Verbs of horizontal and vertical motion: A corpus study in Estonian

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Abstract

This paper presents findings from a corpus study of motion descriptions in Estonian by focusing on the distinction between verbs of horizontal and vertical motion. It is based on the assumption that as language has embodied underpinnings, the experiential traces of motion conducted either along the vertical axis or the horizontal axis should also be observable in language structure. The study aims to clarify whether the verbs of horizontal motion (e.g., *kõndima* 'walk') are different to the verbs of vertical motion (e.g., *kukkuma* 'fall') in terms of their (i) semantic clausal patterns and (ii) morphological marking. The analysis of clausal patterns by means of statistical modelling yielded that the verbs of horizontal motion occur frequently in combination with Location and Trajectory expressions (i.e., in atelic clauses), and the verbs of vertical motion in combination with Source, Goal, and Result expressions (i.e., in telic clauses). Regarding grammatical behaviour, the verbs of horizontal motion were biased towards the first person and the verbs of vertical motion were biased towards the third person. No effect was found in the use of tense and aspect markers. The clustering analysis additionally showed that semantic clausal patterns distinguish perfectly between the two types of verbs (horizontal vs. vertical), whereas morphological markers of the verbs provided a more heterogenous result. The findings illustrate the richness of motion descriptions that go beyond Talmyan motion events, while also providing evidence for the embodied nature of language.

Keywords: horizontal and vertical motion, motion verbs, semantic roles, verb morphology, corpus analysis, statistical methods, Estonian

1 Introduction

The experience of horizontal motion is substantially different from the experience of vertical motion (see also Rose & Büchel 2005; Johnson 2007: 136–138; Ke et al. 2013; Leigh & Zee 2015; Scott et al. 2016). That is, the default mode of moving tends to occur along the horizontal rather than the

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vertical axis. As for our visual field, the starting and final point of vertical motion is often visually observable, which is not necessarily the case with horizontal motion (see also Tragel & Veismann 2008). Furthermore, due to gravity, vertical motion entails force dynamics in that moving upwards typically requires energy and resistance, whereas moving downwards is fast and effortless. Horizontal motion has a more modest association with the characteristics of force dynamics, as there is less resistance from gravity (with regard to force, see also Talmy 1988; 2000a; Glenberg & Kaschak 2002; Huumo 2007).

Therefore, and if language is grounded in experience and perception (Johnson 1987; Glenberg & Kaschak 2002; Tyler & Evans 2003; Zwaan 2003; Bergen & Chang 2005; Gibbs 2006; Barsalou 2008; Johansson Falck & Gibbs 2013), the descriptions of horizontal motion and vertical motion should be significantly different. This facet of motion – horizontal vs. vertical motion – has gained little research interest despite the fact that the domain of motion is extensively studied in cognitive linguistics (for an overview, see Filipović & Ibarretxe-Antuñano 2019).

That is, much of the research on motion descriptions is based on Leonard Talmy's (1985; 2000b) seminal work on motion events and lexicalisation patterns. Since then, a plethora of studies have been devoted to establishing how motion is expressed in individual languages and across languages (e.g. Aske 1989; Choi & Bowerman 1991; Slobin 1996; 2004; Gennari et al. 2002; Ibarretxe-Antuñano 2004; Bohnemeyer et al. 2007; Pasanen & Pakkala-Weckström 2008; Croft et al. 2010; Goschler & Stefanowitsch 2013a; Slobin et al. 2014; Matsumoto & Kawachi 2020; Tuuri & Belliard 2021).[1] In Talmy's (1985; 2000b) model, the focus is on the expression of Path and Manner, and languages are divided into two broad categories based on the general preferences of a language. Languages that tend to encode Path in the verb are *verb-framed languages* (e.g., Spanish), and those that tend to encode Path outside the verb as a "satellite" are *satellite-framed languages* (e.g., English). Typically, and as also pointed out by Talmy (2000b: 52–53), languages can combine these strategies. This can be exemplified by the English language. The verb-framed strategy is used in the phrase *they entered the room*, and the satellite-framed strategy in the phrase *they ran into the room*. Thus, and because languages tend to use both strategies, and some languages

[1] An interested reader will find a thorough overview of Finnish motion verbs in Pajunen (2001: 185–272) and Sivonen (2005).

do not seem to fit into this model at all (Slobin 2004; Huang & Tanangkingsing 2005), researchers generally agree that these typological observations should be taken to refer to tendencies rather than to a strict dichotomy (Talmy 2000b: 52–53; Kopecka 2006; Filipović 2007; Ibarretxe-Antuñano 2009; Goschler & Stefanowitsch 2013a).

A somewhat separate line of research in motion descriptions has focused on the expression of spatial information in terms of the starting and endpoints of motion. This line of research has mainly focused on the *goal-over-source* principle, originally proposed by Ikegami (1987), and developed by Dirven & Verspoor (1998). According to this principle, Goal tends to be expressed far more frequently in languages than Source or Trajectory due to its prominence for a human mind. Again, a number of studies have been conducted in order to test this principle (Stefanowitsch & Rohde 2004; Lakusta & Landau 2005; Nikitina 2009; Papafragou 2010; Lakusta & Carey 2015; Georgakopoulos et al. 2019; Johanson et al. 2019). The result of these Talmyan and goal-bias studies is a rich knowledge on how Path and Manner, and Source and Goal are expressed in the world's languages when depicting motion. However, a motion event comprises much more than just Path and Manner (see also Naidu et al. 2018; Matsumoto & Kawachi 2020), and the goal-bias is not absolute in that some motion verbs are frequently not accompanied by Goal expressions, but rather with other spatial expressions (see also Aske 1989; Stefanowitsch & Rohde 2004; Kopecka 2010; Taremaa 2017; Kopecka & Vuillermet 2021).

Curiously, the expression of motion in terms of horizontality and verticality has received only limited research attention (Naigles & Terrazas 1998; Taremaa 2017; Łozińska & Pietrewicz 2018). For instance, Naigles & Terrazas (1998) demonstrated that in Spanish (a verb-framed language) and English (a satellite-framed language), the use of manner vs. path verbs is closely related to whether the stimuli depict horizontal or vertical motion. Focusing particularly on boundary-crossing events (e.g., entering the room) and events with Sources and/or Goals, they showed that vertical motion triggered a more extensive use of manner verbs in both languages, whereas horizontal motion yielded more path verbs in Spanish and manner verbs in English. Łozinska and Pietrewicz (2018) further showed that in Polish, Russian, and English (all satellite-framed languages), the expression of horizontal motion strongly prefers path verbs, whereas vertical motion is equally likely to be expressed either by manner or path verbs. Thus, the use and choice of motion verbs seem to be closely related to the direction of motion in terms of horizontal and vertical motion. In addition, Taremaa's

(2017) study on Estonian (a satellite-framed language) motion verbs provides preliminary information on whether a verb that expresses horizontal or vertical motion may be in association with the expression of spatial information. For example, verbs of vertical motion tend to co-occur with Source and Goal expressions more frequently than do verbs of horizontal motion. Regarding Estonian in particular, it is also known that aspectual meanings often have a horizontal/vertical motion basis: verbal particles that express vertical motion (e.g., *üles* 'up', *maha* 'down') tend to convey the perfective aspect, whereas verbal particles expressing horizontal motion are more likely to convey the progressive aspect (Tragel & Veismann 2008).

Apart from these few studies, the expression of horizontal and vertical motion is infrequently discussed in the literature of motion events. Consequently, little is known about the linguistic differences between the descriptions of horizontal and vertical motion. The current study aims to examine whether there are linguistic differences in the use of verbs of horizontal vs. vertical motion by focusing on their clausal patterns (e.g., the expression of Source and Goal) and morphology (e.g., person and tense) in the Estonian language. Estonian is a satellite-framed language that shows much intra-language variation with respect to lexicalisation patterns as it commonly applies also verb-framed strategies (Pool & Pajusalu 2012; Pajusalu et al. 2013; Nelis & Miljan 2016; Taremaa 2017). In addition, Estonian features rich morphology which, in turn, enables spatial information to be expressed by various grammatical means such as verbs, case endings, pre- and postpositions, verb particles, and adverbs.

As for terminology used in this study, *motion descriptions* and *motion clauses* both refer to clauses that express actual motion. *Clausal patterns* refer to the structure of motion clauses in terms of the expression of semantic information (e.g., Source and Goal). In other words, clausal patterns stand for typical combinations of semantic units that tend to occur together with a particular verb in a clause. The *morphological behaviour of the verbs* refers to verb morphology (e.g., tense and person). The verbs included can all express *translocational motion*, which is defined here as a change in the position of the mover in space (Langacker 1987: 167; Talmy 2000b: 35–36). Furthermore, the study has a verb-centred approach in that a distinction is made between verbs that express *horizontal motion* (e.g., *kõndima* 'walk') and verbs that express *vertical motion* (e.g., *kukkuma* 'fall'). Thus, in this study, the terms *horizontal* and *vertical* are used only in relation to the meaning of the motion verbs. The corpus data is also gathered via the verbs. Whether or not the clauses themselves express horizontal or vertical motion is not analysed. For example, verbs of horizontal motion can frequently occur in clauses that in fact express vertical motion (e. g., one can walk up and down the stairs). It should also be noted that exact horizontal and vertical motion may not be very typical when one moves over natural landscapes. This is because the landscape may be hilly, and as a result, the mover has to move along higher or lower ascents and descents. Thus, horizontal motion embedded in the meaning of the verbs is taken as motion that is more or less horizontal, and vertical motion is motion that is more or less vertical.

The structure of the paper is as follows. § 2 restates the aim of the study and outlines the research questions. § 3 explains the data extraction principles and analysis methods. § 4 presents the results of the corpus study on Estonian motion descriptions. § 5 discusses the main findings of the study.

2 Aim and research questions

The aim of the study is to clarify the extent to which the use of verbs of horizontal motion can be different to verbs of vertical motion in a satellite-framed language, Estonian. Even though the semantics of the verbs that express horizontal motion (e. g., *kõndima* 'walk') is clearly different to those that express vertical motion (e. g., *kukkuma* 'fall'), it is an open question how these differences in semantics manifest themselves in how the verbs are used in sentential context. Because the two types of motion – horizontal and vertical – are considerably different, I predict that clausal patterns and grammatical characteristics of verbs of horizontal motion (e. g., *kõndima* 'walk') differ from those of verbs of vertical motion (e. g., *kukkuma* 'fall') in that verbs of vertical motion would combine with expressions that indicate the final state or location of the mover more frequently than verbs of horizontal motion.

More specifically, the study has two research questions:

1. Which semantic components (e. g., Source and Goal) are typically co-expressed with verbs of horizontal motion and which with verbs of vertical motion in Estonian?
2. Do verbs of horizontal motion have different morphological behaviour as compared to verbs of vertical motion?

To address these two research questions, a corpus study is conducted in which half of the data was gathered via the verbs of horizontal motion, and half of the data via the verbs of vertical motion. The principles of data extraction, and the procedure of data coding and quantitative analysis are covered in the following section.

3 Data and method

Five verbs of horizontal motion (e.g., *kõndima* 'walk') and five verbs of vertical motion (e.g., *kukkuma* 'fall'; see Table 1) were included in the study. The verbs were chosen on the basis of a sorting experiment (Taremaa 2021b). In this mouse-tracking experiment, participants were asked to evaluate the meaning of motion verbs that were presented on a computer screen without any context. Taking one verb at a time, the participants then had to classify the verbs as verbs of horizontal motion, verbs of vertical upwards motion, verbs of vertical downward motion, or verbs with ambiguous meaning.

In order to focus on the verbs that are more or less "specialised" in expressing either horizontal or vertical motion, only the verbs in which the agreement rate in the experiment was equal or near to 100% were included. This ensured that only the verbs upon whose meaning the participants almost unanimously agreed were included in this study. In addition, only the verbs that yielded a sufficient amount of clauses (i.e., those having at least 200 clauses) in the corpora were included in the corpus study.[2] To ensure comparable data across the verbs of horizontal and vertical motion, the verbs of vertical motion only consist of the verbs of downward motion (i.e., the two verbs of upward motion, *kerkima* 'rise' and *tõusma* 'rise, ascend', were excluded from the analysis).

Four verbs of horizontal motion express movement along a surface (e.g., *jalutama* 'walk, stroll') and one verb expresses motion through water (i.e., *ujuma* 'swim'). Three verbs of vertical motion express movement through the air (e.g., *kukkuma* 'fall'), one depicts movement along a surface (i.e., *laskuma* 'descend'), and one describes motion through a liquid (i.e., *vajuma*

[2] Four verbs – two verbs of vertical motion, *prantsatama* 'fall with a crash' (agreement rate 97%, freq. = 84) and *sukelduma* 'dive' (agreement rate 100%, freq. = 197), and two verbs of horizontal motion, *sammuma* 'walk, step' (agreement rate 97%, freq. = 340) and *sõudma* 'row' (agreement rate 97%, freq. = 91) – were disregarded due to their lack of data in the corpora. In addition, the verb *käima* 'walk, go' (agreement rate 95%, freq. = 13,680) was disregarded due to its high polysemy and distinct grammatical behaviour as a core verb (Pajusalu et al. 2013).

Table 1. Motion verbs included in the corpus study on the basis of the sorting task (Taremaa 2021b); HorVerb = verbs of horizontal motion, VertVerb = verbs of vertical motion

Verb	Type of verb	Agreement rate	Frequency in the frequency list[a]
jalutama 'walk, stroll'	HorVerb	97%	927
kõndima 'walk'	HorVerb	97%	1,298
marssima 'march'	HorVerb	97%	282
ratsutama 'ride, gallop'	HorVerb	95%	133
ujuma 'swim'	HorVerb	100%	630
kukkuma 'fall'	VertVerb	100%	2,438
langema 'fall, come down'	VertVerb	100%	3,462
laskuma 'descend'	VertVerb	100%	604
pudenema 'fall off, crumble'	VertVerb	100%	319
vajuma 'sink'	VertVerb	100%	1,416

[a] The frequencies of the verbs are taken from the frequency list that is based on the Balanced Corpus of Estonian (the frequency list is available at: http://www.cl.ut.ee/ressursid/sagedused1/failid/lemma_kahanevas.txt, accessed 2021-01-29). The size of the Balanced Corpus of Estonian is 15 million words.

'sink'). The verbs in both groups vary greatly as to their general frequencies (frequencies were taken from the frequency list created on the basis of the Balanced Corpus of Estonian). In addition, the verbs of horizontal motion have lower frequencies (min $= 133$, max $= 1,298$, mean $= 654$, median $=$ 630) than the verbs of vertical motion (min $= 319$, max $= 3,482$, mean $=$ $1,648$, median $= 1,416$).

With each of the verbs, 200 clauses of actual motion were randomly taken from the written Estonian corpora. *Actual motion* means that all corpus clauses in the data express a visible change of position of some physical entity. Half of the data with each of the verbs (100 clauses) originate from the Estonian fiction corpus[3] and half of the data (100 clauses) originate from

[3] The data from the Estonian fiction corpus was collected in 2013 from: https://www.cl.ut.ee/korpused/segakorpus/eesti_ilukirjandus_1990/.

the Estonian newspapers' corpora.[4] Altogether, the data consists of 2,000 motion clauses.

The corpus clauses were tagged for a number of variables that characterise the semantic structure of motion clauses and the morphosyntactic patterns of motion verbs. The variables can be divided into four major groups (see Table 2): (i) the dependent variable (i. e., the type of verb (HorVert)); (ii) the general clause-related variables ($N = 2$); (iii) the variables of the semantic units of the clause ($N = 13$); (iv) the variables of the grammatical form of the verb in a clause ($N = 7$). The coded data and the R code can be accessed through DataDOI (Taremaa 2021a).

As such, the data to be analysed is multivariate and categorical. In order to assess the inherently multifactorial clausal patterns of motion clauses, a mixture of statistical techniques is applied. First, and as an exploratory study, agglomerative hierarchical clustering is applied to investigate if clustering based on the independent variables results in verb clusters in which the verbs of vertical motion are distinct from the verbs of horizontal motion. Then, the main factors that contribute to the distinction between the two types of verbs are established and the clausal differences of the two types of verbs are further detailed. For these purposes, multifactorial analyses (conditional random forests and inference trees) and univariate analyses (the chi-square test alongside effect size calculations and Pearson's residuals) are applied. All analyses are conducted in R. Agglomerative clustering is performed by the R base package "stats" (R Core Team 2020), conditional random forests and the inference tree by "party" (Hothorn et al. 2015), calculations of the concordance index C by "Hmisc" (Harrell 2021), and uni- and bivariate analyses by "stats" (R Core Team 2020) and "sjPlot" (Lüdecke 2021). The statistical code used can be found in Taremaa (2021a).

[4] The data from the Estonian newspapers' corpora was collected in 2017 via Keeleveeb (http://www.keeleveeb.ee/). Keeleveeb was chosen because of its user-friendly search engine (currently, both the fiction and newspapers' corpora are accessible via Keeleveeb). To collect newspaper data, 200 random sentences per verb were taken from the seven individual corpora of newspapers (*Eesti Päevaleht*, *Postimees*, *(SL) Õhtuleht*, *Eesti Ekspress*, *Maaleht*, *Valgamaalane*, and *Lääne Elu*). This resulted in 1,400 sentences per verb of which 100 sentences were randomly selected for the analysis.

Table 2. Coding scheme of the corpus study

Variable types	Variables	Levels	Explanations
Dependent variable	HorVert	HorVerb, VertVerb	Type of the verb in terms of horizontal (e.g., *kõndima* 'walk') vs. vertical motion (e.g., *kukkuma* 'fall')
Clause-related variables	Genre	fiction, journal	Genre of the corpus clause
	SpatExprPresent	yes, no	The presence of a spatial expression (other than the verb) in a clause. Spatial expressions include the expressions of Source, FromDirection, Location, Trajectory, Direction, Goal, and Distance. They can occur as adverbials (e.g., *kõndis aias* '(s)he was walking in the garden') or verbal particles (e.g., *kõndis välja* '(s)he walked out').[a]
Semantic variables representing the clausal units	Source	yes, no	The starting point of motion (e.g., *linnast* 'from the town')
	FromDirection	yes, no	The direction from which motion occurs (e.g., *maja poolt* 'from the direction of the house')
	Location	yes, no	The place of motion (e.g., *aias* 'in the garden')
	Trajectory	yes, no	The path followed during motion (e.g., *mööda teed* 'along the road')
	Direction	yes, no	The place towards which motion is carried out (e.g., *maja poole* 'towards the house')
	Goal	yes, no	The ending point of motion (e.g., *majja* 'into the house')
	Distance	yes, no	The length of the trajectory covered during motion (e.g., *kümme meetrit* 'ten metres')
	MannerInstr	yes, no	The way motion is conducted, including the means of motion (e.g., *kiiresti* 'fast', *rattaga* 'by bike')

Table 2 continued

Variable types	Variables	Levels	Explanations
	Result	yes, no	The final state of the mover in terms of its position (e.g., *näoli* 'on one's face') or condition (e.g., *kildudeks* 'into pieces')
	Cause	yes, no	The reason why motion is conducted (e.g., *löögist* 'because of the stroke')
	Purpose	yes, no	The aim of the mover (e.g., (*läks*) *sööma* '(s)he (went) to eat')
	CoMover	yes, no	The accompanying mover (e.g., *sõbraga* 'with a friend')
	Time	yes, no	The time of motion (e.g., *eile* 'yesterday')
Grammatical variables of the verb in a clause	Tense	present, past	Verb tense, being either present (e.g., *uju-b* swim-PRS.3SG 'swims, is swimming') or past (e.g., *uju-s* swim-PST.3SG 'swam', *on uju-nud* be.PRS.3SG swim-PTCP 'has swum').[b]
	Aspect	unspecified, perfective, progressive	Verb aspect, being either unspecified (e.g., *uju-b* swim-PRS.3SG 'swims'; *uju-s* swim-PST.3SG 'swam'), perfective (e.g., *on uju-nud* be.PRS.3SG swim-PTCP 'has swum'; *on uju-nud* be.PRS.3SG swim-PTCP 'had swum'), or progressive (e.g., *on uju-ma-s* be.PRS.3SG swim-INF-INE 'is swimming'; *oli uju-ma-s* be.PST.3SG swim-INF-INE 'was swimming')
	Polarity	affirmation, negation	Verb polarity, being either affirmation (e.g., *uju-b* swim-PRS.3SG 'swims, is swimming') or negation (e.g., *ei uju* 'don't swim')
	Mood	indicative, conditional, imperative, jussive, quotative	Verb mood, being either indicative (e.g., *uju-b* swim-PRS.3SG 'swims'), conditional (e.g., *uju-ks* swim-COND.PRS.3SG 'would swim'), imperative (e.g., *uju* swim.IMP.PRS.2SG 'swim!'), jussive

Table 2 continued

Variable types	Variables	Levels	Explanations
			(e.g., *uju-gu* swim-JUSS 'should swim'), or quotative (e.g., *uju-vat* swim-QUOT 'had been said to swim')
	Voice	personal, impersonal	Verb voice, being either personal (e.g., *uju-s* swim-PST.3SG '(s)he swam') or impersonal (e.g., *uju-ti* swim-IMPERS.PST 'had been swum')
	Person	1st, 2nd, 3rd	Verb suffixes of first (e.g., *uju-n* swim-PRS.1SG 'I swim'), second (e.g., *uju-d*; swim-PRS.2SG 'you swim'), and third person (e.g., *uju-b* swim-PRS.3SG '(s)he swims'). "Unclear" is assigned to cases of impersonal voice (e.g., *uju-takse* swim-IMPERS.PRS 'it is swum')
	Number	SG, PL, unclear	Verb suffixes of singular (e.g., *uju-b* swim-PRS.3SG '(s)he swims') and plural (e.g., *uju-vad* swim-PRS.3PL 'they swim'). "Unclear" is assigned to cases of impersonal voice (e.g., *uju-takse* swim-IMPERS.PRS 'it is swum')

[a] Admittedly, spatial reading may emerge also from other variables, but these are not analysed as spatial variables here. For instance, expressions of Purpose are mostly expressed by means of the *ma*-infinitive (e.g., *läks sööma* '(s)he went to eat') which also indicates the goal of motion (Pajusalu & Orav 2007). The progressive form in Estonian is also formed from the *ma*-infinitive inflected in inessive (e.g., *on uju-ma-s* 'is swimming') implying, thus, spatial meanings (Metslang 2006; Pajusalu & Orav 2007).

[b] Note that in Estonian reference grammars (Erelt 2003; 2009; Erelt & Metslang 2017; Viht & Habicht 2019), tense and aspect are not differentiated. Instead, verb tenses (e.g., present simple, present perfect, etc.) are described. Furthermore, progressive constructions are not included in verb tenses. For the purposes of this study, tense and aspect are coded separately (see also Bybee & Dahl 1989).

4 Results

4.1 Exploratory analysis: cluster analysis

The aim of the cluster analysis is to examine whether the type of verb (verbs of horizontal motion vs. verbs of vertical motion) could be predicted solely from (i) the clausal units of motion descriptions when these units are distinct from the verb itself, and (ii) the morphological form of the verb. Thus, two agglomerative clustering analyses are presented. If the clustering classifies

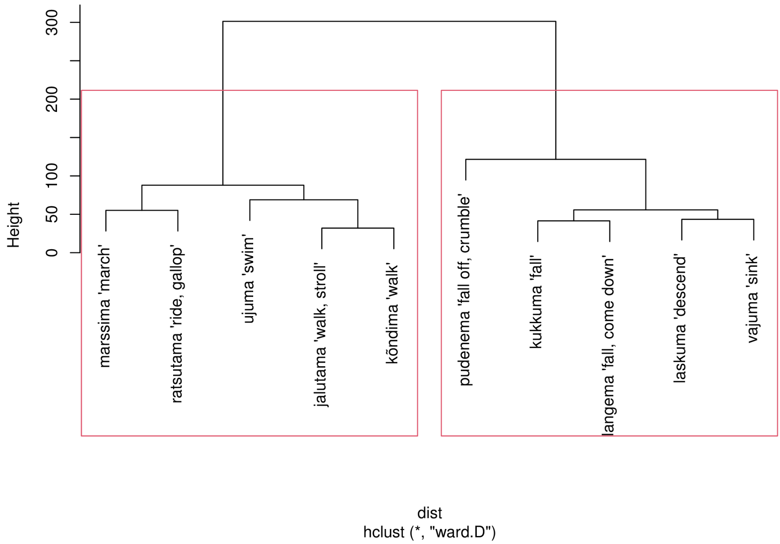

Figure 1. Hierarchical agglomerative clustering of motion verbs on the basis of the semantic variables of clausal units (Source, FromDirection, Location, Trajectory, Direction, Goal, Distance, Result, Cause, Purpose, Time, MannerInstr, CoMover)

verbs into those of horizontal motion and vertical motion, this indicates that the verbs of the two types have indeed distinct (i) clausal patterns and (ii) morphological behaviour. In the first analysis, the variables of the semantic units that can be expressed in motion clauses are used as input: Source, FromDirection, Location, Trajectory, Direction, Goal, Distance, Result, Cause, Purpose, Time, MannerInstr, and CoMover (see also Table 2). All of these are binary variables showing whether or not a particular category is explicitly expressed in a clause. The clustering analysis is based on the contingency table in which the occurrences (i. e., the "yes" values) are counted.

The results of the clustering on the basis of the clausal units is presented in Figure 1. There are two clear clusters of the verbs as predicted. To the left of the figure are the five verbs of horizontal motion and to the right of the figure are the five verbs of vertical motion. Furthermore, two verbs of horizontal motion (*marssima* 'march' and *ratsutama* 'ride, gallop') cluster together and are set apart from the other three verbs of horizontal motion (*ujuma* 'swim', *jalutama* 'walk, stroll', and *kõndima* 'walk'). The verbs of vertical motion fall also into two major sets in which one of these sets contains only one verb (*pudenema* 'fall off, crumble'). The other set contains verbs of further two sets. In one of them, there are the verbs *kukkuma* 'fall' and *langema* 'fall, come down' (in fact, these verbs express downward motion through the air). In the other, there are the verbs *laskuma* 'descend' and *vajuma* 'sink', both of which express downward motion in which the mover is in contact with the surface or liquid environment (descending takes normally place along a surface, and sinking through a liquid). Taken together, the analysis of clustering clearly shows that the semantic structure of motion clauses is different when the verbs of vertical motion are used, as compared to clauses where the verbs of horizontal motion are used (see § 4.2 for further details). Moreover, the analysis indicates that clausal patterns are also sensitive to the more fine-grained distinctions in verb semantics such as medium of motion. Thus, statistically speaking, the semantic clausal patterns of the verbs seem to be clear predictors to the semantics of the verbs.

In the second analysis, the grammatical variables characterising the verb in a clause are used: Tense, Aspect, Polarity, Mood, Voice, Person, and Number. The aim is to investigate whether semantic differences of the verbs (verbs of horizontal vs. vertical motion) can also be detected in the grammatical behaviour of the verbs.[5] The analysis reveals three main sets of verbs (see Figure 2). Compared to the previous clustering tree based on the semantic variables (cf. Figure 1), these three sets are clearly more heterogeneous in terms of the clusters identified in the analysis. That is, only the left cluster contains solely verbs of vertical motion (i. e., *kukkuma* 'fall', *vajuma* 'sink'), whereas the other two clusters have a mixture of verbs. This indicates that verbs of horizontal motion and verbs of vertical motion do not have a clearly different morphological behaviour. Nevertheless, the right cluster is homogeneous in terms of agentivity. That is, the verbs in this cluster (e. g., *kõndima* 'walk', *ratsutama* 'ride, gallop') express agentive motion, whereas the two vertical verbs in the left group (i. e., *kukkuma* 'fall', *vajuma* 'sink') express non-agentive motion. The middle cluster is a mixed group in terms of

[5] For this analysis of grammatical variables, the variables are converted into a wide format and recoded as binaries showing whether or not a particular grammatical form (e. g., conditional mood, present tense, 1st person) characterises the verb in a particular clause.

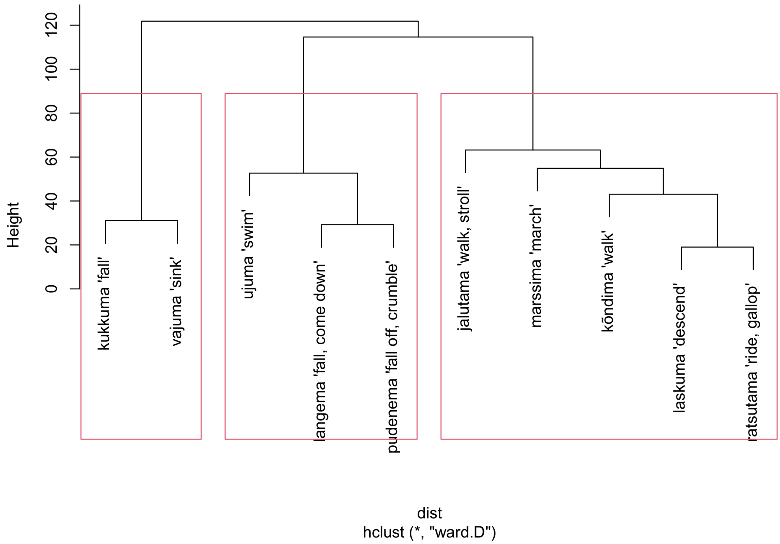

Figure 2. Hierarchical agglomerative clustering of motion verbs on the basis of the grammatical variables of the verbs (Tense, Aspect, Polarity, Mood, Voice, Person, Number)

agentivity as it has one verb of agentive motion (i.e., *ujuma* 'swim') and two verbs of non-agentive motion (i.e., *langema* 'fall, come down' and *pudenema* 'fall off, crumble'). The presence of an agentive verb in this group (i.e., *ujuma* 'swim') may be related to it profiling the medium of motion (i.e., water) as it occurs next to another verb which profiles the liquid medium of motion (i.e., *vajuma* 'sink'). In sum, there seems to be a link between the preferable grammatical behaviour of a verb in motion clauses and agentivity of motion as implied by the verb. The semantics of the verbs in terms of depicting either horizontal or vertical motion is less relevant.

In summary, the analysis of clustering shows that the verbs of horizontal motion have distinct clausal patterns (in terms of semantic roles) compared to the verbs of vertical motion. It also shows that in terms of verb morphology, horizontal and vertical motion as encoded in verbs is less relevant. Instead, the semantics of the verb in terms of motion agentivity seems to be closely related to the grammatical behaviour of the verbs. However, the clustering only shows that the verbs cluster into the types, but does not provide us with any information regarding what drives these separations. In order to examine the distinctive factors, as well as the clausal patterns and grammatical behaviour of the verbs in more detail, we now turn to modelling the data.

4.2 Modelling the data: conditional random forests and chi-square tests

Having established that the verbs of horizontal motion and the verbs of vertical motion have differences in their clausal patterns and grammatical behaviour, the aim of the current section is to zoom in and to reveal the main factors that contribute to such results.

To start with, the verbs of horizontal motion combine with spatial expressions more frequently (73.6%) than do the verbs of vertical motion (41.4%; $\chi^2(1, N = 2{,}000) = 49.54$, $p < 0.001$, Cramér's V = 0.16;[6] see Table 3). Importantly, in comparison to the verbs of horizontal motion, the verbs of vertical motion tend not to be combined with spatial expressions though such combinations are possible.

That is, spatial expressions (other than the verb) tend to be used in clauses together with the verbs of horizontal motion, as in example (1), whereas in clauses with the verbs of vertical motion, such combinations are somewhat less frequent, although they are possible in Estonian (cf. examples 2–3).

(1) HorVerb + Goal + Direction

jaluta-si-n	***toimetu-sse***	***tagasi***
walk-PST-1SG	office-ILL	back

'I walked back to the office.' [FC]

[6] The values of Cramér's V should be interpreted as follows: 0.1 = weak association; 0.3 = moderate association; 0.5 = strong association (Cohen 1988: 224–225). Pearson's residuals (presented in the tables) indicate whether the co-occurrence of the values of the variables is significant (residuals are larger than +2) or, on the contrary, whether the absence of co-occurrence is significant (residuals are smaller than −2) (Agresti 1996: 38–39). This allows one to assess whether differences in proportions are large enough to be taken to indicate significant tendencies.

Table 3. The presence (= "yes") and absence (= "no") of spatial expressions (other than the verb) in the motion clauses with the verbs of horizontal motion (HorVerb) and vertical motion (VertVerb)

HorVert	SpatExprPresent						Total	
	no			yes				
	N	%	resid.	N	%	resid.	N	%
HorVerb	264	26.4%	−4.1	**736**	**73.6%**	**2.9**	1,000	100%
VertVerb	**414**	**41.4%**	**4.1**	586	58.6%	−2.9	1,000	100%
Total	678	33.9%		1,322	66.1%		2,000	100%

$\chi^2 = 49.54$, df $= 1$, Cramér's V $= 0.16$, $p < 0.001$

(2) VertVerb

lehe-d *lange-vad*

leaf-PL.NOM fall-PRS.3PL

'The leaves are falling.' [NC]

(3) VertVerb + Goal

tellingu-d *lange-si-d* ***tänava-le***

scaffold-NOM.PL fall-PST-3PL street-ALL

'Scaffolds fell to the street.' [NC]

Second, the analysis of conditional random forests with verb type (HorVert) as the dependent variable (see Figure 3) indicates that the type of verb is most strongly associated with Goal, Result, Source, Location, and Trajectory. These are all semantic variables. More modestly, but still significantly, the morphosyntactic variable, Person, is important (to similar degrees with two other semantic varbiables, Direction and MannerInstr). Genre is important only to a very small degree, whereas the rest of the 12 variables (5 semantic and 7 morphosyntactic variables) do not associate with HorVert (type of verb) as the dependent variable. The index of concordance is $C = 0.87$, which indicates that the model explains the data very well.

As for the spatial variables, the verbs of horizontal motion and the verbs of vertical motion thus tend to have different clausal patterns (see Table 4).

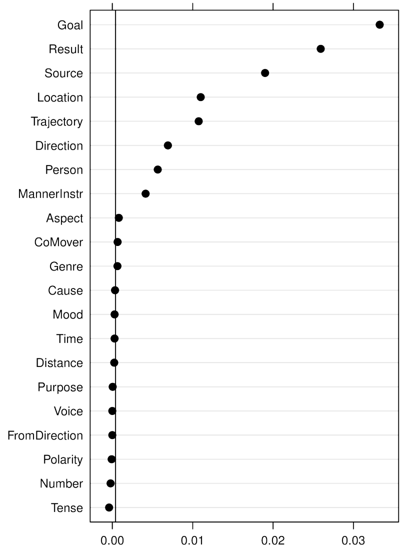

Figure 3. Conditional relative importance in predicting verb type (HorVert; predictors to the right of the vertical line are significant): HorVert ~ Source + FromDirection + Location + Trajectory + Direction + Goal + Distance + Time + CoMover + Result + Purpose + Cause + MannerInstr + Mood + Aspect + Polarity + Voice + Tense + Person + Number + Genre

The verbs of horizontal motion are biased towards Location (27.3%) and Trajectory expressions (24.8%). The verbs of vertical motion are biased towards Source (19.8%) and Goal expressions (51.0%).

To demonstrate, a verb of horizontal motion combines with Location in (4) and with Trajectory in (5), and a verb of vertical motion with Source in (6) and with Goal in (7). As illustrated by example (6), the clause can then also contain other expressions (e.g., a Location expression), but importantly, the main distinctive feature is Source. In fact, there are only four clauses in the data in which the verb of vertical motion co-occurs with a Source and Location expression (see also the analysis of the conditional inference tree below; Figure 4). These examples illustrate the flexibility of motion verbs

Table 4. The presence of spatial expressions in the motion clauses with the verbs of horizontal motion (HorVerb) and vertical motion (VertVerb)

HorVert	Source			Location			Trajectory			Direction			Goal			Total	
	N	%	resid.	N	%	resid.	N	%	resid.	N	%	resid.	N	%	resid.	N	%
HorVerb	50	5.2	−6.3	**262**	**27.3**	**7.6**	**238**	**24.8**	**7.6**	224	23.4	2.2	184	19.2	−8.2	958	100
VertVerb	**185**	**19.8**	**6.4**	62	6.6	−7.7	51	5.5	−7.7	159	17.0	−2.2	**476**	**51.0**	**8.3**	933	100
Total	235	12.4		324	17.1		289	15.3		383	20.3		660	34.9		1,891	100

$\chi^2 = 461.98$, df = 4, Cramér's V = 0.49, $p < 0.001$

in that the depicted motion does not need to be (and in most cases is not) absolutely horizontal or vertical. Rather, the verbs of horizontal motion can be used if motion is horizontal to an adequate degree (and the particular manner of motion such as marching or riding a horse can be conducted on a surface; see examples 4–5). The verbs of downward motion can be used if a lower point is reached by the mover even if direct downward motion does not occur (as it does not with planes; see example 7).

(4) HorVerb + Location

New	***Yorgi-s***	*marss-i-s*	*10 000*	*inimes-t*
New	York-INE	march-PST-3SG	10,000	human-PRT

'10,000 people were marching in New York.' [NC]

(5) HorVerb + Trajectory

Nad	*ratsuta-si-d*	***läbi***	***linna***
they	ride-PST-3PL	through	town.GEN

'They rode a horse through the town.' [FC]

(6) VertVerb (+ Location) + Source

Leediküla-s	*kukku-s*	***katuse-lt***	*laudaehitaja*
Leediküla-INE	fall-PST.3SG	roof-ABL	barn.builder.NOM

'In Leediküla, a barn builder fell off the roof.' [NC]

(7) VertVerb + Goal

Lasku-si-n	*ilusasti*	***lennuvälja-le***
descend-PST-1SG	nicely	airfield-ALL

'I descended nicely onto the airfield.' [FC]

As for Result, the verbs of vertical motion are considerably more likely to co-occur with Result expressions (20.7%) than the verbs of horizontal motion are (1.8%; see Table 5).

For example, Result is expressed in (8) in combination with a vertical verb, *kukkuma* 'fall', and describes the final state of the mover. In (9), Result co-occurs with Goal and a vertical verb, *laskuma* 'descend'. Moreover, the verbs of horizontal motion typically do not combine with Result expressions despite the fact that in certain constructions in Estonian they can.[7] This is exemplified in (10).

[7] This construction is a specific one for resultative events in which Result is expressed as a

Table 5. The presence (= "yes") and absence (= "no") of Result expressions in the motion clauses with the verbs of horizontal motion (HorVerb) and vertical motion (VertVerb)

HorVert	Result						Total	
	no			yes				
	N	%	resid.	*N*	%	resid.	*N*	%
HorVerb	982	98.2	3.2	18	1.8	−8.9	1,000	100
VertVerb	793	79.3	−3.2	**207**	**20.7**	**8.9**	1,000	100
Total	1,775	88.8		225	11.2		2,000	100

$\chi^2 = 177.0$, df $= 1$, Cramér's V $= 0.30$, $p < 0.001$

(8) VertVerb + Result

kukku-si-n *korra* ***ninuli***
fall-PST-1SG once to.nose

'I fell to my face once.' [FC]

(9) VertVerb + Result + Goal

Ta *lasku-s* ***põlvili*** ***liiva-le***
(s)he descend-PST.3SG to.knees sand-ALL

'(S)he descended on his/her knees, to the sand.' [FC]

(10) HorVerb + Result

Nakamura *uju-s* ***maailmarekordi***
Nakamura.NOM swim-PST.3SG world.record.GEN

'Nakamura swam the world record.' [NC]

In addition, in comparison to the verbs of vertical motion, the verbs of horizontal motion are slightly biased towards co-occurring with Manner expressions (25.2%; cf. 16.8% for vertical verbs; see Table 6), but no great difference with regard to the other semantic variables included in the study

direct object. This resultative construction is well-known in many languages (see, for example, Goldberg 1995; Goldberg & Jackendoff 2004; Huumo 2010; Leino 2010; Kratzer 2011; Beavers 2012).

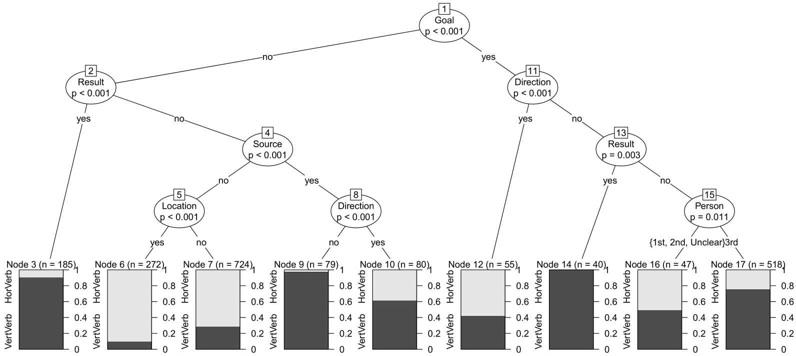

Figure 4. Conditional inference tree for the type of verb: HorVert ~ Source + FromDirection + Location + Trajectory + Direction + Goal + Distance + Time + CoMover + Result + Purpose + Cause + MannerInstr + Mood + Aspect + Polarity + Voice + Tense + Person + Number + Genre, controls = ctree_control(maxdepth = 3, minbucket = 20)

(CoMover, Distance, Cause, Purpose, Time) is observed. To illustrate, in (11), a Manner expression occurs together with a verb of horizontal motion.

(11) HorVerb + Manner

Mõisatee-d	<u>*kõndi-si-me*</u>	***jala***.
manor.path-PRT	walk-PST-1PL	on.foot

'We were walking this manor path on foot.' [NC]

As for the morphological patterns of motion verbs, only Person appeared to be significant in the model (see Figure 4). In particular, the verbs of horizontal motion are more frequently inflected in the 1st person (16.1%) than the vertical verbs (6.4%; see Table 7). Conversely, the verbs of vertical motion are more frequently inflected in the 3rd person (93%) than the horizontal verbs (78.1%). In addition, the verbs of vertical motion are slightly biased towards singular uses (76.8%; cf. 68% for horizontal verbs; see Table 8). Horizontal verbs are slightly biased towards plural uses (30.3%; cf. 23% for vertical verbs).

The structure of motion clauses across the two types of motion verbs can be further detailed by means of the conditional inference tree (see Figure 4;

Table 6. The presence (= "yes") and absence (= "no") of Manner expressions (incl. Instrument) in the motion clauses with the verbs of horizontal motion (HorVerb) and vertical motion (VertVerb)

HorVert	MannerInstr						Total	
	no			yes				
	N	%	resid.	*N*	%	resid.	*N*	%
HorVerb	748	74.8	−1.5	**252**	**25.2**	**2.9**	1,000	100
VertVerb	832	83.2	1.5	168	16.8	−2.9	1,000	100
Total	1,580	79.0%		420	21.0%		2,000	100%

$\chi^2 = 20.76$, df = 1, Cramér's V = 0.10, $p < 0.001$

Table 7. The distribution of person markers across the verbs of horizontal motion (HorVerb) and the verbs of vertical motion (VertVerb) in the motion clauses

HorVert	Person												Total	
	1st			2nd			3rd			Unclear				
	N	%	resid.	*N*	%	resid.	*N*	%	resid.	*N*	%	resid.	*N*	%
HorVerb	**161**	**16.1**	**4.6**	41	4.1	3.9	781	78.1	−2.5	17	1.7	2.4	1,000	100
VertVerb	64	6.4	−4.6	4	0.4	−3.9	**930**	**93.0**	**2.5**	2	0.2	−2.4	1,000	100
Total	225	11.2		45	2.3		1,711	85.6		19	1.0		2,000	100

$\chi^2 = 97.06$, df = 3, Cramér's V = 0.22, $p < 0.001$

Table 8. The distribution of number markers across the verbs of horizontal motion (HorVerb) and the verbs of vertical motion (VertVerb) in the motion clause

HorVert	Number									Total	
	SG			PL			Unclear				
	N	%	resid.	*N*	%	resid.	*N*	%	resid.	*N*	%
HorVerb	680	68	−1.6	**303**	**30.3**	**2.2**	17	1.7	2.4	1,000	100
VertVerb	**768**	**76.8**	**1.6**	230	23.0	−2.2	2	0.2	−2.4	1,000	100
Total	1,448	72.4		533	26.6		19	1.0		2,000	100

$\chi^2 = 27.19$, df = 2, Cramér's V = 0.12, $p < 0.001$

$R^2 = 0.77$). The analysis of the tree shows that the verbs of horizontal motion are most likely to have the following three clausal patterns:

(i) absence of Goal, Result and Source, but presence of Location expressions (Node 6; see also example 4);

(ii) absence of Goal, Result, Source and Location expressions (the presence of other expressions is irrelevant; Node 7; examples 5 and 11);

(iii) simultaneous presence of Goal and Direction expressions (Node 12; example 1).

The verbs of vertical motion are most likely to have the following three clausal patterns:

(i) absence of Goal, but presence of Result expressions (Node 3; example 8);

(ii) absence of Goal, Result and Direction, but presence of Source expressions (Node 9; example 6);

(iii) simultaneous presence of Goal and Result, but absence of Direction expressions (Node 14; example 9).

Person is the only morphological variable to become significant when the clause contains a Goal expression, but no Direction and Result expressions (see Nodes 15–17). In such clauses, as compared to the verbs of horizontal motion, the verbs of vertical motion are biased towards 3rd person marking.

Summarising, the verbs of horizontal motion are most likely to occur in clauses which comprise a Location or Trajectory expression, and also in combination with Manner expressions. The verbs of vertical motion are most likely to occur in clauses that depict the starting or endpoint, or the final state of the mover. In addition, the verbs of horizontal vs. vertical motion exhibit only somewhat distinct grammatical behaviour so that horizontal motion is more likely to trigger 1st and 2nd person, and vertical motion 3rd person encodings.

5 General discussion

Experiencing vertical motion is considerably different from that of horizontal motion. This intuitive observation has found empirical support from a number of studies (Rose & Büchel 2005; Johnson 2007: 136–138; Ke et al. 2013; Leigh & Zee 2015; Scott et al. 2016). Intuitively, the semantics of the verbs of vertical motion (e.g., *kukkuma* 'fall') also differs from the semantics of the verbs of horizontal motion (e.g., *kõndima* 'walk'). This, in turn, should result in differences in use. To confirm this prediction in data, the current study applied quantitative analysis techniques to corpus data. This was done (i) to obtain evidence for tendencies one could intuitively predict and (ii) to uncover tendencies not available for intuition and explicit thinking. The results of the study provide evidence that these two types of motion – horizontal vs. vertical motion – are also expressed by means of distinguishable clausal patterns and morphological encodings. These tendencies were not absolute, but nevertheless suggest clear differences between the uses of verbs of horizontal and vertical motion.

In particular, it was found that the verbs of vertical motion frequently occur in combination with expressions of Source, Goal, and Result (e.g., *Pall kukkus **laualt põrandale*** 'The ball fell **off the table** [Source] **down to the floor** [Goal]', *kukkusin **ninuli*** 'I fell **to my face** [Result]'). In other words, such events tend to be finished. The verbs of horizontal motion occur frequently with expressions showing that the event is not finished. That is, when horizontal motion is expressed, it is likely that Location or Trajectory is also expressed (e.g., *Ta kõnnib **aias*** '(s)he is walking **in the garden** [Location]'). Furthermore, from the perspective of lexical aspect (Vendler 1957; Aske 1989; Naigles & Terrazas 1998; see also Erelt 2017: 112–128 for lexical aspect in Estonian), events whose starting and ending points are expressed can be seen as telic; events which are described by means of Location and Trajectory expressions can be analysed as atelic. In other words, lexical aspect in terms of telicity seems to be closely related to the expression of horizontal and vertical motion.

Regarding verb morphology, there was an effect of person and number in that the verbs of vertical motion were more likely to have 3rd person and singular encodings, and the verbs of horizontal motion were more likely to have 1st (and 2nd) person as well as plural encodings. No effect of aspect and tense was found in verb choice, meaning that the two types of verbs occur in similar tense and aspect constructions. In other words, grammatical aspect as manifested in verb morphology does not seem to be straightforwardly related to the expression of horizontal and vertical motion.

However, the choice of person and number markers suggests semantic motivations behind grammar. That is, vertical motion happens to someone or, more likely, something else, and for this reason, it is also referred to with the 3rd person marking. Horizontal motion, on the other hand, is something we deliberately perform ourselves, which explains why we frequently use 1st person marking to express that type of motion. This, in turn, suggests agentivity effects in that agentive motion is described by means of a different set of linguistic means than non-agentive motion. In addition, the clustering of the verbs on the basis of their morphological behaviour showed that verb morphology may be linked to the agentivity as embedded in verb semantics. Verbs that express agentive motion (e.g., *ratsutama* 'ride, gallop', *laskuma* 'descend') tended to be clustered into one group, and non-agentive verbs (*kukkuma* 'fall', vajuma 'sink') into another group. These results are in accord with the studies on goal-bias that show that goal prominence is significant to agentive motion, not non-agentive motion (Lakusta & Carey 2015). In other words, animate and agentive movers tend to have goals for their motion. This feature of agentivity is, of course, closely related to horizontality and verticality in that horizontal motion is more likely to be also agentive, and vertical motion non-agentive. In any case, these findings support previous research into semantic motivations of grammar and provide further knowledge of the cognitive underpinnings of verb morphology (see also Janda 2007).

Thus, the usage patterns of language reflect the fact that motion along the horizontal axis differs significantly from motion along the vertical axis in terms of our physical experience of these motions. The idea that vertical motion may have a "special status [in language] resulting from particular aspects of embodied cognition" (Hickmann et al. 2017: 85) has also been proposed by other authors (e.g., Gibbs 2006; Johnson 2007: 136–138; Morita 2020). Furthermore, the two types of motion – horizontal and vertical – may be causally different (e.g., downward motion occurs due to or in spite of gravity, whereas horizontal motion is caused by other factors). In addition, the physical properties of the two types of motion (e.g., speed and force) vary. Consequently, these physical properties may also receive different attention when expressing horizontal vs. vertical motion. In other words, when expressing motion, a need arises to foreground different aspects of a motion event. These foregrounded aspects, in turn, do not necessarily coincide across the two types of motion – horizontal vs. vertical – and this explains the results of the current study.

Nevertheless, when motion clauses were examined in this study, only the verbs had been assigned the labels *horizontal* and *vertical motion*. When analysing the structure of motion clauses, the meaning of the clauses was not examined. That is, the resulting clause was not analysed in terms of it expressing horizontal or vertical motion, or a mixture of these motions. The verbs of the study were chosen based on the experiment (Taremaa 2021b) which established the associated meaning of the verbs in terms of horizontal and vertical motion. The verbs with which the current corpus study was conducted were clearly verbs of either horizontal or vertical motion. However, even the clearest instances do not necessarily indicate that the verbs are always used to refer to exact horizontal or vertical motion. Such "exact" or "absolute" horizontal and vertical motion is rare in real life, as most actual motions are a combination of both, and this is also reflected in language. To exemplify, the clause *kukkusin ninuli* 'I fell to my face' contains a verb of vertical motion, but the clause itself describes motion that is not absolute vertical motion. Instead, it describes motion along both the horizontal and vertical axes. It also seems that some verbs of horizontal motion can easily be used to describe vertical motion as well if contextual clues are added (e.g., *ämblik kõndis seina mööda alla* 'the spider walked down the wall'), whereas using verbs of vertical motion in contexts that imply only horizontal motion seems very unlikely.

As for the general tendencies with regard to motion events as put forward by Talmy (1985; 2000b), and concerning the goal-bias as proposed by Ikegami (1987) and Dirven & Verspoor (1998), the following three conclusions can be drawn from the current study.

Firstly, the study illustrates that motion descriptions contain much more information than Path and Manner, and Source and Goal, and that these other aspects (e.g., horizontality/verticality, but also speed and force) should also be investigated in order to understand the composition of motion descriptions in a language. As language is inherently multivariate, these other important aspects of motion descriptions allow us to conceptualise the scene in more detail. Our knowledge about language structure, including typological similarities and differences, could thus greatly benefit from a broader investigation of the expression of motion.

Secondly, the results of the study should definitely be interpreted in relation to the fact that Estonian is a satellite-framed language (on manner saliency, see also Slobin 2006; Cardini 2008; Slobin et al. 2014). Indeed, the study's verbs of horizontal motion are clearly manner verbs (i.e., *jalutama* 'walk, stroll', *kõndima* 'walk', *marssima* 'march', *ratsutama* 'ride, gallop', *ujuma* 'swim'). The verbs of vertical motion (i.e., *kukkuma* 'fall', *langema* 'fall, come down', *laskuma* 'descend', *pudenema* 'fall off, crumble', *vajuma* 'sink') can be analysed differently, though, and thus seen as either manner verbs

(Cardini 2008; Goldberg 2010) or as path verbs (Lakusta & Landau 2005; Rappaport Hovav & Levin 2010). That is, all these verbs of vertical motion express at least two manner features (for the lists of possible manner features, see Cardini 2008; Slobin et al. 2014): speed and force. As for speed, according to the experiment presented in Taremaa (2017), *kukkuma* 'fall' expresses relatively fast motion; *langema* 'fall, come down', *laskuma* 'descend', and *pudenema* 'fall off, crumble' express medium speed; and *vajuma* 'sink' expresses relatively slow motion. Given that they, nevertheless, incorporate strong directional meaning (downward motion), they can also be viewed as verbs that incorporate both Manner and Path components. This is a strategy which applies for several verbs in many languages (Aske 1989; Cardini 2008; 2012; Cifuentes Férez 2010; Goldberg 2010; Kopecka 2010). In any case, it seems that the tendencies for horizontal and vertical motion as found in this study apply mainly to manner of motion verbs. Consequently, future studies are needed to clarify the use of path verbs in the context of horizontal and vertical motion.

Finally, the results of the study also indicate the language-internal variation with respect to the goal-over-source principle (Ikegami 1987; Dirven & Verspoor 1998). This principle states that Goal is the most commonly expressed spatial category in languages. The data of the current study shows that the principle applies to the verbs of vertical motion in that these are most frequently combined with Goal expressions (followed by Source expressions). However, the verbs of horizontal motion are inclined towards Location and Trajectory, and not towards Source and Goal. In other words, the principle seems to apply only to the verbs that are inherently Goal-directed in terms of their meaning, as noted also by several earlier studies (Aske 1989; Stefanowitsch & Rohde 2004; Filipović 2007; Kopecka 2010; Cardini 2012; Taremaa 2017).

On the whole, the study supports previous research into the embodied underpinnings of language (Johnson 1987; Glenberg & Kaschak 2002; Zwaan 2003; Gibbs 2006; Barsalou 2008) and concurs with the well-attested fact that differences in experience result in differences in linguistic expressions (Harris 1954; Johnson 1987). The results also add to the growing body of knowledge on motion events (Talmy 1985; 2000b; Slobin 1996; Goschler & Stefanowitsch 2013b; Ibarretxe-Antuñano 2017; Matsumoto & Kawachi 2020). The findings of this study suggest that it is essential to take the direction of motion in terms of horizontality and verticality into account when discussing the structure of motion descriptions.

6 Conclusion

The everyday experience of horizontal motion differs greatly from the experience of vertical motion. Following an assumption that such experiential differences can be seen in language, the study examined Estonian motion descriptions. The corpus study focused on the comparison between verbs of horizontal and vertical motion. The main finding was that the two types of motion – horizontal vs. vertical – are also expressed by means of specific structures. That is, the semantic and grammatical structure of motion clauses differs across the verbs of horizontal and vertical motion. In general, the study adds to the large body of research on embodiment and motion events by providing fine-grained information about the structure of motion expressions with regard to horizontal vs. vertical motion.

Acknowledgements

This work has been supported by the Estonian Research Council grant (PSG671) and by the European Union through the European Regional Development Fund (Centre of Excellence in Estonian Studies).

Abbreviations

2, 3	person
ABL	ablative
ALL	allative
GEN	genitive
COND	conditional
FC	a motion clause that originates from the fiction corpus
HorVerb	verbs of horizontal motion
HorVert	the type of verb in terms of horizontal vs. vertical motion
IMP	imperative
IMPERS	impersonal
INE	inessive
INF	infinitive
JUSS	jussive
NOM	nominative
NC	a motion clause that originates from the newspapers' corpora

PL	plural
PRS	present
PRT	partitive
PST	past
PTCP	present participle
QUOT	quotative
SG	singular
VertVerb	verbs of vertical motion

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