvement of a motion activity. This right boundary is not linked to a discernible path whose different segments could independently be referred to without reservation.

The observations by von Stutterheim and Gerwien, as well as the observations reported in Beavers et al. (2009), can be accounted for in the FAMEu approach by (a) assuming that French MoMVs are nonbounding motion verbs of the non-path-generating type *move* & $\overline{\textit{move\_p}}$ and (b), by treating general delimiters like Fr. *jusqu'à*, but also e.g. Jap. *–made* and Kor. *–kkaci* (see below, 6.3), as homogeneous measure functions which semantically determine the minimum extent of their argument.

On the one hand, being nonbounding, French MoMVs semantically resist directional PPs that decidedly introduce a change-of-state in terms of crossing some boundary, i.e. ingressive and egressive directional PPs. On the other hand, general delimiters, being homogeneous measure functions, are generalizations across various conceptual domains of what durational adverbials like *for two hours* are for the temporal domain and thus perfectly match with the AC of French MoMVs. Similar like durational adverbials, they introduce a boundary for the designated motion but do not semantically imply any change-of state that consists in crossing that boundary.

In terms of the present phase-theoretical approach this means that general delimiters set a right boundary to the intermediate phase μ of a motion activity but do not express any particular property of the final phase ω. More specifically: They do not define any contrast between μ and ω with regard to a given predicate P and its negation ∼P.

But why then do general delimiters like *jusqu'à X* under normal conditions close off the motion activity against any explicit elongation by way of adding a subsequent path segment, as observed by von Stutterheim and Gerwien (cf. (9) above)? My proposed response requires a deeper look into the semantics and pragmatics of general delimiters. The following, quite spacious excursus is justified by the fact that general delimiters play a critical role in the appreciation of motion phenomena across a whole variety of typologically diverse languages, including Korean (see 6.3).

6.2.2 An excursus on general delimiters

The crucial behaviour of general delimiters is due to the fact that, as homogeneous measure functions, these expressions are subject to a particular kind of a generalized conversational implicature in the sense of Levinson (1983, sec. 3.2.4), namely a scalar implicature (cf. Herweg, 1991b, p. 67)), :

- General delimiters form deductive sequences of the form *if P up to n, then P up to m* for $n > m$.
- The choice of the weaker element in the deductive sequence (*P up to m*) triggers the scalar implicature that the stronger elements (*P up to n*) do not hold.
- This means that, although *P up to m* does not exclude *P up to n* from a logical point of view, the choice of the weaker *P up to m* pragmatically suggests (i.e. implicates) that the stronger *P up to n* does not hold, barring contextual evidence to the contrary.

Note that, although scalar implicatures are defeasible, they are of a quite strong nature. This is due to the fact that they are deeply anchored in the lexical semantics of the linguistic items in question. They may hence be considered to be semantically licensed pragmatic inferences.

Being a scalar element which triggers a scalar implicature, a general delimiter such as *jusqu'à* exhibits the following semantic properties:

- The VP *marcher jusqu'à l'escalier* ascertains that the activity of walking is carried out throughout the μ phase of the PA associated with *marcher*. The right boundary of this μ phase is determined by the fact that the agent has reached the staircase. Its left boundary is often left implicit or determined by the context.

- Like durational adverbials such as *for two hours* (which are also subject to the described scalar implicature; cf. Herweg, 1991b, p. 67), the general delimiter operates on the nonbounding activity predicate and yields a bounding predicate about an event that consists in a phase of the activity being carried out (cf. the PO-operator in Herweg, 1990, 1991a).

- This analysis is borne out by the fact that the resulting expression shows all properties of a bounding event-type predicate, namely compatibility with time-span adverbials (*marcher jusqu'à l'escalier dans une minute*) and temporal count adverbials (*marcher jusqu'à l'escalier trois fois*).

These observations boil down to the fact that general delimiters map nonbounding predicates to intergressive predicates in the sense of Löbner (1989), Herweg (1990, 1991a, 2014) and Egg (1995). Without going into the details here, this means in the present approach that the general delimiter GD applied to a manner-of-motion verb like *marcher* establishes a singleton structure that refers to the intermediate phase segment only, i.e. *GD(marcher)*: $\langle \mu : marcher \rangle$. This constellation is depicted in figure 10.

To summarize: From a semantic point of view, a general delimiter like *jusqu'à X* does not by itself introduce a change of state from a phase μ to a subsequent phase ω. More specifically, the corresponding intergressive PA does not at all refer to a phase ω. This is in stark contrast with ingressive goal PPs like *into X, onto X* etc., which by themselves explicitly introduce a change of state from μ*:* $\sim P$ to ω*:* P (cf. above, 2.2). However, from a pragmatic point of view, *marcher jusqu'à l'escalier* more often than not triggers the scalar implicature that the activity does not continue after the end of the phase μ, i.e. that the activity in question ends in a result state. Since the initiation of this supposed result state coincides with the agent being located in a particular region referred to in the general delimiter phrase, this scalar implicature triggers at the same time the interpretation that there is a concomitant change from a state where the agent is not yet located in the particular region to a result state where s/he is. Thus, as a result of pragmatic reasoning in terms of applying a scalar implicature licensed by the GD phrase, the semantically established intergressive interpretation is non-compositionally expanded into an ingressive interpretation which involves a transition from μ*: marcher & ∼loc@staircase* to ω*: ∼marcher & loc@staircase*. The final interpretation of *marcher jusqu'à l'escalier* may thus look like that of an explicitly ingressive expression, but it is achieved in a different way and, being a pragmatic inference, has only a default status and as such is defeasible.

The proposed approach thus involves (a) a semantics of Romance MoMVs as pure movement activity predicates with no path-creating function and no element of directedness, and (b) a semantic analysis of general delimiters as intergressive operators on nonbounding predicates, on the one hand, and, on the other hand, as scalar elements which give rise to semantically licensed pragmatic reasoning in terms of scalar implicatures. This proposal accounts for a number of observations reported in the literature:

- As nonbounding predicates of type *move*, French MoMVs (and MoMVs from other Romance languages) do not combine well with directional PPs which express the crossing of a boundary, i.e. with ingressive or egressive directional PPs. They accept these complements only under highly specific circumstances (for a synopsis of the relevant factors see Levin et al., 2009). They do, however, accept general delimiters without reservation, which is due to the specific semantic properties of these latter expressions.

- General delimiters are somehow felt to have a 'double nature': On the one hand, they differ in important respects from PPs which unequivocally introduce a result state. On the other hand, they introduce a region which marks the final position of the moving figure. This has led to some considerable debate on the theoretical justification of the boundary-crossing vs. non-boundary-crossing distinction (see, e.g., the cited evidences and references in Beavers et al., 2009, 16f.). According to the proposal at hand, the semantics of general delimiters differs decidedly from the semantics of ingressive PPs, but at the same time their meaning licenses a strong pragmatic inference that may account for the prevailing result-state interpretation, without blurring important semantic distinctions.

- It has often been noted that there is a correlation between the availability of change-of-state MoMV constructions and general resultative

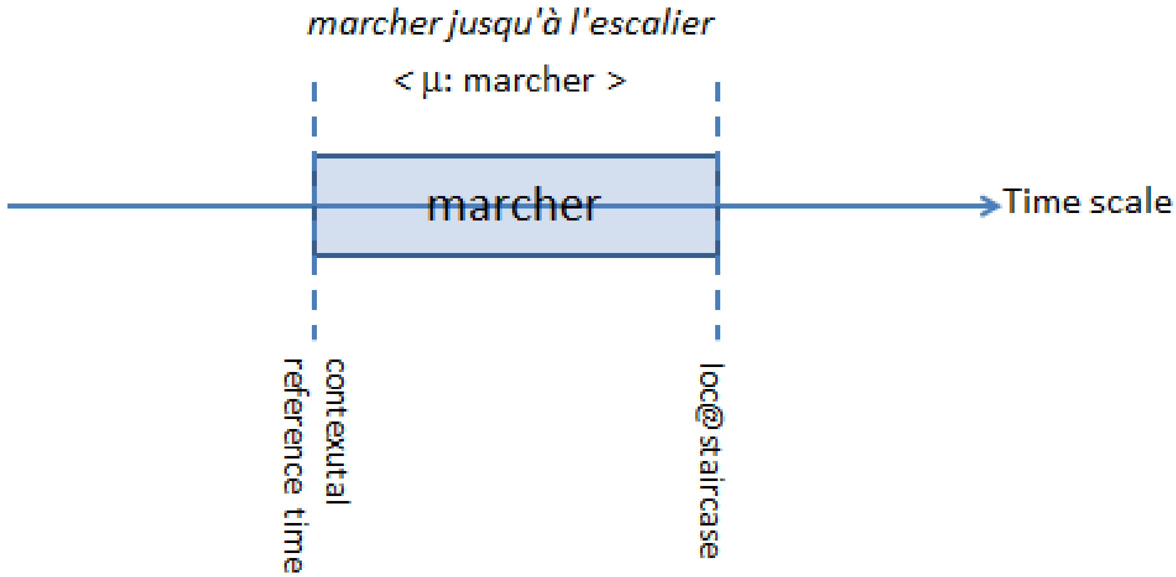

Figure 10: *Graphical representation of the phase structure of "marcher jusqu'à l'escalier"*

constructions (*pound the metal flat, break the safe open*) in typologically diverse languages (see, e.g., Folli and Ramchand, 2005; Levin et al., 2009; Levin and Hovav, 2008, 2013). General delimiters have always presented kind of a puzzle in this context. The present approach is fully consistent with this observation because it explains both the relevant differences and the similarities between general delimiters and change-of-state PPs.

- And finally, the observations which von Stutterheim and Gerwien made in language production tasks (see above, 6.2.1), namely that speakers in general do not combine French MoMVs with directional PPs other than *jusqu'à* and that they do not add additional path segments to sentences involving a MoMV and a general delimiter, are supported by the present approach, which treats the latter as mappings from nonbounding to intergressive predicates.

As mentioned above, I will resume the characteristics of general delimiters in my discussion of Korean motion verbs in 6.3.

6.2.3 French manner-of-motion verbs in the FAMEu type system

French MoMVs are of the FAMEu type *move* and more specifically *move* & $\overline{move\_p}$, i.e. non-path-creating.[23] They hence are of the same FAMEu type as Russian indeterminate MoMVs and German nonbounding MoMVs (see above, 6.1).

On the second tier of verbal types outlined in 5, French MoMVs are assigned the type *cia* (in the case of *courir* 'walk, run', *boiter* 'limp, hobble', *marcher* 'go, walk, march' and similar verbs.) or the type *hom* (in the case of *coulisser* 'glide', *couler* 'flow', *planer* 'float, glide' and the like). French MoMVs thus fit into the FAMEu type system as shown in figure 11.

As atelic verbs, the French MoMVs are assigned PAs of the structure defined in (D22), namely $\langle \alpha : \emptyset \ , \ \mu : P \ , \ \omega : \emptyset \rangle$. This PA permits the combination with a general delimiter but blocks the combination with an egressive or ingressive PP complement. It thus accounts for the observations in 6.2.1, examples (7.b) and (8).

There are, however, some rather specific conditions under which the combination of a finite MoMV with an ingressive(ly interpreted) PP complement may even be preferred to a construction involving a path verb and a gérondif. As an example, see (10), taken from Beavers et al. (2009, 19 f.), who cite Stringer (2003, p. 46). In the context of a mother telling her children that they should all go inside, perhaps as it starts to rain, (10.a) may be more natural than (10.b):

[23] I'm claiming this type assignment only for pure manner-of-motion verbs and not necessarily for verbs like *plonger* 'dive in' and *dévaler* 'rush down', which Pourcel and Kopecka (2005) classify as hybrid verbs that conflate manner and path. The classification of these latter verbs in the present type system requires further investigation. The classification of French pure MoMVs as non-path-generating verbs meshes well with the position put forward in Pourcel and Kopecka (2005), namely that these verbs emphasize the motion activity and de-emphasize any path element.

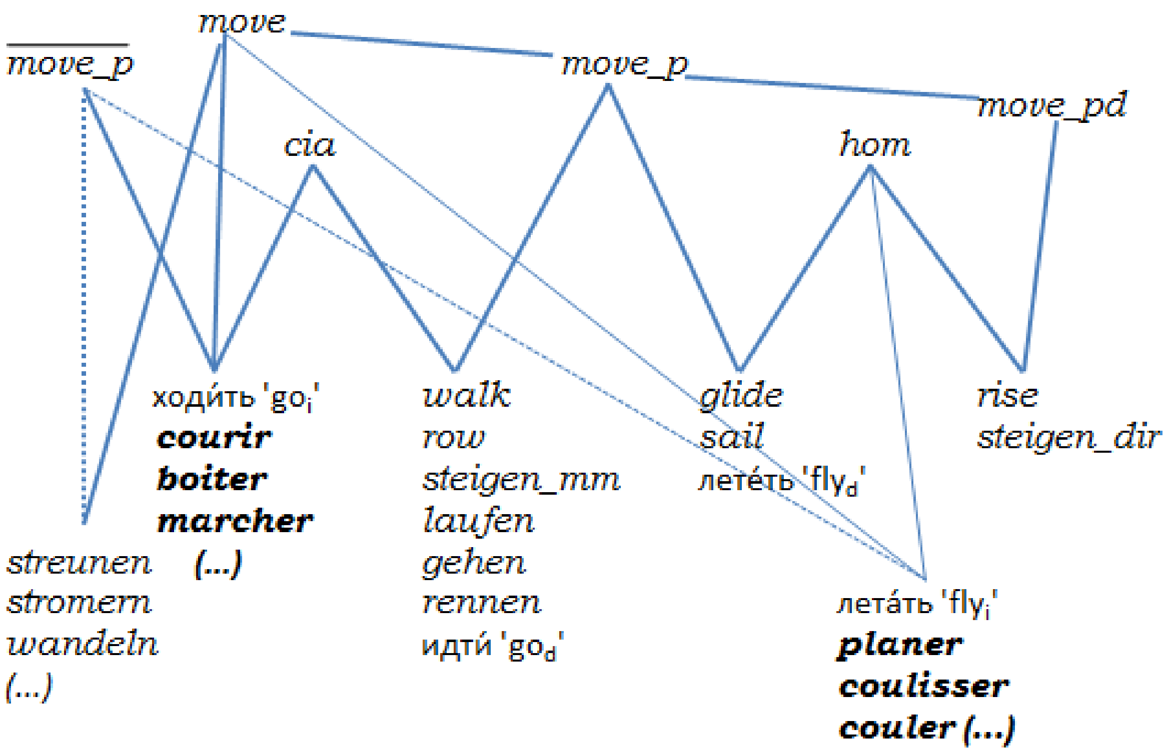

Figure 11: *The FAMEu type system with French manner-of-motion verbs (in boldface)*

(10) (a) *Allez, courons dans la maison!*
[go.2PL, run.1PL in the house]
'Come on, let's run in(to) the house!'

(b) *?/* Allez, entrons dans la maison en courant!*
[go.2PL enter.1PL in the house in running]
'Come on, let's enter the house running!'

Beavers et al. (2009, 19 f.) conclude from this and similar examples that there should not be a complete ban on such constructions in French and other languages which are subject to the same constraints as French. In the present account, we can accommodate this position by conceding that the PA $\langle \alpha : \emptyset , \mu : P , \omega : \emptyset \rangle$ for nonbounding French MoMVs (and MoMVs in other Romance languages) may be expanded under highly specific conditions to the PA for MoMVs whose AC is underspecified, like German *rennen* and its English counterpart *run*, i.e. to the PA $\langle \alpha : \backslash P, \mu : P, \omega : \backslash P \rangle$. The conditions which license this expansion are beyond the scope of the present study. See, however, the comprehensive discussion of relevant factors that support the combination of Romance MoMVs with goal specifications in Levin et al. (2009).

6.3 Korean motion verbs

6.3.1 What the literature says about Korean motion verbs

The literature on Korean motion verbs (see, e.g., Choi and Bowerman, 1991; Pyoun, 2011; Son, 2006; Wienold and Schwarze, 2002; Zubizarreta, 2007; Zubizarreta and Oh, 2007) converges in the position that Korean, a language with serial verb constructions (SVC), has three types of verbs related to motion:[24]

- an extensive and elaborate set of (simplex, i.e. monomorphematic, and compound) path verbs

[24] Note that the inventory of path verbs appears to be exceptionally sophisticated in Korean when compared to other languages that also have an elaborate system of path verbs: For some of the verbs in the first group there are equivalents in languages like French, Italian and Japanese; this holds for *orùda* 'move up' (cf. *salire, monter, agaru*), *naerida-* 'move down' (cf. *scendere, descendre, oriru*), *tùlda* 'move into' (cf. *entrare, entrer, hairu*), *nada* 'move out of' (cf. *uscire, sortir, deru*) and others. For others, there are equivalent or similar verbs in Japanese but neither in French nor Italian; this holds for highly specific path verbs like *kòsùrùda* 'move while turning against an object' (cf. Jap. *sakarau*), *putta* 'move as close as to contact an object' (similar to Jap. *tsuku*) and others. See Wienold and Schwarze (2002, pp. 4 ff) for a survey. As regards the second group, note that the literature apparently does not pay much attention to a considerable number of Sino-Korean MoMVs (thanks to Maike Huth, p.c., for pointing this out to me)

(PVs) which express the directionality of motion, such as *orùda* 'move up', *naerida-* 'move down', *tùlda* 'move into', *nada* 'move out of', *chinada* 'move through', *kònnòda* 'move across', *tagagada* 'move close to an object', *ttònada* 'move away from an object', *kòsùrùda* 'move while turning against an object', *putta* 'move as close as to contact an object', *tolda* 'move around an object', *turùda* 'move in a circle around an object';

- a number of manner-of-motion verbs (MoMV), e.g. *tallida* 'run', *kelda* 'walk', *kida* 'crawl', etc.;

- two light verbs which (predominantly) serve as heads of SVCs that denote directed motion, namely *kada* 'go' and *oda* 'come'. These are often called "deictic motion verbs" (cf. Pyoun, 2011). As they express a directed motion in relation to a contextual vantage point, they will henceforth be called Perspectivizing Directed Motion Verbs (PDMVs).

The following considerations will focus on the PDMVs *kada* 'go' and *oda* 'come', MoMVs like *tallida* 'run' and *kelda* 'walk', and two types of PVs, namely *orùda* 'move up' and *naerida* 'move down', on the one hand, and *tùlda* 'move into' and *nada* 'move out of', on the other hand. The former type of PVs, which I will call "Type 1 PVs", expresses a vertical motion (up, down) without any reference to a ground object, whereas the latter, which I will call "Type 2 PVs", expresses a motion relative to some (explicit or implicit) ground object.

Zubizarreta and Oh (2007, 82 ff.) report that the PVs *tùlda* 'move into' and *nada* 'move out of' (i.e. Type 2 PVs in my terminology), in their intransitive/unaccusative use, in general cannot stand on their own. They rather appear consistently in combination with the PDMVs *kada/ oda* in an SVC (the locative phrase is optional):[25]

(11) (a) *John-i (pang-ey) tul-e ka-ss-ta*
[John-Nom room-Loc move into-L go-Past-Decl]
'John went in(to the room)'

(b) *John-i (pang-eyse) na-e ka-ss-ta*
[John-Nom room-Loc move out-of-L go-Past-Decl]
'John went out (of the room)'

By contrast, the PVs *orùda* 'move up' and *naerida* 'move down' (i.e. Type 1 PVs in my terminology) can in fact stand on their own, without the need for a head verb *kada/ oda* in an SVC. This is witnessed by the following examples taken from Zubizarreta and Oh (2007, p. 83) and Pyoun (2011, p. 41), resp.

(12) (a) *Pihayngki-ka hwalcwulo-ey naeri-ess-ta*
[Airplane-Nom runway-Loc move.down-Past-Decl]
'The airplane landed at the runway'

(b) *say-ka nal-a oru-ta*
[bird-Nom fly-L move.up-Decl]
'The bird flies up'

Note that this difference between the two types of PVs is also borne out by quantitive data from the Sejong Corpus (21st Century Sejong Project of the National Institute of the Korean Language) which Pyoun (2011) ascertained: The frequency of *tùlda* and *nada* as heads of SVCs is close to zero (less than 0.2 % of all SVC heads) in written texts, whereas *orùda* and *naerida* account for 4 % and 3 % of the heads in SVCs, resp. By far the most frequent head verbs in SVCs are, not at all surprisingly, the PDMVs *kada* 'go' and *oda* 'come' (23% of the head verb tokens in the corpus).[26]

We may already hypothesize at this point that the fact that *orùda* and *naerida* are not limited to the position of an argument of a PDMV head in an SVC, but that they rather can themselves appear as verbal heads, presumably shows that these verbs are indeed pure path verbs. This is in contrast to *tùlda* and *nada*, whose dependency on a PDMV as head of an SVC may be attributed to the fact that these verbs might better not be treated as intrinsic path verbs but rather as verbs which assume a directional interpretation only as an argument of a PDMV head in an SVC.[27]

[25] In the sample sentences I'm using the transliteration of Zubizarreta and Oh (2007). 'Nom' designates the nominative case marker, 'Loc' a locative postposition, 'L' a connecting suffix, 'Past' a past tense marker and 'Decl' a declarative sentence-ending marker (cf. Zubizarreta and Oh, 2007). Note that Pyoun (2011, p. 178) mentions that at least *tùlda* 'move into' can be used without *kada/ oda* under quite specific conditions, namely if the moving figure is a human being, as opposed to animals or vehicles. Furthermore, Lee (1992, p. 157) lists two examples in which type 2 PVs appear without *kada/ oda*, namely *Ku-nun- kang-ul heyemchi-e kenn-ess-ta* [he-Top river-Acc swim-L cross-Past-Decl 'He swam across the river'] and *Ku-nun tam-ul ttwuy-e nem-ess-ta* [he-Top wall-Acc jump-L go_over-Past-Decl 'He jumped over the wall'].

[26] The remaining SVCs are mostly covered by a large number of general (non-motion-related) action head verbs.

[27] This hypothesis goes again back to a suggestion by Maike Huth (p.c.).

Moving on to MoMVs like *tallida* 'run' and *kelda* 'walk', Zubizarreta and Oh (2007) provide evidence that these have to assume the role of the modifier of a PDMV, i.e. *kada* 'go' or *oda* 'come', in an SVC in order to express manner-of-directed-motion:

(13) a) *John-i kongwen-ey talli-e-ka-ss-ta*
[John-Nom park-Loc run-L-go-Past-Decl]
'John ran to the park'

b) *John-i kongwen-ey kel-e-ka-ss-ta*
[John-Nom park-Loc walk-L-go-Past-Decl]
'John walked to the park'

MoMVs alone cannot, however, combine with locative phrases headed by the postposition –*ey*, which, when combined with the PDMVs *kada* and *oda*, assumes a goal reading. This directional reading is not available in combination with stand-alone MoMVs:

(14) (a) **John-i kongwen-ey talli-ess-ta*
John-Nom park-Loc run-Past-Decl
'John ran to the park'

(b) **John-i kongwen-ey kel-ess-ta*
John-Nom park-Loc walk-Past-Decl
'John walked to the park'

From the observations on their stand-alone behaviour in the context of the locative postposition *-ey*, Zubizarreta (2007) and Zubizarreta and Oh (2007) conclude that Korean MoMVs are purely activity-denoting verbs which themselves do not encode any directed motion. Consistent with this view, Son (2006) claims that Korean MoMVs are unambiguously nonbounding (unbounded in her terms), as the criterial contexts of durational and time-span adverbials reveal:[28]

(15) (a) *John-i kongwen-ulo sip-pwun-tongan / *sip-pwun-man-ey talli/kel-ess-ta.*
[John-NOM park-Dir ten- minutes-for/ ten-minutes-interval-at run/ walk-Past-Decl]
'John ran / walked towards the park for ten minutes / *(with)in ten minutes'

(b) *John-i kongwen-kkaci sip-pwun-tongan / *sip-pwun-man-ey talli/kel-ess-ta.*
[John-Nom park-up.to ten-minutes-for / ten-minutes-interval-at run/walk-Past-Decl]
'On his way up to the park, John ran / walked for ten minutes / *(with)in ten minutes'

It comes as no surprise now that Korean MoMVs, being nonbounding, are compatible with path-denoting adjuncts that involve postpositions – or relational nouns, according to the classification in Wienold and Schwarze (2002) – such as *-(u)lo* 'toward' and *-kkaci* 'up to', as Zubizarreta and Oh (2007, p. 85) report:

(16) (a) *John-i hakkyo-lo kel-ess-ta.*
[John-Nom school toward walk-Past-Decl]
'John walked toward the school'

(b) *John-i kongwen-kkaci talli-ess-ta.*
[John-Nom park-up to run-Past-Decl]
'John ran up to the park'

The adjunct *-(u)lo* 'toward' specifies just a general direction, similar to French *vers*, Italian *verso* and the (somewhat outmoded) German *gen* and does not imply any change of state. And I consider *-kkaci* 'up to' to be a general delimiter in the sense of 6.2.2, with its characteristic semantics and pragmatics similar to French *jusqu'à*.

As regards the Korean PDMVs *kada* 'go' and *oda* 'come', Zubizarreta and Oh (2007) and Son (2006) present examples where these verbs appear in both bounding and nonbounding contexts. This holds for stand-alone occurences as well as for occurrences as heads of SVCs with a MoMV, as the examples in (17) show:

(17) (a) John-i sip-pwun-tongan kongwen-ccok-ulo ka-ss-ta.
[John-Nom ten-minutes-for park-direction-toward go-Past-Decl]
'John went towards the park for ten minutes'

(b) *John-i kongwen-ey sip-pwun-man-ey / *sip-pwun-tongan ka-ss-ta.*
[John-Nom park-Loc ten-min-interval-at / ten-min-for go-Past-Decl]
'John went to the park (with)in ten minutes /*for ten minutes'

(c) *John-i kongwen-ulo il-pwun-tongan talli-e ka-(a)ss-ta.*

[28] Note that these are approximate glosses which serve to capture the status of the temporal adverbials as durational and time-span adverbials. Note furthermore that neither Zubizarreta and Oh (2007) nor Son (2006) explicitly state that MoMVs indeed resist time-span adverbials. However, their overall rationale clearly points into this direction and the *-judgements have been confirmed by my informant on Korean, Maike Huth (p.c.), albeit with the following qualification: *talli-/kel-* could be combined with a time-span adverbial if there was no *-ulo/-kkaci*-PP. In this case, the MoMV would be coerced into an ingressive reading (which is quite typical for nonbounding verbs in bounding contexts; see, e.g., Herweg, 1991a, 2014)

[John-Nom park-Dir one-minute-for run-L go-Past-Decl]
'John ran towards the park for one minute'

(d) *John-i kongwen-ey il-pwun-man-ey talli-e ka-(a)ss-ta.*
[John-Nom park-Loc ten-min-interval-at run-L go-Past-Decl]
'John ran to the park in one minute'

I conclude from these observations that the AC of Korean PDMVs is underspecified. The specific AC is determined by the respective boundary-marking (-*ey*) or non-boundary-marking (-*ulo*) adposition. Korean PDMVs only express a perspective on a motion event and do not contribute any constraints with regard to the internal temporal structure of that event. This property distinctly contrasts with English *to come* and German *kommen*, which are bounding, as the combinations with durational adverbials in (18) show:

(18) (a) **/??He came through the forest for two hours.*

(b) **/??Er kam zwei Stunden lang durch den Wald.*

Neither of these sentences can designate an individual event. At best, they could be arduously coerced into an iterative or habitual reading (this motivates the flag '??').

6.3.2 Knitting the facts together: hypotheses about Korean motion expressions

The observations reported above yield the following picture of Korean motion expressions:

(19) Summary: Semantic properties of Korean motion expressions

(a) Korean MoMVs like *tallida* 'run' and *kelda* 'walk' do not express a path-generating motion, i.e. they are assigned the FAMEu type *move & $\overline{move\_p}$*. This in turn means that they also deny any directionality. As regards their AC representation, they are assigned the PA for nonbounding expressions, namely $\langle\alpha : \emptyset\ ,\ \mu : P\ ,\ \omega : \emptyset\rangle$.[29]

(b) In Korean, the path-generating expressions are

i. the PDMVs *kada* 'go' and *oda* 'come';

ii. path adjuncts headed by postpostions such as -*kkaci* 'up to' and –*(u)lo* 'toward'.

(c) Korean PDMVs are underspecified with regard to their AC; accordingly, their PA has the structure $\langle\alpha : \backslash P,\ \mu : P,\ \omega : \backslash P\rangle$.

(d) It follows from (19.a) and (19.b.ii) that non-path-generating MoMVs can stand-alone, i.e. without support by a PDMV in an SVC, when combined with a path-generating path adjunct that selects for nonbounding verbs. This AC requirement is met by -*kkaci* 'up to' and -*(u)lo* 'toward', which moreover provide the path element required for a motion expression.

(e) The so-called Path Verbs in Korean provide a mixed picture:

i. The type 2 PVs *tùlda* 'move into' and *nada* 'move out of' (and presumably other verbs of type 2 as well), which can only appear as verbal arguments of a PDMV head in an SVC (leaving aside rare occurrences without a PDMV, as mentioned above in footnote 25), are not path-generating. They are no independent path verbs but have a more general locative function which is turned into a directional interpretation in the context of a (path-generating) PDMV.

ii. In contrast, the pure path verbs *orùda* 'move up' and *naerida* 'move down' (type 1 PVs in my nomenclature), which can appear stand-alone, indeed designate a path-generating motion when they appear as verbal heads in their own right without a PDMV.[30]

iii. However, when *orùda* and *naerida* appear as arguments of *kada/oda* in an

[29] Note that the nonbounding AC is confirmed only if the MoMV is not a constituent of an SVC. In order to account for bounding readings like in (13) – which Son (2006) does not consider –, we may hypothesize that a MoMV which appears as the dependent, non-head constituent in an SVC with *kada* or *oda*, does not have any AC contribution of its own (which may turn out to be tantamount to an underspecified AC in these contexts). The determination of the AC of MoMVs that accounts for all potential contexts is subject to further investigation.

[30] Ines Marberg (p.c.) offered an interesting conjecture re *orùda* and *naerida*: These verbs may well have assumed this autonomous role because it is often quite difficult, if not impossible, to relate a vertical motion to a contextual perspective as expressed by the PDMVs *kada* and *oda*.

SVC, they do not by themselves generate a path but rather nest in the path structure provided by their PDMV head, where they provide information about the path in terms of its vertical orientation.

The so called path verbs in a language with SVCs, like Korean, thus palpably differ from path verbs in other languages, like English and Romance languages.

6.3.3 Korean motion verbs in the FAMEu type system

The Korean motion verbs fit into the FAMEu type system as shown in figure 12.

Manner-of-motion verbs like *tallida* 'run' and *kelda* 'walk' occupy the same position as the Russian indeterminate motion verb ходить 'go$_{\text{i}}$' and some of the French manner-of-motion verbs, namely verbs which designate a pure non-path-generating motion that is composed of a homogeneous iteration of atomic parts. The type 1 path verbs *orùda* 'move up' and *naerida-* 'move down' are assigned the same type as English *rise* and German directed *steigen* in order to reflect that they designate a homogeneous directed-path-generating motion when they appear as verbal heads in their own right.

The perspectivizing deictic motion verbs *kada* 'go' and *oda* 'come', whose primary role is to serve as heads of serial verb constructions, are only typed as verbs that designate a directed-path-generating motion, without any additional commitment to a particular internal structure of the motion. This accounts for the fact that these verbs are underspecified with regard to both aspectual class and the microstructure of the motion: It is up to other verbs in the sentence to determine if the described motion is homogeneous or an iteration of atomic parts.

And finally, the type 2 "path" verbs *tùlda* 'move into' and *nada* 'move out of' are typed as nothing but change-of-state verbs, without any specific motion component of their own. This is represented by the negation $\overline{cum}$ of the type *cum* for general cumulative event types, which was introduced in 5.2, This analysis puts these verbs in a position similar to that of egressive and ingressive PPs like *out of x* and *into x* and should best capture their characteristics as described above. The English bounding path verbs *come* and *leave* are added to the type system in figure 12 as verbs of the complex type *move_pd & $\overline{cum}$* in order to underline the contrast to PDMVs as well as Type 2 PVs in Korean.

7 Concluding remarks

The preceding sections presented an account of dynamic concepts in a specific format of frame-semantics developed for the domain of motion expressions, namely FAMEu (short for "A Frame-semantic Account of Motion Expressions with Underspecification"). A basic *locomotion* frame was introduced which facilitates the comprehensive representation of various elements of motion events and aims at taking into consideration the typological diversity of motion expressions. A key ingredient of the *locomotion* frame is an attribute that represents a phase array, which is a concept that was independently developed by the author in a phase-theoretical account of aspectual class composition. In the proposal at hand, the values of the corresponding attribute, which represent the internal temporal set-up of the situation designated by a motion expression pursuant to the aspectual class of the verb and its projections, are interpreted in terms of a dynamic temporal logic. Thereby, the *locomotion* frame receives a dynamic foundation which reflects different kinds of changes expressed by motion verbs and their directional complements. Building on that, a basic type system for motion verbs has been defined, augmented with a second tier of types that serves as a first step towards a more fine-grained representation of different manners of motion. In the final chapter, the proposed type system for motion expressions has been applied to selected phenomena from typologically diverse languages.

A recurring element of the analyses of particular instances of motion verbs in German, Russian, French and Korean is the distinction between verbs that designate a motion which incrementally generates a path, on the one hand, and verbs that designate a non-path-generating motion, on the other hand. In the proposed FAMEu type system, this difference is reflected in the distinction between verbs of type *move_p* and verbs of type *move*, resp. Looking at representatives of the type *move* in typologically diverse languages we observe that these verbs are consistently atelic, i.e. nonbounding. Verbs which allow a telic interpretation – either as their determinate aspectual class (AC) or, in the case of underspecified verbs, as their contextual AC instantiation – appear to be at least of the type *move_p*. This suggests that there is a strong correlation between the path-generating capacity of motion verbs and their AC properties: We hypothesize that verbs have a telic potential only if they autonomously introduce a path into the semantic representation, i.e. only if they are

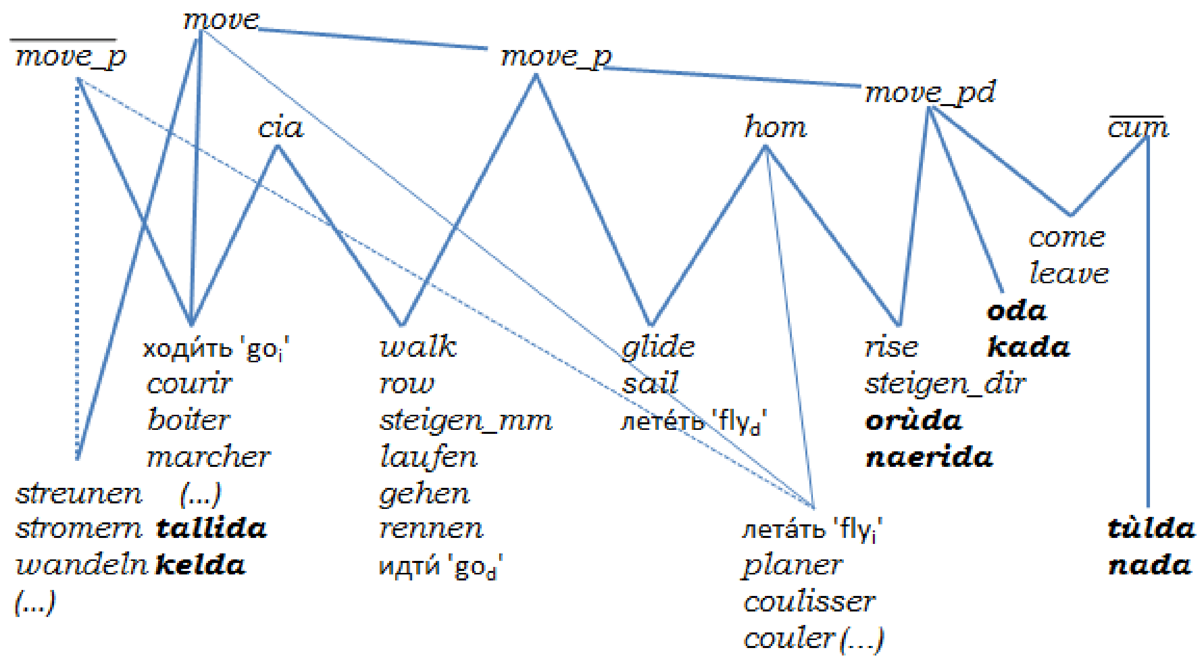

Figure 12: *The FAMEu type system with Korean motion verbs (in boldface)*

of the types *move_p* or *move_pd*. Verbs without the capacity to generate a path by themselves, i.e. verbs of type *move*, are peremptorily atelic/nonbounding.

Non-path-generating verbs apparently put more emphasis on the pure activity facet than on the spatial component of their meaning. They designate an activity that is certainly linked with a translocation, albeit one that appears to be conceptually circumstantial, compared to path-generating verbs. However, verbs of the latter sort may also be subject to this kind of preponderance of the pure activity factor. This happens primarily when the focus is put on a specific trait of the movement in contrast to other competing, possibly more common or prevailing characteristics. (20.a) contrasts a standard gait with an impaired one; (20.b) mentions a striking manner of executing a gait and (20.c) a noteworthy location where the motion happens:

(20) (a) *Er geht nicht, er hinkt.*
'He does not walk, he limps'

(b) *Er geht schwerfällig/barfuß.*
'He walks clumsily/barefootedly'

(c) *Er geht auf dem Radweg.*
'He walks on the bikeway'

In these usages the path-generating component in the meaning of the motion verb is suppressed and specifics of the activity are accentuated. This can be considered as an attenuation of the verb's type from *move_p* to *move*, which is licensed under specific conditions whose details are beyond the scope of the present study.

While the present study primarily dealt with a specific element of the EVENT_PROPERTIES section of the *locomotion* frame, namely the conceptual foundation of the PHASE_ARRAY attribute, Herweg (2020) elaborates on the representation of motion expressions in the EVENT_LAYERS section of the frame. It is a well-known fact that languages exhibit notable differences in their inventory for motion descriptions, some of which we already encountered in 6 above. In the FAMEu approach, these differences can primarily be modelled in terms of characteristic configurations a language imposes on the *locomotion* frame by means of selecting, augmenting and diversifying, as well as deselecting particular frame elements specifically in the sections that represent the multifaceted path structure and different kinds of manners. The account in Herweg (2020) makes use of an extended notion of profiling as developed in Cognitive Grammar (cf., e.g., Langacker, 2013). Subsequent work will dive more deeply into the varieties of manners of motion beyond the differentiations introduced in 5.2. It will also introduce a mechanism for the assignment of weights to particular frame elements and their propagation within the broader construct. The introduction of weights serves to bring FAMEu closer to being able to represent insights from different branches of linguistics in an integrated format, in particular insights from formal and cognitive semantics, psycholinguistics, corpus linguistics and typology. Weights in frames will be beneficial whenever we deal with gradation phenomena in semantic valuation, such as interpretation preferences, graded semantic judgements and distributional biases observed in corpora.

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