

Semantic maps and typological hierarchies: Evidence for the Actionality Hierarchy

Laura Becker* & Andrej Malchukov** (laura.becker@linguistik.uni-freiburg.de, malchuko@uni-mainz.de))

*University of Freiburg, Sprachwissenschaftliches Seminar

**Johannes Gutenberg-Universität Mainz, FB 05, Department of English and Linguistics Linguistik, General Linguistics, Language Typology

**Institute for Linguistic Studies of the Russian Academy of Sciences (ILS RAS).

*Belfortstraße 18, 79085 Freiburg im Breisgau

**Jakob-Welder-Weg 18, 55099 Mainz

**Tuchkov Pereulok 9, 199053 St. Petersburg, Russia

Abstract. Although semantic maps and typological hierarchies are different analytical tools and make different predictions, there is, arguably, a particular kind of a semantic map that shares certain features with typological hierarchies, in particular, the property of directionality. First, we briefly illustrate that such maps are based on the notion of local markedness and are designed to model the interaction between grammatical categories. We then explore the Actionality Hierarchy, formulated in terms of Vendlerian classes, which models the interaction between actionality and grammatical aspect. On the one hand, it will be shown that the Actionality Hierarchy can be reconstructed as a semantic map, based on common semantic features shared selectively between individual Vendlerian classes. Notably, it is directional and can be used to capture relations of local markedness between actionality and aspect. On the other hand, we will provide first systematic, quantitative evidence for the Actionality Map, using cross-linguistic parallel corpus data of four languages.

Keywords. aspect, actionality, semantic map, typological hierarchy, parallel corpus

1 Introduction¹

In this paper we will discuss the relation between semantic maps and typological hierarchies. Although semantic maps and typological hierarchies (as envisioned by Greenberg, Croft and others; cf. Croft (1990: ch. 5)) are different analytical tools and make different predictions, there is, arguably, a particular kind of a semantic map that shares certain features with typological hierarchies, in particular, the property of directionality. It will be further shown that such maps, as briefly illustrated in the paper, are based on the notion of local markedness and are designed to model the interaction between grammatical categories. In the empirical part, we will explore the *Actionality Hierarchy*, formulated in terms of Vendlerian classes,

¹ The order of the authors is alphabetical. The authors equally contributed to the content of the paper, with AM primarily responsible for the general/theoretical Sections 2,3 and LB for the empirical part in Section 4. The authors thank two anonymous reviewers for very helpful comments, Martin Haspelmath for discussion as well as the issue editors for editorial feedback. The usual disclaimers apply.

which models the interaction between actionality and grammatical aspect. Tackling the notoriously complex domain of actionality, we will proceed both in a top-down and bottom-up fashion, following up on our earlier work. First, it will be shown that the Actionality Hierarchy briefly introduced in Xrakovskij and Malchukov (2016) can be reconstructed as a semantic map, based on common semantic features shared selectively between individual Vendlerian classes. However, it is different from conventional semantic maps as it is directional and can be used to capture relations of local markedness between actionality and aspect (lexical and viewpoint aspect). Representing local markedness in terms of frequency of use, we will then provide more systematic evidence for the Actionality Map, based on a cross-linguistic corpus study of four languages (Russian, Czech, German, Hungarian). Building on the results of a pilot study of distribution of prefixation over actionality classes in these languages (Becker 2018), the paper provides first quantitative evidence for the *Actionality Map*.

The paper is structured as follows. In Section 2 we discuss the question how semantic maps relate to typological hierarchies. In Section 3 we show how the Actionality Hierarchy can be reconstructed as a semantic map. Section 4 provides quantitative evidence for the Actionality Map. Section 5 summarizes the main findings of the study.

2 Semantic maps and typological hierarchies

In spite of an ever growing popularity of semantic maps in the typological community (see Georgakopoulos and Polis (2018) and this issue for overviews), on the one hand, and the central interest of typological hierarchies in the field of language typology, on the other hand, there are few studies which address the question how semantic maps and typological hierarchies relate to each other. Indeed, at first glance, semantic maps and typological hierarchies are quite different analytic tools which capture different kinds of generalizations.

Semantic maps basically make predictions about polysemy patterns of grammatical or lexical items based on their configuration; due to contiguity requirements, if nonadjacent nodes on the map share the same form, it should be true of intermediate nodes as well. Furthermore, most work on semantic maps assumes that they are semantically coherent or monotonic, i.e. supported by selective sharing of semantic components (features) for adjacent nodes (cf. Malchukov 2010, Zwarts 2010). Typological hierarchies, on the other hand (as proposed by Greenberg (1966) and Croft, among others; see Croft (1990: ch. 5) for a discussion), make predictions with regard to the cross-linguistic availability of certain categories, intra-linguistic markedness relations (choice of overt vs. zero forms), and the frequencies of respective forms. Thus, consider the number hierarchy in (1) below (Croft 1990: 97):

(1) singular > plural > dual > trial ...

This hierarchy (going back to Greenberg's Universal 34), is aimed to capture implicational relations across languages (if a language has trial, then it has dual, etc.), as well as markedness relations between the categories (preferential use of zero / less marked forms for categories higher on the hierarchy). Already Greenberg (1966) related the markedness of grammatical

forms to their frequency, noting that zero or shorter forms generally occur more frequently in language use than longer forms.² We will take up this relation between markedness and frequency in Section 4. Note, further, that the hierarchy above does not make any contiguity-based predictions related to form, neither are they assumed to be monotonic (clearly, the sequence of singular-plural-dual cannot be motivated on the basis of shared features).³ Yet, there is one type of a typological hierarchy which shares certain features with semantic maps. Consider the Imperative Hierarchy originally proposed in the work of van der Auwera and his associates (van der Auwera et al. 2004), and later adopted in typological studies of imperatives in one form or another (Aikhenvald 2010, Gusev 2013, Schalley 2008). In most studies the Hierarchy appears in the following form:



Figure 1. Person hierarchy for imperatives (Aikhenvald 2010, Gusev 2013, Schalley 2008, van der Auwera et al. 2004)

The hierarchy in Figure 1 makes predictions concerning the building up of imperative systems across languages, predicting for example, that if a language has a 3rd person imperative form, it will also feature 1PL inclusive as well as 2nd person forms, which has been largely confirmed in the literature.

However, in the present context, it is interesting to note that early on, van der Auwera and colleagues proposed to conceptualize this hierarchy as a semantic map. Thus, in van der Auwera et al. (2004) the hierarchy is represented as a two-dimensional semantic map (cf. its telling title: “A Semantic Map for Imperative-Hortatives”). On this interpretation it is explicitly modeled through sharing of semantic features (‘± addressee’, ‘± speaker’, ‘± referent’), and it makes predictions concerning extensions of certain forms. Figure 2 (van der Auwera et al. 2004: 60) shows the general layout of the map, as well as the distribution of two imperative forms in West Greenlandic.⁴ As can be readily seen from the map, the distribution of the two series of forms in West Greenlandic conforms to the contiguity requirements on semantic maps (the domains of the two markers are circled in Figure 2).

² The relation between markedness and frequency has since then received a lot of attention in typology (e.g. in Bybee 2001, Bybee 2007, Comrie 1986, Croft 1990, Diessel 2007, Du Bois 1987, Haiman 1983, Haspelmath 2008, Haspelmath 2021).

³ Cf. Croft (1990: 116): “For example, it is virtually impossible to recast the number hierarchy (singular < plural < dual < trial/paucal) as a hierarchy of features with any natural set of features”.

⁴ Data from Fortescue (1984: 24-27, 291-292).

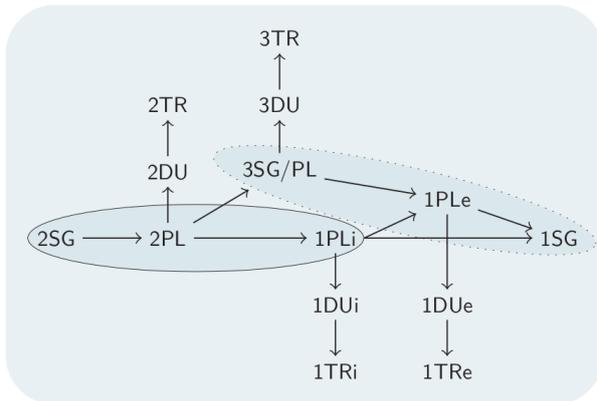


Figure 2. Distribution of imperative forms in West Greenlandic on the Imperative-Hortative map (van der Auwera et al. 2004: 60)

An important aspect of the hierarchy in Figure 2, which sets it apart from the hierarchy in Figure 1, is that this hierarchy captures the relation of local markedness due to the interaction of grammatical categories rather than general markedness. Local markedness (originally introduced in Tiersma (1982)), refers to the relative markedness of a linguistic category with respect to its context, or, more generally, “represents a natural (unmarked) correlation between values on different grammatical parameters” (Croft 1990: 135). In other words, unlike the cases where typological markedness of individual values is determined in the context of respective categories (see the number hierarchy in (1) above and the other markedness hierarchies introduced by Greenberg; see Croft 2003: 156-157), local markedness relates to cases where, in Croft’s (2003: 165) formulation, “the markedness is assimilated to, or determined locally by, the cross-cutting category”. Since local markedness relations arise from the interaction of grammatical categories, we will refer to hierarchies that capture such relations as *Interaction Hierarchies*.⁵

For the domain at hand, the imperative is least marked in the context of 2sg (which is central to the imperative paradigm),⁶ while the 1sg imperative form is most marked (least natural) for imperatives. Such marked forms are either lacking, are less frequent than unmarked forms, or undergo reinterpretation (see Malchukov 2011). For instance, in Tungusic languages, the 1sg and 1pl exclusive forms, which are least compatible with the imperative meaning, are reinterpreted (as illustrated in (2) below). On the one hand, in combination with 1sg, the forms of the “delayed imperative” in *-dA-* have developed a future tense function. This reinterpretation is clear from the fact that forms with *-dA-ku* may be used in questions:

- (2) Even
 (a) *Hör-de-j!*
 GO-IMP-REF.SG
 ‘Go (later)’

⁵ We thank an anonymous reviewer for suggesting this label.

⁶ As already acknowledged by Greenberg (1966: 44) and Croft (1990: 149).

- (b) *Hör-de-ku?* *Inge, hör-li-e!*
 go-IMP-1SG OK, go-IMP-PTCL
 'May I go? OK, go'

On the other hand, the combination of the distant imperative with the 1PL exclusive marker, *-(k)un*, which in other mood contexts indicates a set of persons excluding the hearer (cf. *hör-ri-vun* 'we left (without you)' vs. *hör-ri-t* 'we left (with you)'), results in the reinterpretation of the person marker. The latter has developed an inclusive reading, which is semantically more compatible with the function of the imperative speech act:

- (3) Even
Hör-de-kun!
 go-IMP-1PL.EXCL
 'Let's go!'

What is equally important is that the map in Figure 2 still bears similarity to hierarchies, by being inherently directional. Note, in particular, that on this map the adjacent categories are connected by arrows instead of lines as on conventional maps. As explained in van der Auwera et al. (2004: 55), in this context the arrows represent the "typicality" of a particular combination, in other words, relative naturalness or (un)markedness. It is also worth pointing out that this use of arrows is quite different from the (more familiar) use of arrows on "dynamicized semantic maps", where arrows show the paths of diachronic extensions of a particular form. For the Imperative Map in Figure 2 above, it is possible that some extensions proceeded along the paths indicated by arrows, but this need not be the case.

In the revised version of his classic typology textbook, Croft (2003: ch. 5) also highlights a connection between typological hierarchies and semantic maps, but his point is different from the point we are making here. Croft (2003: 133ff) argues that semantic map model can provide a deeper explanation for typological hierarchies but acknowledges the difference between the two concepts. Thus, typological hierarchies involve asymmetries which impose constraints going beyond connectivity and furthermore do not always represent conceptual space directly.⁷ Croft also discusses local markedness but, curiously, in connection to typological prototypes rather than semantic maps (Croft 2003: ch.6). The discussion, insightful as it is, does not make a case for intermediate status of Interaction Hierarchies with respect to implicational hierarchies, on the one hand, and semantic maps on the other, as we argue here. To recapitulate: a) implicational hierarchies make predictions about implicational relations of individual values of grammatical categories, which do not share the same form; b) semantic maps are concerned with the formal identity of related functions; c) Interaction Hierarchies relate to the availability of a specific value from one grammatical category (most

⁷ As Croft (2003: 142) observes, "text frequency of grammatical categories defines hierarchies with respect to universals of structural coding and behavioral potential, but they do not map directly onto conceptual space".

commonly the same grammatical marker) for members of another cross-cutting category. In most cases this specific value (aka grammeme) refers to a specific grammatical morpheme (for example, distribution of accusative case across different types of objects, or imperfective form across different actionality classes), but in some cases it can relate to a more abstract pattern (sharing the same construction on the alignment map in Figure 3) or subsume several forms under the same grammeme (for example, as discussed in Section 4 below, perfectivization in Slavic can be performed by a large range of perfectivizing prefixes, which are lexically selected).

In what follows we will provide another example of Interaction Hierarchies. The example below stems from the field of alignment studies.⁸ To give an example based on Malchukov (2015), Figure 3, shows a two-dimensional hierarchy designed to constrain alignments splits. The TAM forms on the top of the hierarchy have a general accusative bias (even ergative languages can be realigned to the accusative patterns when the verb is in imperative), while the forms on the bottom on the hierarchy have an ergative bias (that is, resultative forms may pattern ergatively even in accusative languages).

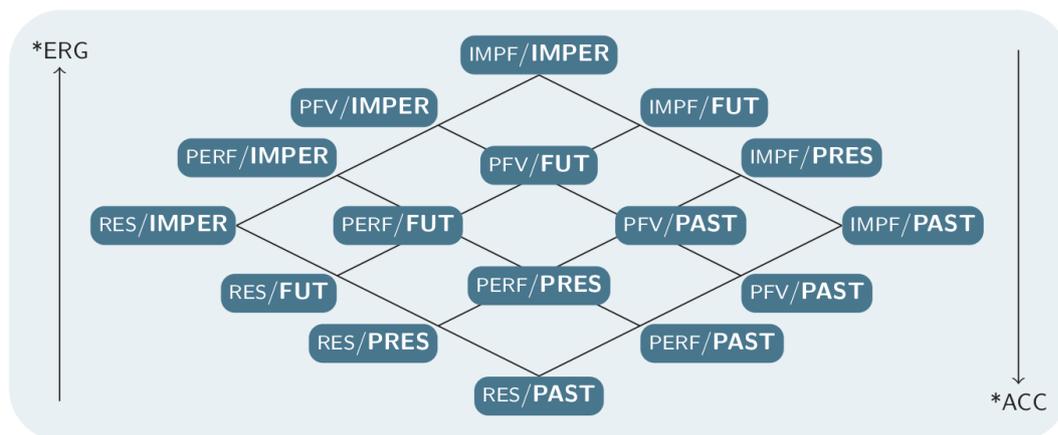


Figure 3. A two-dimensional TAM-hierarchy for alignment splits (Malchukov 2015: 288)

The hierarchy in Figure 3 is called a two-dimensional hierarchy or lattice in Malchukov (2015), but it may also be interpreted as a semantic map (with directionality added) based on the shared features, or as an Interaction Hierarchy constraining the interaction of case-marking and TAM features.

It is instructive to compare the two-dimensional hierarchy in Figure 3 above with the two-dimensional animacy/definiteness hierarchy for differential object marking in Aissen (2003: 459), shown in Figure 4.

⁸ Cf. Malchukov (2008, 2009, 2015).

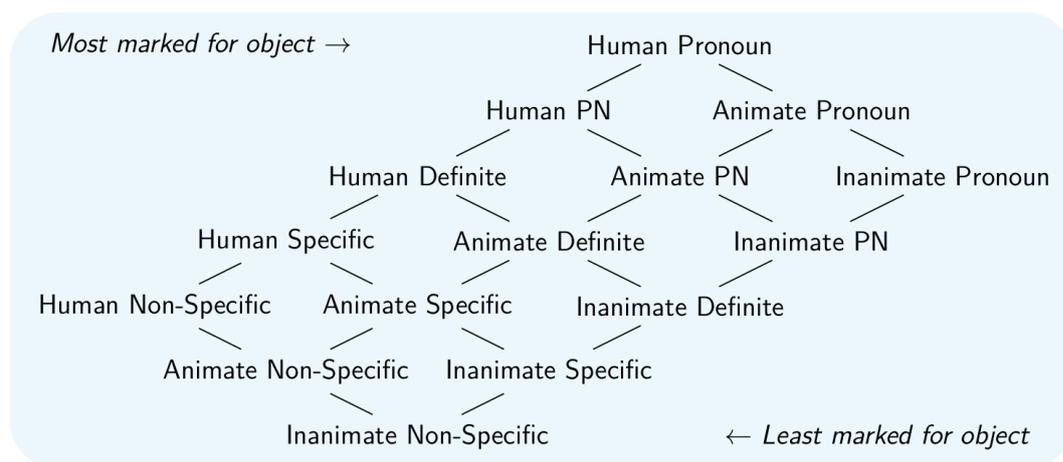


Figure 4. A two-dimensional DOM-hierarchy (Aissen 2003: 459)

We find a very similar representation of two-dimensional conceptual space of the extended animacy and definiteness hierarchies in Croft (2003: 168), who explicitly characterizes it as a semantic map for (the coding of) animate/definite direct objects. Indeed, both Aissen’s lattice and Croft’s map constrain the possible spreads of object marking across the map. Thus, the domain of object marking (by accusative case and the like) should be subject to a general contiguity requirement on semantic maps, but, additionally, includes directionalities, predicting that the spread starts from the nominals highest on the animacy/definiteness hierarchies. The TAM-hierarchy for alignment splits (Figure 3) has the same layout as Aissen’s two-dimensional lattice (Figure 4), but describes the distribution of more abstract **constructions**, rather than particular **forms** across the map. That is, the hierarchy in Figure 3 constrains the distribution of constructions with accusative or ergative alignment across TAM forms in individual languages, which should likewise respect both contiguity requirements on semantic maps as well as directionalities embodied in the hierarchies.

There are different ways in which markedness relations can be captured on semantic maps. Thus, the following map for voice markers (adapted from Malchukov (2016)) in Figure 5 represents the relative markedness of the combination of different voice markers with the verb’s transitivity; less marked combinations are represented by a bigger font size (in addition to arrows).

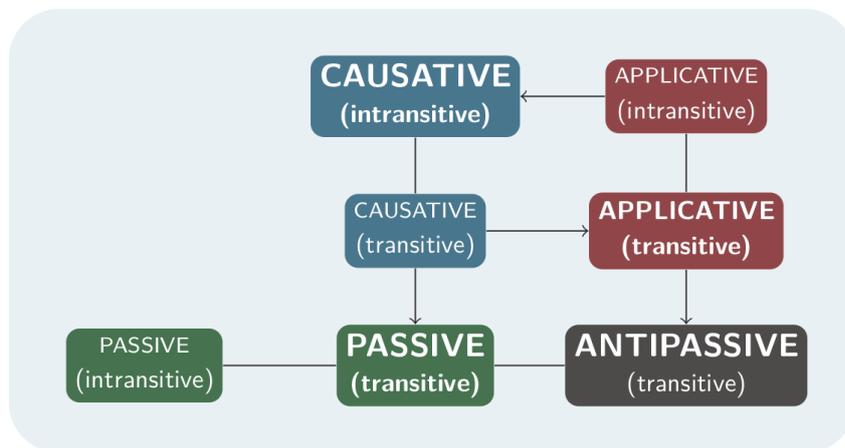


Figure 5. Semantic map for core voice categories (Malchukov 2016)

As explained in Malchukov (2016), this map is grounded in the sharing of syntactic features. It represents selective similarities between passives and causatives of transitives (both demote a transitive subject of the active), as well as similarities between applicatives based on transitives and antipassives (both demote an object of the active to an oblique). In this sense it adheres to the general design of semantic maps, built on shared features, even though the features involved are syntactic rather than semantic. On the other hand, it also shows directionalities, in that less natural (more marked) combinations of features may cause a functional shift on the part of the voice marker. For example, the causative may shift to a passive when applied to transitives. Thus, the map shown in Figure 5 is different from conventional maps (and closer to Interaction Hierarchies) by trying to incorporate relations of local markedness into its design, where (un)markedness is indicated by the font size. Another advantage of this layout is that it explicitly shows the direction of shifts for less felicitous combinations. For this reason, the map is also called an *attractor network*, where the unmarked combinations function as *attractors* in a dynamic system, conditioning a meaning shift on the part of the marked combinations. The direction of the shift is indicated through arrows. These arrows also allow for a diachronic interpretation, such as a shift of causative uses to passive uses when extended to transitives. Yet, as the markedness account is more general (as also in case of the Imperative-Hortative map discussed above), for example, it would equally apply to more complex scenarios such as when categories develop from a third source (e.g., both passives and causatives developing from a source construction that specializes in the passive function in the context of transitives, and in the causative function in the context of intransitives).

To conclude: apart from typological hierarchies grounded in the notion of general markedness, which are indeed quite different from conventional semantic maps, we have seen that there is a special kind of hierarchy grounded in local markedness, which is more similar to semantic maps, but which additionally has a feature of directionality. In what follows we will explore one type of Interaction Hierarchies for the domain of actionality

(Section 3) and show how local markedness can be tested empirically by comparing the usage frequencies of the different value combinations on the Interaction Hierarchy (Section 4).

3 Actionality Hierarchy as Actionality Map

Cross-linguistic variation in actionality is a notoriously difficult topic. In spite of the vast literature on actionality and the interaction between actionality and aspect (see Croft (2012), Sasse (2002), Smith (1997), Tatevosov (2002) for overviews), the question about the universality of actional classes and limits of cross-linguistic variation in this domain is far from settled. The perspective adopted here is based on the work by Xrakovskij (1990, 1996) on the interaction of grammatical categories: in case of a (syntagmatic) interaction of grammatical categories, one grammeme (a value of a particular category) may be defined as ‘dominant’, while another is ‘recessive’; i.e. the latter is blocked or shifts its meaning in the context of the former. For example, Xrakovskij (1990, 1996) concluded that imperative forms are often ‘dominant’ with respect to person; they either exclude certain person forms (e.g. 1SG), or force their reinterpretation (cf. the Imperative-Hortative map in Section 2). Thus, in example (2b) above, the 1SG grammeme is dominant with respect to imperative, while in (3) the imperative is dominant with respect to person agreement, coercing the inclusive interpretation on the part of the 1SG exclusive form.

Malchukov (2011) tried to integrate insights of Xrakovskij with the work in the tradition of markedness studies, using hierarchies of local markedness as a basic tool. To give an example from the domain of tense-aspect interaction, consider the case of perfective presents. As noted by de Wit (2017) and Malchukov (2009), the present perfective combination is functionally infelicitous; therefore, it needs to be resolved, through blocking or reinterpretation of one of the categories. As pointed out by Malchukov (2009) (see also de Wit (2017: ch. 7) for more details), Slavic languages differ in the way of resolving the present perfective paradox. In East Slavic languages like Russian, this combination is routinely reinterpreted as a future (cf. Russian *delat* does.IPFV.PRS.3SG ‘does/is doing’ vs. *s-delat* PFV-does.PRS.3SG ‘will do’), while in South (and West) Slavic the default interpretation is habitual (cf. Bulgarian *pousmixnat* smile.PFV.PRES.3PL ‘used to smile’; Malchukov (2011: 235)). In terms of Xrakovskij (1990) and Malchukov (2011), aspect is a dominant category in East Slavic causing tense to shift, while tense is dominant in South Slavic languages. Breu (1994) comes to very similar conclusions, starting out from somewhat different premises.

Against this background, let us consider the logic of the interaction between actionality and aspect (or, in different terms, between lexical and grammatical aspect). Before we introduce the Actionality Hierarchy, which first appeared in print in Xrakovskij and Malchukov (2016), some general comments on the actionality classes are in order. As most work on actionality (Croft 2012, Sasse 2002, Smith 1997, Tatevosov 2002), we take Vendler’s (1957) classification as a point of departure. Now, it is also well-known that actionality classes (Vendler’s major classes) have preferences for their combinability with aspectual categories. For example, the

progressive form typically does not apply to achievements in English (**is finding*), while in Russian perfective forms are usually not available for states and activities.⁹ Moreover, when such infelicitous combinations do occur, the verb type is coerced into another interpretation. Breu (1994) illustrates these shifts for a language with derivational aspect (Russian) and for a language with inflectional aspect (Italian):

- (4) a. Atelic verbs (states and activities), if occurring in perfective aspect, receive an inchoative (cf. Russian *znat’/uznat’* ‘know/get to know’, Italian *sapeva/seppe* ‘knew/got to know’) or a delimitative interpretation (cf. Russian *rabotat’/porabotat’* ‘work/work for a while’, Italian *lavorava/lavorò* ‘worked/worked for a while’);
 b. Achievements (‘find’, etc.), if occurring in imperfective aspect, receive an iterative interpretation (Russian *naxodit’/najti* ‘find repeatedly/find’, Italian *trovava/trovò* ‘used to find/found once’).

Subsequent studies (Malchukov 2009, 2011, Xrakovskij et al. 2009) attempted to generalize these patterns. In an exploratory study, Xrakovskij et al. (2009) discuss these constraints for a limited number of lexemes (SIT, LOVE, BUILD) in five languages (Russian, English, Arabic, Even, Khmer). Following up on this work (as well as on Malchukov (2009) and Bohnemeyer and Swift (2004)), Xrakovskij and Malchukov (2016) propose to capture the relation of actionality to aspect in the form of the hierarchy given in Figure 6.

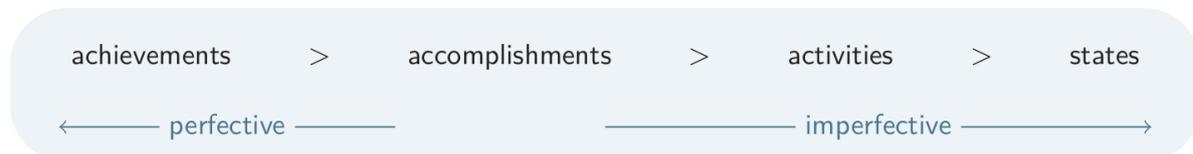


Figure 6. Actionality markedness scale for aspect

This hierarchy may also be read as a semantic map, where neighboring categories share certain semantic features. In fact, it follows from the conventional characterization of actional classes in terms of features in the tradition of Bertinetto (1997), Dowty (1979), Smith (1997), Van Valin (2005), Van Valin and LaPolla (1997), and Vendler (1957). According to Van Valin and LaPolla (1997: 93), the verb types are characterized in terms of three binary features: [± static], [± telic], [± punctual].¹⁰ We will briefly define each actionality type in turn. States do not require energy to be maintained and have no inherent temporal boundaries. However, an additional temporal delimitation can be imposed in some cases (cf. Section 4.2). Activities denote situations that do not have an inherent point of culmination but a necessary temporal delimitation because they require a constant input of energy from an agent to be maintained

⁹ Stative verbs in Russian normally lack a perfective form, except for the aspectual pairs of the type *ponimat’* vs. *ponjat’* (‘understand’) – ‘perfektnye pary’ in terms of Paducheva (1996).

¹⁰ Bertinetto (1997), Smith (1997) use [– durative] instead of [+ punctual]; for more details on achievements and punctuality, see Section 4.2.

(cf. Comrie 1976: 49). Because there is no culmination, activities can be temporarily delimited at any given point in time (Breu 2009: 218). Typical activities are *talk, hold, run, or sing*. Accomplishments can be defined as complex¹¹ situations consisting of an activity-like first phase, and a second phase of a point of culmination, which entails a state-like result (Breu 2009: 219). Typical examples are *build, go bad, go away, sit down, prepare*. Usually, the activity-like phase is incremental and involves a patient argument: the activity of building something, e.g. a house consists of an incremental increase in the portion of the house that is built.¹² The latter does not have to be reached in each instance of an accomplishment context, though. A verbal expression can also point to the activity-like phase: the progressive expression *I am learning* does not refer to the point of culmination in which the speaker of that utterance has learnt something; it rather refers to the first activity-like phase of that accomplishment, focusing on the mental activity of learning without pointing towards its result. The exact characteristics of achievement verbs are probably the most controversial ones, especially regarding their distinction from accomplishments. Following Binnick (1991), Durst-Andersen (1994: 105-106), Filip (1999: 111), Tatevosov (2002), Smith (1997: 31), Breu (1994), achievements only refer to the change of state (culmination) and the state-like result phase entailed by the change of state (in contrast to accomplishments, which necessarily refer to the activity phase that leads to the change of state or culmination). Examples are *find, start, chose, save*.

Figure 7 illustrates the semantic map for actionality types based on this set of binary features that serves to distinguish the four actional classes. Overlap of features between individual actional classes is represented on the map below by boxes.

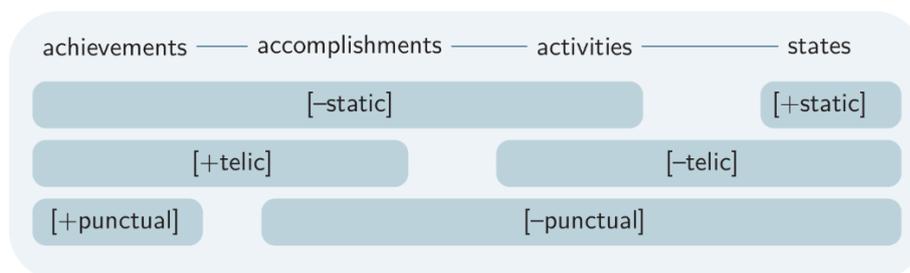


Figure 7. Semantic map for actionality types

It is remarkable that the map for the basic actional types has not been explicitly proposed before in the vast literature on actionality and aspect, even though it resonates with the ideas

¹¹ Although the representation of accomplishments varies in its details across theories, many approaches analyse accomplishments as complex, involving the two phases of a process/activity and a change of state entailed by that activity (cf. Dowty 1979, Kearns 2003, Tatevosov 2008: 394, Tatevosov & Ivanov 2009: 88, Binnick 1991: 195). Here, we mention Breu (2009), who labels such verbs “gradually-terminatives”, since the empirical part in Section 4 is based on Breu’s distinction of actional classes.

¹² Accomplishments do not have to be transitive, though: *sit down* or *go away* equally denote accomplishments that are intransitive, involve no patient argument, but consist of an activity-like action that is incremental and eventually reaches a point of culmination.

of aspectologists like Breu (1994), Johanson (2000), Sasse (2002).¹³ Indeed, this map directly follows from the traditional feature decomposition of actionality types as well as from conventional conceptualization of the maps, where neighboring (connected) categories are assumed to share semantic features (e.g., Malchukov (2010), Zwarts (2010); see Georgakopoulos and Polis (2018) for an up-to-date discussion of the semantic maps methodology). As such, the semantic map constrains the distribution of aspectual forms through imposing a contiguity requirement; that is if a certain aspect is shared by achievements and activities it should be present with accomplishments as well. Yet, as a comparison of Figure 6 and Figure 7 shows, the hierarchy in Figure 6 makes further predictions as it involves directionality predicting preferences (and dispreferences) of combination of certain aspectual categories with actionality types. Thus the hierarchy in Figure 6 predicts that the perfective aspect has achievements as a natural domain of application, while imperfective forms have states and activities as a natural domain of application (cf. Sasse 2002: 206-207). This means that we expect achievements to be unmarked when perfective, and marked when imperfective, and vice versa for states. As was mentioned earlier, local markedness can be observed in the relative frequencies of such value combinations, which is why we also expect marked combinations to be less frequent in language use than unmarked combinations.

This hypothesis received partial confirmation in the literature. Thus, Croft (2012: ch. 4), building on Croft and Poole (2008), reanalysed Dahl's 1985 typological dataset (250 contexts across 64 languages) of tense aspect categories using multidimensional scaling. Their analysis confirmed an association between perfective forms being used mostly with achievements, and imperfective forms being mainly used with unbounded (atelic) predicates, i.e. states and activities.¹⁴ These results, while providing a solid crosslinguistic overview, do not tell us much about the frequencies of such actionality-aspect combinations in usage within single languages yet, given that they use a limited number of contexts, focusing on default situations (cf. Dahl (1985: 198-206) for the TAM questionnaire). As we will show in Section 4, using corpus data from four languages, these preferences or markedness relations between actional and aspectual values are indeed reflected in their frequencies in language use as well.

Moreover, apart from preferences, the hierarchy in Figure 6 predicts that if an aspectual category is extended beyond its natural domain, the extension proceeds in accordance with the hierarchy. That is, the availability of imperfective aspect with achievements would imply that it is also found with all the other verb types; conversely, the availability of a perfective

¹³ Tatevosov (2016) proposed a semantic map for actionality types which is different from the map in Figure 6. Tatevosov's work is a remarkable typological contribution, yet his maps are inheritance hierarchies rather than conventional semantic maps supported by overlapping features. Similarly, the semantic map for Russian aspect suggested in Janda (2007) is not a conventional map but a radial category in the cognitive grammar tradition, which further attempts to capture derivational relations between activities (typically expressed by simplex verbs) in the centre of the map and different types of their perfective derivatives.

¹⁴ It should be noted though that aspectual distributions **within** subclasses of telic (achievements, accomplishments) and atelic (activities, states) predicates and their relative preferences with respect to viewpoint aspect are less clear from Croft's 2012 findings.

aspect for states would predict that it is also found with other verb types. Furthermore, our approach predicts that if an aspectual category is extended to a less natural domain, either its lexical or grammatical value may be reinterpreted in an infelicitous combination. For example, in Arabic, aspectual distinctions are inflectional and are extended to states like ‘love’ and ‘sit’ as well; yet, when a state is used in the perfective form it receives an inchoative interpretation (Xrakovskij et al. (2009): *yadlisu ziyd ‘al l-kursiyyi* ‘Ziyad sits on the chair’ vs. *dalasa ziyd ‘al l-kursiyyi* ‘Ziyad sat down on the chair’). In aspectual studies, this is often construed as evidence for postulating a special class of “inchoative-stative verbs” (Johanson 2000, Tatevosov 2002, 2016¹⁵). However, in the work of Xrakovskij et al. (2009) this pattern is interpreted in terms of reanalysis (coercion¹⁶) more in line with Brey’s 1994 approach, or, more generally, in line with ‘derivational approaches’ to aspectual construal in the sense of Croft (2012: ch. 3).

In other languages, the marked (least natural) combination such as perfective states may be simply lacking. Thus, in Russian most stative verbs lack a perfective form, on a traditional interpretation of an aspectual pair (see Footnote 8 above). Similarly, imperfective achievements, another marked combination, may be either lacking in individual languages (cf. **is finding* in English) or may be reinterpreted; cf. Russian *naxodit* ‘finds repeatedly’, with an achievement coerced into iterative (serial) event in the context of (present) imperfective.

Thus, the hierarchy in Figure 6 above predicts that felicitous combinations (imperfective aspects for states, perfective aspects for achievements) will always be available,¹⁷ while infelicitous combinations (e.g., imperfective aspect with achievements; perfective aspect with states) will be either blocked or reinterpreted. It further predicts that felicitous combinations would be less marked (involve structurally “lighter” - shorter or zero - markers), as compared to less natural combinations. Since less marked includes zero-marked, this prediction relates to the work by Bohnemeyer and Swift (2004) on default aspect. Similarly to our approach, Bohnemeyer and Swift (2004) highlight the natural correlation between aspectual categories and actionality classes. On the one hand, they note a typological tendency for telic verbs to contrast unmarked perfective with a marked imperfective, while for atelic verbs the pattern is reversed: an unmarked imperfective contrasts with a marked perfective. On the other hand, Bohnemeyer and Swift (2004) noted that the interpretation of the unmarked form itself can differ depending on the actional class. Thus, they proposed a concept of ‘default aspect’, pertaining to (unmarked) aspectual form, whose aspectual value depends on the verb’s actional class. Their prime example was Inuktitut (Eskimo), where the unmarked aspectual form has different interpretation for telic vs. atelic verbs; for atelic verbs it refers to present, for telic verbs it refers to recent past:

¹⁵ In fact, as shown by Tatevosov (2002), there is still more variation in this domain.

¹⁶ See De Swart (1998), Michaelis (2006) on aspectual coercion.

¹⁷ Unless blocked / pre-empted by a lighter marker; cf. impossibility of progressive (marked imperfective) with (permanent) states in English.

(5) Inuktitut (Bohnmeyer and Swift 2004: 267)

- a. *Pisu-ttuq*
walk-PART.3SG
'He/she is walking.'
- b. *Ani-juq*
go.out-PART.3SG
'He/she went out.'

Thus, according to Bohnmeyer and Swift (2004), the interpretation of the default aspect in Inuktitut depends on the telicity of the verb. Later research showed that this conclusion needs certain correction; Clarke (2009) showed that in fact only achievements in Inuktitut receive a recent past interpretation, while accomplishments pattern in that respect rather with atelic verbs. Still, the concept of default aspect is an important one, since many languages manifest aspectually ambiguous forms, whose interpretation depends on the actionality of the verb (see Shluinsky (2012) for a recent overview of such forms, which he calls 'factatives'). Moreover, the concept of default aspect finds independent support in acquisition studies. Thus, Shirai and Andersen (1995) propose an Aspect Hypothesis according to which learners first use past and perfective marking for achievements and accomplishments, and imperfective marking for activities and states.

It is interesting to consider Tungusic languages (Evenki and Even) from this perspective. Both Evenki and Even have a form traditionally called 'aorist', whose temporal interpretation depends on actionality. In modern grammars (Nedjalkov 1997, Robbek 1982) the aorist form in *-ra-/-re-/-a-/-e-* is commonly labelled nonfuture and contrasted with the future marker *-d'i-* as one of the two basic temporal forms of the verb. In Even, as shown by Robbek (1982:38-42) and others, the temporal interpretation depends on actionality (telicity): atelic verbs (states and activities) refer to present (6c), (6d), telic verbs (accomplishments and achievements) to the (recent) past (6a), (6b).

(6) Even (fieldnotes)

- a. *Hepken-e-m*
catch-AOR-1SG
'I caught'
- b. *Hör-re-m*
go-AOR-1SG
'I left.'
- c. *Nuulge-re-m*
nomadize-AOR-1SG
'I nomadize'
- d. *Haa-ra-m*
know-AOR-1SG
'I know'

Thus, telic verbs (achievements as in (6a) and accomplishments as in (6b)) refer to the recent past in Even, and need to be combined with the progressive marker *-d'* in order to refer to (actual) present (*hepken-did-de-m* 'I am trying to catch'; *höre-d-de-m* 'I am leaving'). The situation in Evenki is similar, only that all verbs except for states (such as *saa-* 'know', *bi-* 'be') are interpreted as referring to the past (Nedjalkov 1997).¹⁸ This may be due to the fact that the progressive aspect is more grammaticalized in Evenki as compared to Even (Gorelova 1979, Nedjalkov 1997).

While according to the conventional view, the temporal interpretation depends directly on the actionality (telicity) of the verb (aorist/nonfuture receives a past interpretation with telic verbs, and a present tense interpretation with atelic verbs), there are good reasons to believe that this relation is mediated by aspect along the lines envisaged by Bohnemeyer and Swift (2004). Indeed, if telic verbs in the unmarked form are assigned the perfective value by default, this explains why they cannot refer to the present (see Malchukov (2009) on perfective presents as an infelicitous combination). Moreover, this analysis is not that unorthodox for the field of Tungusic studies either. In fact, it is in line with the analysis of the Evenki aspectual system by Gorelova (1979: 82-83), who assumes a binary aspectual opposition for Evenki¹⁹ with the unmarked perfective opposed to the marked imperfective in *-d'e-*:

(7) Evenki (cf. Gorelova 1979: 82-83)

- a. *Eme-∅-re-n*
come-PFV-AOR-3SG
'He came.'
- b. *Eme-d'e-re-n*
come-IPFV-AOR-3SG
'He is coming.'

In principle, we follow this analysis, except for the fact that the zero aspect is treated as a variety of a default aspect rather than a zero perfective here, given its behavior with stative predicates. That is, the unmarked default aspect has the imperfective value when combined with stative predicates and has a perfective value elsewhere. As a result, non-future forms in Evenki refer to the present only if derived from stative predicates (see meaning (b) mentioned in Footnote 17), and refer to past with other actional classes. Figure 8 shows the distribution of the default aspect (more specifically, the default perfective) in the three languages

¹⁸ "Non-future tense forms in *-rA* [...] have four meanings: (a) aoristic (a single perfective recent past action), with verbs of achievement, accomplishment and activity; (b) present of prolonged state, with verbs of state; (c) present habitual with verbs having the habitual aspect marker *-ngnA*; (d) past imperfective, with a few activity verbs" (Nedjalkov 1997: 237).

¹⁹ Numerous other aspectual forms in Evenki are treated by Gorelova (1979) as aspectual derivation (aktionsarten), since they are far less frequent as compared to the progressive marker.

(Inuktitut, Even, Evenki). As is indicated on the map, the interpretation of the default (zero-marked) aspect differs across languages, but it is still constrained by the hierarchy:



Figure 8. Default perfective and actionality classes in three languages

As noted above, the default perfective in Inuktitut is only found in the context of achievements (punctual verbs in Clarke (2009)); in Even, it is found with all telic verbs (both achievements and accomplishments), while in Evenki, it is further extended to activities (only states induce default imperfective in Evenki). As can be seen from Figure 6, this distribution is in accordance with the hierarchy,²⁰ although there may be more lexical variation in this domain that is not captured here (cf. Tatevosov 2002).

The discussion of default aspect has shown that the Actional Hierarchy above is not restricted to production, but that it also constrains the interpretation of the unmarked form. In this regard, the ambiguous ‘default aspect’ is similar to the phenomenon of ambivalent voice considered in Section 2, where the interpretation of a voice/valency marker is dependent on the lexical features (transitivity) of the verb. In both cases the ambiguity of a recessive grammeme is resolved through lexical context. Of course, in other cases an aspectual grammeme can be dominant. One well-known case of such a reinterpretation, a perfective gram combined with a state leading to an inchoative state, has been qualified above as a case of coercion.

4 Empirical evidence for the Actionality Map: A cross-linguistic corpus study

Having focused on how marked combinations of actional and aspectual classes can lead to functional reanalysis in the previous section, this section will examine the frequency distributions of such combinations comparing them with the ones of their unmarked counterparts. Using corpus data from Becker (2018), we fit a model to predict the aspectual value of single verb forms from the actional class of the verb, i.e. we test the strength of the association between actional and aspectual classes. This allows us to compare the aspectual preferences across actional classes and languages.

4.1 Verbal prefixation, actionality, and aspect

This study follows up on the pilot study by Becker (2018) which used parallel corpus data from Russian, Czech, Hungarian and German to examine the role of prefixation in the expression of aspect in Hungarian. It is well-known that the Slavic type of aspect involves derivation by

²⁰ Similar cases of interactions have been found elsewhere, e.g. in de Wit’s detailed 2017 discussion of Sranan.

prefixation to derive perfective forms from imperfective ones, together with suffixation that can derive secondary imperfectives from those derived perfectives (e.g., Bondarko 1987, Breu 1980, Dickey 2000, Janda 2004, Lehmann 2009). For instance, example (8) shows three perfective verbs that can be derived from the imperfective form *pisat'* 'write.IPFV' through prefixation in Russian. Such forms can then usually be turned into imperfectives by means of suffixation, as is shown in example (9). Note that not all perfectives necessarily have such a secondary imperfective partner; *na-pisat'* 'write.PFV', for instance, lacks such a form.

(8) Russian (personal knowledge)

- a. *na-pisat'* 'write.PFV'
- b. *pere-pisat'* 'rewrite.PFV'
- c. *po-pisat'* 'write for a while.PFV'

(9) Russian (personal knowledge)

- a. *pere-pisat'* → *pere-pis-yva-t'* 'rewrite.IPFV'
- b. *po-pisat'* → *po-pis-yva-t'* 'write.IPFV for a while (repeatedly)'

Both Hungarian and German also make use of extensive verbal prefixation. For Hungarian, it has been argued that prefixation telicizes or perfectivizes the verb (Arkadiev 2015, Csató 1994, Csirmaz 2006, Forgács 2004, Kiefer 2006, Kiefer and Németh 2012, Piñón 1995, Soltész 1959). Thus, verbal prefixation is certainly involved in marking actional and aspectual values in Hungarian. Example (10) shows this use. Moreover, verbal prefixation is the only morphological device in the language to express aspect, given that the inflection tense system only distinguishes between past and non-past without making further aspectual distinctions.

(10) Hungarian (personal knowledge)

- a. *történik* 'happen.IPFV' → *meg-történik* 'happen.PFV'
- b. *épít* 'build.IPFV' → *fel-épít* 'build.PFV'
- c. *öl* 'kill.IPFV' → *meg-öl* 'kill.PFV'
- d. *fordul* 'turn.IPFV (itr)' → *meg-fordul* (itr) 'turn.PFV around once'

However, prefixation is also used to derive new lexemes (11) or to mark changes in the verbal argument structure (12). In such cases, it is less evident to what extent verbal prefixation involves telicization or perfectivization.

(11) Hungarian (personal knowledge)

- a. *ad* 'give' → *el-ad* 'sell'
- b. *ejt* 'drop' → *ki-ejt* 'pronounce'
- c. *vesz* 'take' → *fel-vesz* 'put on (clothes)'
- d. *alszik* 'sleep' → *meg-alszik* 'turn sour, curdle, clot, stop working (machine)'

(12) Hungarian (personal knowledge)

- a. *beszél* 'talk (itr)' → *meg-beszél* 'talk about / discuss something (tr)'

- b. *csal* 'cheat (itr/tr)' → *meg-csal* 'deceive (tr)'
- c. *gondol* 'think (itr/tr)' → *át-gondol* 'think something over (tr)'

In German, verbal prefixation (traditionally discussed under the label of “particle verbs”) is not primarily used to mark aspect. It rather expresses spatial orientation (13), telicization (14), derives new, semantically more specific or abstract lexemes (15), and it is often involved in changes in the argument structure of the verb (16) (Dehé 2015, Lüdeling 2001, Olsen 1996, Stiebels 1996).

(13) German (personal knowledge)

- a. *legen* 'put (horizontally)'
- b. *ab-legen* 'put down'
- c. *hin-legen* 'lie down'
- d. *um-legen* 'put around, turn around, put/knock down'

(14) German (personal knowledge)

- a. *essen* 'eat' → *auf-essen* 'eat up'
- b. *warten* 'wait' → *ab-warten* 'wait until something is done'
- c. *füllen* 'fill' → *auf-füllen* 'fill up'
- d. *stören* 'disturb' → *zer-stören* 'destroy'

(15) German (personal knowledge)

- a. *stützen* 'support physically' → *unter-stützen* 'support (e.g. economically)'
- b. *tragen* 'carry' → *be-auf-tragen* 'instruct'
- c. *schlagen* 'hit' → *nach-schlagen* 'look up'
- d. *fangen* 'catch' → *an-fangen* 'begin'

(16) German (personal knowledge)

- a. *arbeiten* 'work' → *be-arbeiten* 'work something.ACC'
- b. *fallen* 'fall' → *be-fallen* 'attack, strike'
- c. *drängen* 'urge' → *auf-drängen* 'impose on someone'
- d. *folgen* 'follow someone.DAT' → *ver-folgen* 'follow someone.ACC'

Verbal prefixation in German is therefore yet less clearly related to the coding of actional and aspectual values than in Slavic or Hungarian. Similarly to Hungarian, though, German does not have other morphological devices in the verbal domain to express aspect. Hence, the aspectual interpretation of the situation results from the context and the combination of tense and actionality (cf. Section 4.2).

Becker (2018) investigated how similar the system of verbal prefixation in Hungarian is compared to Slavic in terms of the expression of aspect, with Russian and Czech as an East and West Slavic comparison, and with German as a baseline for a non-aspectual prefixation system. Thus, Becker (2018) examined the role of verbal prefixation amongst other factors (actional class, negation, tense, mood, transitivity) in the expression of aspectual values

across the four languages. Using supervised learning (random forests), the study found that Hungarian is indeed much more similar to Slavic than German is. In Slavic, the classification of a verb form as perfective or imperfective mostly depends on the presence of a perfectivizing prefix, tense (in Russian), and the actional properties of the verb (in that order). In Hungarian and German, on the other hand, the actional class of the verb form was by far the best predictor for its aspectual value; in Hungarian, however, the presence of a prefix was shown to play an important role as well, as is the case in Slavic. This is relevant for the present study in that it confirms that the languages examined here can be divided into three types: Russian and Czech, where the expression of aspect is hard-wired into the morphological make-up of verbs; Hungarian, which marks actionality and aspect to some extent morphologically, and German, where actionality (but not aspect) is sometimes coded morphologically through verbal prefixation. Therefore, data from these languages allows for an analysis and comparison of the association between different actional and aspectual values across different types of system regarding the explicit coding of aspectual values.

4.2 Data and annotation

The dataset consists of parallel movie subtitles taken from the ParTy corpus (Levshina 2016). Since the original subtitles are in English, the subtitles in Russian, Czech, Hungarian, and German are translations. We assume that the expression of aspect should not be affected by it to any substantial extent.²¹ The choice of parallel movie subtitles was motivated by the fact that the texts across the four languages refer to the same contexts. This makes it possible to control for semantic and pragmatic effects that may interact with actionality and the expression of aspect (cf. Dickey (2000), Wiemer (2008) for pragmatic effects on aspectual distinctions in Slavic).

Actionality was annotated manually²² and separately for each verb form in the four languages, following and adapting the classes proposed in Breu (1994, 2000, 2009): relative-stative, activity, gradually-terminative, and totally terminative verbs, which largely correspond to the four Vendlerian classes. Actionality was annotated for verb forms and not lexemes; this allowed for single lexemes to belong to more than one actional class.²³

The stative verbs included in this study, relative-statives, denote states which do not require energy to be maintained and which have no inherent temporal boundaries. However, an

²¹ As an anonymous reviewer correctly pointed out, we cannot exclude with certainty the possibility that some aspectual choices could be influenced by the English original. Given that all the languages analysed here are translations from the same English original, and given that we do find substantial differences across the four languages in how aspectual values are coded, we do not think that the English original substantially distorts our findings. There are other studies concerned with aspect that make use of translations in order to compare the expression of equivalent situations directly across languages, e.g. Dickey & Kresin (2009).

²² There is a number of quantitative corpus studies that explore the automatic identification of verb classes, (cf. Falk & Martin 2016, Schulte im Walde 2009). However, this seems to be only possible within single languages on the basis of richly annotated corpora. On the other hand, Drozd et al. (2015) showed that aspectual values can successfully be induced without additional semantic or syntactic annotation.

²³ The dataset is part of the online supplementary materials ("dataset.csv").

additional temporal delimitation can be imposed (Breu 2000: 37).²⁴ Totally-stative verbs were excluded because only relative-statives are compatible with both imperfective and perfective aspects in Slavic, and most likely, also in the other languages. Examples of relative-stative verbs are *belong to, own, like, know*; an example from the corpus is given in (17).

- (17) *Either way, you'll shine.* (stative)
- a. Russian
tak ili inače, no ty budeš' blistat'.
 like.this or like.that but you will.2SG shine.IPFV
- b. Czech
Ať to dopadne jakkoli, budeš' zářit.
 whether it turn.out.PFV.3SG so will.2SG shine.IPFV
- c. Hungarian
Így vagy úgy, de ragyogni fogsz.
 like.this or like.that but shine will.2SG
- d. German
*Auf die ein oder andere Weise, du wirst auf
 on the one or other way you will.2SG on
 der Bühne strahlen.
 the stage shine*

Activities and accomplishments were classified and annotated according to their definitions given in Section 3. These two actional types are illustrated by an example from the corpus in (18) and (19), respectively.

- (18) *I was dancing the White Swan.* (activity)
- a. Russian
ja tancevala partiju beloju lebedi.
 I dance.IPFV.PST part.ACC white.GEN swan.GEN
- b. Czech
Tancovala jsem roli Bílé labutě.
 dance.PTCP was.1SG role.ACC white.GEN swan.GEN
- c. Hungarian
Én táncoltam a Fehér Hattyút.
 I dance.PST.1SG the white swan.ACC
- d. German
Ich tanzte den weißen Schwan.
 I dance.PST.1SG the.ACC white.ACC swan.ACC

- (19) *Open those gates* (accomplishment)

²⁴ Breu (1994, 2000) makes the distinction between “totally-stative” verbs, which cannot receive an external temporal delimitation (*weigh, be called, consist of*) and relative-statives.

- a. Russian
otkroj *svoi vorota*
open.PFV.IMP your gates.ACC
- b. Czech
otevřete *brány*
open.PFV.IMP gate.ACC
- c. Hungarian
nyisd *ki* *kapuidat*
open.IMP PFX:out gate.yours.ACC
- d. German
öffnet *die* *Tore*
open.IMP the.ACC gates.ACC

As mentioned in Section 3, the definition of accomplishments is the most controversial one and differs across approaches. Using punctuality as the feature to distinguish achievements from accomplishments, as shown in Figure 7 in Section 3, has not stayed unchallenged. Dowty (1986), Engelberg (1999), Tatevosov (2002), Verkuyl (1989) have argued that, if punctuality is taken as an instantaneous event, achievement verbs are not necessarily punctual but can also have a certain (short) temporal duration. Therefore, we did not use punctuality as a criterion to classify verb (forms) here. Rather, following Breu (1994), forms were annotated as achievements only if they refer to the change of state (culmination) and the state-like result phase entailed by the change of state (in contrast to accomplishments, which necessarily refer to the activity phase that leads to the change of state or culmination). A corpus example of achievements is given in (20).

(20) *Are you here to kill me?* (achievement)

- a. Russian
ty *prišël* **ubit'** *menja?*
you come.PFV.PST kill.PFV me.ACC
- b. Czech
Jste *zde,* *abyste* *mě* **zabil?**
be.PRS.2SG here COMP.2SG me.ACC kill.PST.PTCP
- c. Hungarian
Idejött, *hogy* **meg-öljön?**
here.come.PST.3SG COMP PFX-kill.COND.3SG
- d. German
Sind *Sie* *hier,* *um* *mich* **um-zu-bringen?**
are you here for me.ACC PFX-to-kill

The dataset of the corpus study consists of 588 comparable verb forms in each of the four languages Russian, Czech, Hungarian, and German. The distribution of actional classes is very

similar and thus comparable across the four languages. In general, activity verbs are the most frequent ones in the dataset (around 150 tokens per language), while stative verbs are somewhat less frequent than the other verb types (around 95 tokens per language), which simply reflects the distribution of verbs across actional classes in language use.

The annotation of aspect corresponds to the classification of verbs into perfective and imperfective forms. Perfective forms present a situation, independently of their inherent lexical properties, as a situation limited in time.²⁵ Thus, if a situation does not have an inherent inner temporal limit, the perfective aspect imposes such a limit externally. Imperfectives, on the other hand, present a situation with no temporary limit, i.e. as *non-terminative* or *unbounded*.

Since aspect is a grammatical category of verbs in Slavic, the aspectual value of a verb form in Russian and Czech directly followed from the form of the verb itself, given that all forms included could unambiguously be identified as either perfective or imperfective forms. Since Hungarian and German do not encode aspect in this way, the classification of verb forms as perfective or imperfective in those two languages was based on the interaction between the context, the lexical semantics of the verb, the tense, mood, and argument structure of a given verb form. On the basis of these factors, a verb form was classified as perfective if it presented the situation as a temporarily limited one or as a situation with an (imposed) temporal limit (*terminative*). If a verb form presented the situation as temporarily unlimited without any (imposed) temporal limit (*non-terminative*), then it was annotated as imperfective. Examples of German and Hungarian imperfective and perfective verbs from the data set are given in (21) and (22).

(21) imperfective

a. German

Wir graben hier.
 we dig.PRS.1PL here
 ‘We mine here.’

b. Hungarian

Azt akarom, hogy a papám énekeljen nekem.
 that.ACC want.1SG.DEF COMP the dad.POSS:1SG sing.SUB.3SG DAT:1SG
 ‘I want my daddy to sing to me.’

(22) perfective

a. German

Helfen Sie uns mit diesem Zeug?
 help.IMPER you us with this.DAT things
 ‘Are you going to help us with this gear?’

²⁵ This corresponds to what e.g. Arkadiev (2015: 23) and Paducheva (2009) call “terminative”, and what is labelled “bounded” in e.g. Binnick (1991), Richardson (2007), Verkuyl (1993).

- b. Hungarian
Senki sem fogja meg-látni.
 no.one NEG will.3SG.DEF PFX-see
 'No one will see it.'

4.3 Results

Figure 9 shows the distribution of aspectual values in the data set across verb forms of the four different classes. Already the raw counts in Figure 9 suggest that the combinations of aspectual and actional values in the data set corroborates the predictions of the Actionality Hierarchy outlined in 3: stative verbs have by far the lowest proportion of perfective verbs in all four languages. Activities also show a preference for the imperfective, but to a lesser extent, especially in the two Slavic languages. Accomplishment and achievement verbs, on the other hand, show a clear trend towards being expressed as perfectives in all languages. In addition to those trends, Figure 9 shows that we do not find a clear-cut distinction between the two atelic classes (states, activities) on the one hand, and the two telic classes (accomplishments, achievements) on the other in any of the four languages. Rather, we can see a gradual trend across the four classes along the Actionality Hierarchy. States and achievements, the two extreme values on the hierarchy, have a much more unequal proportion of perfective vs. imperfective forms than activities and accomplishments, the two mid-values. Thus, the raw distributions shown in Figure 9 reflect the gradual proportional increase of perfectives from states to achievements, while the proportion of imperfectives gradually decreases.

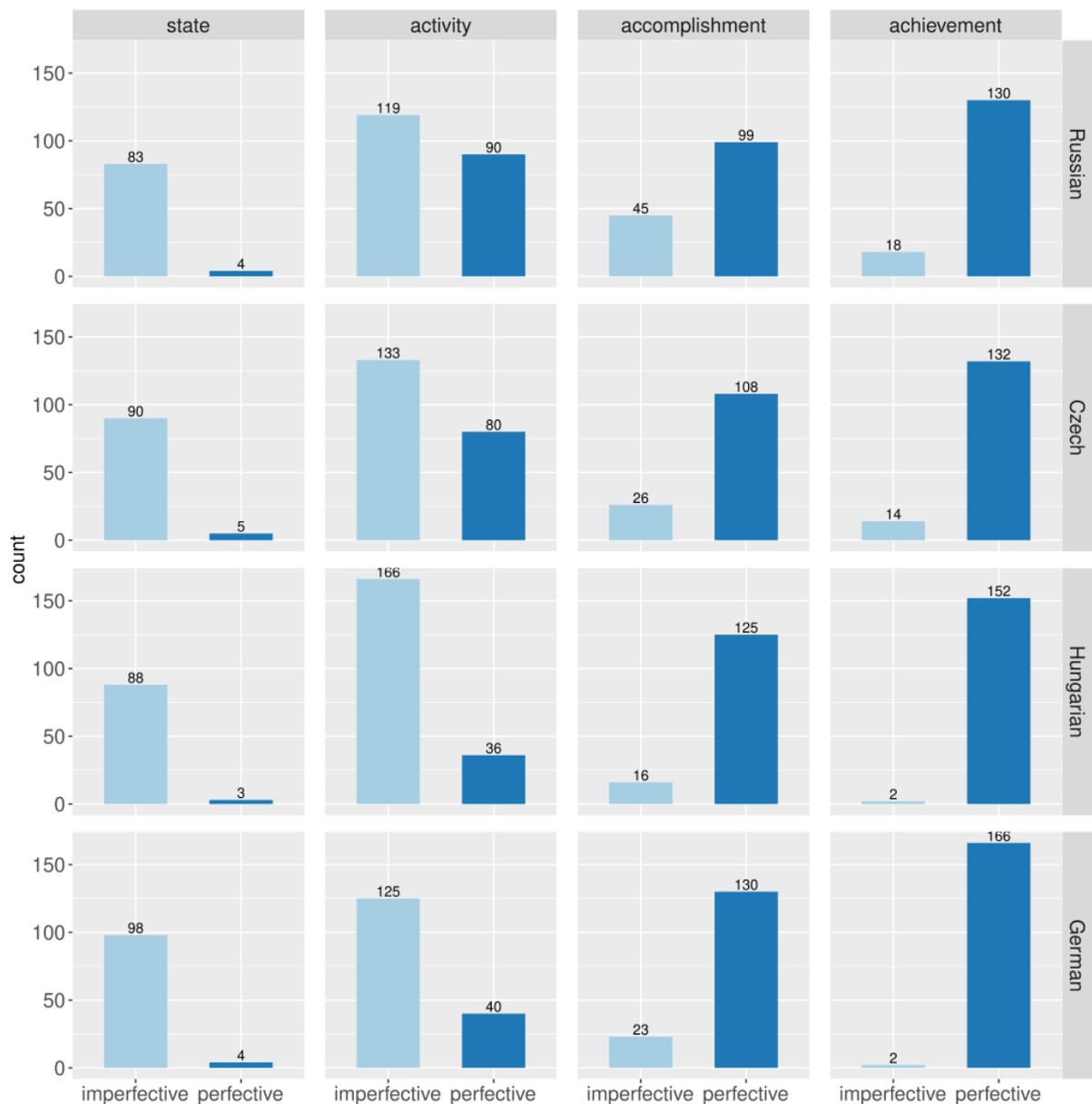


Figure 9. Aspectual values across actional classes in the four languages

In order to examine the relation between actional classes and aspectual values as suggested by the raw counts in more detail, a binomial regression model was fitted using Bayesian methods (Markov chain Monte Carlo sampling with Stan) with the brms package (Bürkner 2017, 2018) in R (R Core Team 2019). The model fitted is described in (23):²⁶

- (23) A binomial regression that models the proportion of perfective and imperfective forms as a function of the actional class and language. This estimates the association between the actionality of the verb and the probability of perfective/imperfective forms in the four languages:²⁷ $\text{aspect} \sim \text{actional class} * \text{language}$

²⁶ This description is adapted from McElreath (2015: 304).

²⁷ For details about the model, see the code in the online supplementary materials (“code.R”).

In opposition to the “traditional” frequentist approach, Bayesian models do not assume single coefficients, e.g. for the estimated proportion of perfective verbs in this case. Instead, the coefficient is modelled as a probability distribution of many different possible coefficients. This is how certainty is integrated into the Bayesian model: many different coefficients are possible, but some are (much) more likely given the data and the model. The results of the model are shown in Figure 10. We see four plots for Russian, Czech, Hungarian and German which in turn show the probability density functions of the estimated proportions of (im)perfective verbs for states, activities, accomplishments, and achievements. The x-axis includes values between 0 (imperfective) and 1 (perfective): the closer the value is to 0, the higher the proportion of imperfective forms, and the closer the value is to 1, the higher the proportion of perfective forms. The density functions visualize how confident we can be in the estimated proportion: a wide curve indicates that the sample and the model do not allow for much certainty, while a narrow curve means that we can be very confident about the estimated underlying proportion. Here this means that a wide curve can be interpreted as the absence of a strong preference for either aspectual form, while a narrow curve indicates a stronger trend towards either perfective or imperfective forms. In addition, the black bars indicate a credible interval for each estimated proportion: it corresponds to 95% of the area covered by the probability density function. In other words, the credible interval is the interval that contains the underlying coefficient of the proportion with 95% certainty (given the data set and the model). The dot in the middle corresponds to the median of the probability density function; this value can be taken as the most likely coefficient for the underlying proportion of perfective and imperfective forms across actional classes and languages.

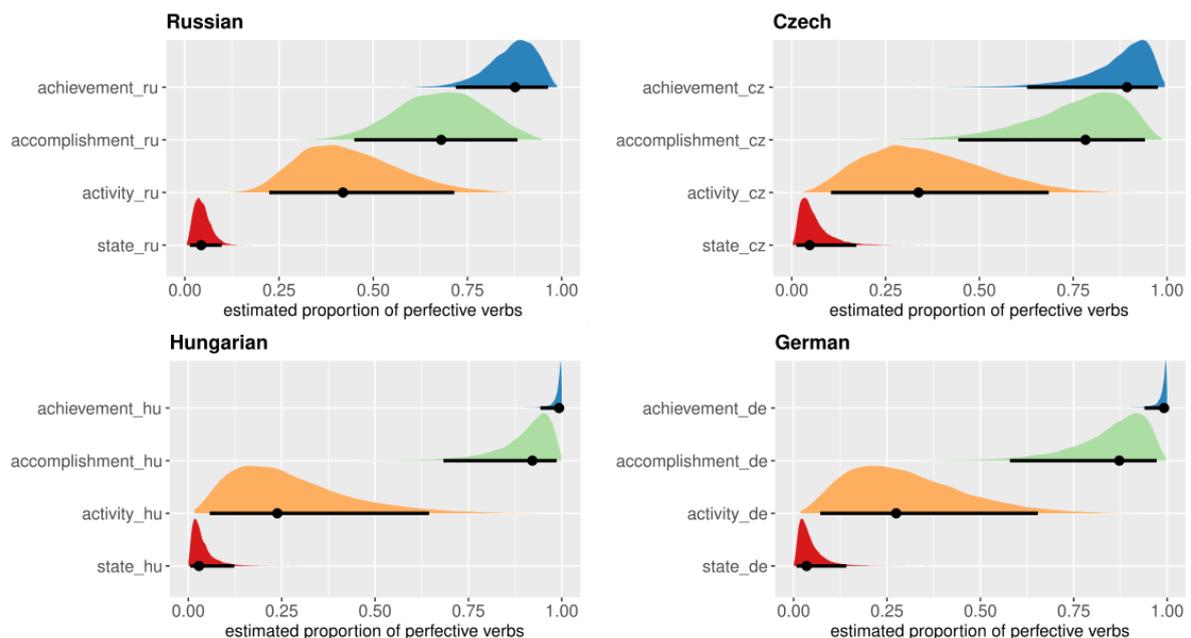


Figure 10. Estimated aspectual values across actional classes in the four languages

Figure 10 can confirm that the trend observed in the raw counts (Figure 9) holds for the underlying distributions of aspectual values across actional classes in Russian, Czech,

Hungarian, and German. For all four languages we clearly see the gradual increase of perfective forms from states to activities, accomplishments, and finally achievements, as was predicted by the Actionality Hierarchy. States have a very strong preference for imperfective forms in all four languages. In Russian and Czech, they form the class of verbs with the strongest trend towards one aspectual value. On the other extreme, achievement verbs show a strong trend towards perfective forms in all languages. This trend is the strongest one found in German and Hungarian; Russian and Czech achievement verbs on the other hand appear to allow for more imperfective forms and show a slightly less strong preference towards perfectives.²⁸

In all four languages, the verbs of the two classes in the middle of the Actionality Hierarchy, activities and accomplishments, show less clear trends concerning aspectual values, since the interval covered by the probability density function of the estimated proportion is much larger than for states and achievements. In the two Slavic languages, we additionally see a large degree of overlap between the credible intervals of those two central actional classes: this means that we cannot be certain that their underlying proportion of (im)perfective forms would be different. This illustrates well that there is no sharp division between the two atelic (states, activities²⁹) and telic classes (accomplishments, achievements) in terms of their aspectual preferences, but that we indeed find a gradual cline along the Actionality Hierarchy.

For Hungarian and German, Figure 10 shows that the preference for imperfective or perfective forms is less gradual; both achievement and accomplishment verbs show a strong preference for perfective forms, states for imperfective forms, and only activities appear to have more flexibility and despite their overall preference for the imperfective aspect, they are also relatively compatible with a perfective interpretation. This difference between the two Slavic languages on the one hand and Hungarian and German on the other is expected insofar as the former two languages feature aspect as a grammatical category of the verb, while the latter two do not. Given that aspect is incorporated formally into the verbal system in Russian and Czech, we can expect to find a higher number of “marked” combinations of actional class and aspectual value, i.e. inherently atelic verbs with the perfective aspect as well as inherently telic verbs with the imperfective aspect, as predicted by the Actionality hierarchy discussed in Section 3. Figure 10 shows for both Russian and Czech that the credible intervals for the proportion of perfective verbs with achievements, accomplishments, and activities overlap between two neighboring classes on the Actionality Hierarchy, respectively. Even though in Hungarian and German the aspectual interpretation of verbs largely

²⁸ The fact that Russian shows slightly more achievement verbs in the imperfective than Czech could be due to the fact that East Slavic typically uses imperfectives in general factual contexts, whereas West Slavic requires perfective forms for achievement verbs in such contexts, as was shown in Dickey (2000: 97-104) and Dickey & Kresin (2009: 125-126).

²⁹ The minor difference we see between Russian and Czech activities in terms of their preference for the imperfective supports the difference pointed out in Dickey (2000), Dickey & Kresin (2009): in sequences of events, Russian prefers the expression of activities by perfective forms, while Czech uses more imperfective forms.

corresponds to the unmarked value depending on whether the verb is atelic or telic, this study could show that languages which do not encode aspect grammatically into their verbal system still have a gradual preference of aspectual values across actional classes along the Actionality Hierarchy, and that aspect is by no means always determined categorically depending on the telicity of the verb. Thus, for Hungarian and German, we could show the cline along the Actionality Hierarchy in terms of strength of aspectual preference: states and achievements, the two extremes of the Hierarchy, show a much stronger preference for the unmarked aspectual interpretation than the two classes in the middle, activities and accomplishments.

5 Conclusions

In the present paper, we tried to tackle several issues relevant to semantic map research, including methodological, theoretical and empirical questions. First, we discussed the relation between semantic maps and typological hierarchies, arguing that Interaction Hierarchies (grounded in local markedness) represent a kind of hybrid structures, sharing features with semantic maps, on the one hand, and with hierarchies, on the other hand. Second, we discussed a particular case, namely the Actionality Hierarchy, which may be conceived as either an Interaction Hierarchy or a semantic map, grounded in shared features. Third, we provided empirical evidence for the Actionality Hierarchy based on parallel corpus data from Russian, Czech, Hungarian, and German. Our analysis showed that across different types of aspectual systems, the use of perfective forms increases gradually across the Actionality Hierarchy, while the use of imperfective forms gradually decreases from states, activities, accomplishments, to achievements. Thus, examining local markedness relations as usage frequencies of combinations of actional and aspectual types could show the expected markedness effects along the Actionality Hierarchy and confirm that we do not deal with categorical but with gradient preferences along the hierarchy.

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