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## What differentiates Serbo-Croatian verbal theme vowels: content or markedness?

**Stefan Milosavljević**, University of Graz, AT, [stefanmilosavljevic@gmail.com](mailto:stefanmilosavljevic@gmail.com)

**Boban Arsenijević**, University of Graz, AT, [b.arsenijevic@gmail.com](mailto:b.arsenijevic@gmail.com)

We examine two hypotheses regarding the role of theme vowels (ThVs) in Serbo-Croatian (SC): (i) that the various ThVs attested in SC are markedness-based realizations of the same syntactic feature specification, and (ii) that different ThVs carry different syntactic features. We focus on the two SC ThVs occurring with the highest number of bases: <a, a> and <i, i> (the ordered pair specifies the infinitive-stem and the present-tense-stem realization of the ThV). We show that if these ThVs are to be distinguished by feature specification, the best fitting analysis has <a, a> bearing only the categorial verbal feature, while <i, i> is additionally specified for the feature [SCALE], which contributes scalarity to the verbal predicate (Hay et al. 1999; Kennedy & Levin 2008). A corpus-based exploration shows that the stronger hypothesis (ii) encounters problems, the most obvious being that the regularities are only tendential, with a significant number of exceptions. If the ThVs carried different features, they would be expected to yield systematic patterns. We conclude that the weaker alternative (i) provides an empirically more accurate account and propose a specific model where at the interface with phonology, the aggregate degree of markedness of the context in which the ThV is realized is computed from a set of markedness hierarchies of the relevant phonological and semantic properties of that context (the latter mediated by the corresponding syntactic features). A mapping of the aggregate degree of markedness onto the morphological markedness hierarchy of ThVs determines the realization.

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## 1 Introduction

A verbal theme vowel (ThV) in Serbo-Croatian (SC) is typically a single vowel as in (1a), but possibly also richer material as in (1b'), standing between the base (whereby we mean the root or other expression that builds a verb by combining with verbal morphology) and the inflection of the verb. It is traditionally taken to adhere with the base, thus forming a stem. In case the language maps a single set of features to various sets of realizations (different inflection classes: declensions, conjugations, comparisons), the ThV is also taken to specify the stem for the inflection class (e.g. Aronoff 1994; see Oltra-Massuet 2020 for a detailed overview).

- (1) a. snim-i-ti  
 record-THV-INF  
 'record'
- a'. snim-i-m  
 record-THV-PRS.1SG  
 'I record'
- b. zob-a-ti  
 peck-THV-INF  
 'peck'
- b'. zob-lje-m  
 peck-THV-PRS.1SG  
 'I peck'

A majority of ThVs in SC have two different realizations depending on the verb form – as illustrated in the contrast between the infinitive and the present of the verb *zobati* in (1b, b'). Traditionally, they are referred to as the infinitive and the present tense ThV, forming, respectively, the infinitive and the present tense stem. We therefore refer to each ThV as an ordered pair of the infinitive and present tense realization, in that order: e.g. <i, i>, <a, je>.

Due to their lack of systematic semantic, syntactic, morphological or phonological conditioning or effects, since its early days, the research of grammar found ThVs extremely difficult to model and explain. It is unclear whether they are morphemes or completely lack underlying representations, whether they have different underlying representations or are different realizations of the same underlying item, whether they make constituents with the base or with the inflection.

In formal literature, different accounts have been proposed for ThVs, ranging from the lexicalist paradigm-based approaches like Aronoff (1994), to syntactic analyses associating different ThVs with different features and heights in the structure such as Jabłonska (2004; 2007); Taraldsen Medová & Wiland (2019).

Aronoff (1994) has verbs listed with class indices which govern realization rules for the inflection, including ThVs. This account is able to capture the data, but needs abundant lexical storing. Additional complications emerge when the same base takes two or more different ThVs. Finally, this approach fails to explain not just the existence of ThVs, but also the regularities that they show, such as those discussed in this paper. Oltra Massuet (1999a; b; 2020) models ThVs as bundles of subatomic abstract features  $[\pm\alpha, \pm\beta, \pm\gamma]$  forming a feature geometry, which are adjoined to every functional head in the verb's projection. Her analysis, coached in the Distributed Morphology (DM, Halle & Marantz 1993), employs readjustment rules in late insertion to account for their surface forms. While her approach sheds light on the underlying structure, it either predicts that ThVs will induce certain semantic or phonological regularities, corresponding to the different configurations of the three features involved, or involves fully vacuous syntactic and phonological operations. While she significantly simplifies the model by getting rid of the need for (giant) lists in favor of combinations of the three features, the failure to identify them reduces the gain of the analysis. Fabregas (2018), also in the DM perspective, models ThVs in the verbal domain as realizations of the verbal category head  $v$ , just like verbal(izing) suffixes. His analysis takes vocabulary insertion of the category feature to involve contextual allomorphy (relative to a list of categories, roots and inflections), thus yielding different realizations including traditional ThVs and suffixes. This approach suffers from a similar problem as Aronoff's in requiring long lists of individual items which trigger particular allomorphs, and needing an additional tool to handle those bases that take more than one item from the union of verbal themes and suffixes.

Although semantic and syntactic regularities related to different ThVs are observed in the literature, they are usually only briefly reported, without extensive analyses. For instance, it has been noted that Slavic verbs with different ThVs correlate with different argument and/or aspectual properties (Svenonius 2004a: 181–185; Milićević 2004; Romanova 2004; Griбанова 2013: 131–133; Kagan 2016a: 33), but the correlation is in most cases described as tendential, and no systematic explanations are offered. The most articulated proposals of syntactic and semantic analysis of ThVs come from the approaches coached within Nanosyntax and those broadly compatible with nanosyntactic architecture (e.g. Jabłonska 2004; 2007; Taraldsen Medová & Wiland 2018; 2019). This comes as no surprise, since Nanosyntax does not assume an autonomous component responsible for morphology (cf. e.g. Starke 2009), hence there is no 'space' for an analysis of ThVs as pure markers of the conjugation class membership. For instance, Jabłonska (2004) provides data from Polish showing strong correlations of ThVs, analyzed as verbalizers, and different syntactic classes of verbs: one group of ThVs correlates with unaccusative syntax, while another occurs in unergative and transitive verbs. She proposes an account according to which the two groups of themes determine the structural position of root insertion, thus setting a limit to what the root can name. Themes from the first group can only name a BECOME predicate, while those from the second group require high root insertion,

so the root names both the causing and the caused subevent. A similar type of approach – where ThVs spell out trees of different sizes (comprising different argument-structure and aspectual information) is proposed in Taraldsen Medová & Wiland (2018; 2019) for Czech and Polish. Their approach once again exemplifies the nanosyntactic credo that the attachment height of a ThV in the structure depends on the root size (see also Holaj 2018).<sup>1</sup> Within a framework compatible with DM, Kovačević et al. (2021) propose an analysis of themes <ova, uje> and <i, i> in SC as the exponents of different flavors of the verbal head *v*. Specifically, they propose that the theme <ova, uje> is an exponent of the head *v*[DO], whereas the theme <i, i> is an exponent of the unaccusative head *v*[BECOME], or alternatively of a complex head *v*[BECOME] + *v*[CAUSE], responsible for causative transitive structures. A potential drawback of these syntactic accounts lies in the tendential nature of the empirically observed regularities, i.e. in the fact that there are verbs with ThVs belonging to the opposite classes than the one predicted by their syntax and semantics (for instance, the theme <i, i> in verbs whose flavor is *v*[DO], e.g. *tegliti* ‘tow’, *grditi* ‘scold’), and that they are not few in number.

Finally, there are approaches arguing that Slavic ThVs do not form a homogeneous category, but can be split into ‘real’ verbalizers (or derivational affixes) and ‘proper’ ThVs, which may be just morphological reflexes, or ornamental morphemes (Matushansky 2009; 2021, Gribanova 2015; Simonović & Mišmaš 2022).<sup>2</sup> One of the main properties that distinguish verbalizers from ThVs in such approaches is that only the former ‘survive’ the process of secondary imperfectivization in Slavic (cf. Matushansky 2009; 2021 for Russian; but see Simonović et al. 2021 for an analysis according to which all SC themes are actually preserved after the secondary imperfectivization, even if not as segments). One problem for the ‘split’ view lies in the fact that it yields a picture where some verbs have only a verbalizing suffix, others only a proper ornamental ThV, and yet a third group has both these components – without specifying what determines this property, let alone explaining why this variation exists.<sup>3</sup>

Three general directions are available for the analysis of ThVs. For concreteness, we discuss these three directions with respect to theme vowels in SC. The weakest is to treat ThVs as completely orthogonal to syntax, inserted purely for reasons of morphology and/or phonology. On this view, the ThV carries no (morpho)syntactic features whatsoever.

An intermediate solution is to consider ThVs to have syntactic significance – but to be identical among each other in this regard. On this view, different ThVs are allomorphic realizations of the relevant set of features. As the distribution of these various realizations is sensitive to a range of

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<sup>1</sup> Holaj (2018) goes a step further, proposing that both roots and themes have different sizes, and that in Czech the thematic vowel *-i* is ‘contained’ in the thematic vowel *-á*.

<sup>2</sup> For Gribanova (2015), the proper ThVs are not just ‘ornamental’: rather, they are associated with the Asp head, but they are still inserted post-syntactically, as proposed in Oltra-Massuet (1999a; b).

<sup>3</sup> Alternatively, either null verbalizers or null ThVs are stipulated in the majority of cases in order to have them both always present in the structure (Gribanova 2015).

semantic and phonological properties of the verb, yet all these dependencies are tendential rather than absolute, modelling in terms of specific syntactic or phonological contexts cannot capture the data. We therefore consider an alternative in which the different ThVs are determined by a special procedure operating on degrees of markedness. This procedure considers a set of relevant properties of the local syntactic and phonological context of the ThV, each of which has a range of potential values which are projected on a scale of markedness, and are computed into the aggregate degree of markedness of the verb. This aggregate degree is then mapped onto the markedness scale, thus determining the ThV to be inserted, as illustrated in **Table 1** on the two most productive ThVs in SC, which will be in the focus of the paper. The relevant properties most importantly involve aspect (boundedness, scalarity) and (morpho)phonological properties of the derived verb (the final segment of the base: is it a consonant or a vowel, is it palatalized etc.), as sketched in **Table 1**.

Domain	Morph	Semantics		Phonology
Property	<i>Theme vowel</i>	<i>Boundedness</i>	<i>Scalarity</i>	<i>Shape</i>
Marked	< a, a >	Bounded	Scalar, linear	Vowel
Unmarked	< i, i >	Unbounded	Non-scalar, unstructured	Consonant

**Table 1:** Markedness oppositions among properties relevant for ThV realization.

The strongest analysis takes different ThVs to carry, i.e. realize, different syntactic features. The number of possible (well-formed) combinations of those features, their values, possibly their structural distribution too, should be equal to or greater than the number of different ThVs. For the contrast between the two ThVs in the focus of our attention, one feature which may be present or absent is sufficient. In particular, we consider the feature [SCALE] (e.g. Hay et al. 1999; Kennedy & Levin 2008) as a candidate for this role. On this approach, all verbs that are realized with the theme < i, i > and no verbs realized with the theme < a, a > are predicted to denote scalar predicates.

The present paper tackles the question which of these types of analysis suits the data best. As the weakest alternative trivially makes for a good fit, due to its weak claim, which renders it scientifically uninteresting – we only test the two stronger alternatives. Our focus is on the two largest (in terms of the number of bases they combine with) and most productive themes: < a, a > and < i, i >. The view that only classes < i, i > and < a, a > are productive is supported by the generalization that only these two classes can derive new verbs, borrowed, denominal or deadjectival, without any (visible) suffixes, as in *lajk-a-ti* ‘like-THV-INF’ or *krindž-i-ti* ‘cringe-THV-INF’. The paper reports and discusses a range of quantitative data about the differences between the two verbal ThVs in SC and their consequences for the theoretical question above. We argue

that they support the intermediate claim: all ThVs have the same feature specification – they carry the verbal category (see e.g. Svenonius 2004a; b; Fabregas 2018; Biskup 2019), and match contexts of various degrees of markedness.

Empirical data suggest that the mapping is reverse: the likelihood that a ThV be realized in a context is then inversely proportional to the markedness degree of the semantic and phonological properties manifested in it. The more marked a relevant property of the context, the less marked a ThV is preferred in realization. We do not exclude that for some possible additional factors, the mapping is direct: the more marked the property, the more marked the ThV. In section 7, we consider one such mapping. The fact that the direct mapping in section 7 is between two morphological markedness scales opens the possibility that reverse mappings are only possible between scales from different domains (i.e. semantic vs. morphological, phonological vs. semantic).

The view based on markedness is best tested in minimal pairs, where phonological contexts are the same due to the base being the same, and only semantic properties play a role. For instance, when the same base occurs only with the two investigated themes, the one with more marked semantics will take the ThV  $\langle i, i \rangle$ , as the unmarked one, and that with less marked semantics will take the ThV  $\langle a, a \rangle$ . As boundedness entails scalarity, scalarity is consulted first. Hence among a scalar and non-scalar verb, the scalar one will realize the theme  $\langle i, i \rangle$  and the non-scalar one the theme  $\langle a, a \rangle$ . If both are scalar but differ in boundedness, the bounded verb will realize the ThV  $\langle i, i \rangle$  and the unbounded  $\langle a, a \rangle$ .<sup>4</sup>

This procedure is assumed to take place at the interface with phonology. Realizational approaches to morphology postulate an interface domain after the lexical material is introduced, at which both syntactic and phonological information are available. At this point, also the realization of the ThV needs to be determined. It unrolls as follows. First, the lexical storage, however it be modelled for functional items, is consulted for the availability of idiomatic specification. In DM, this means checking for an allomorphy rule specified in terms of adjacency to an item from a list, such that the base at hand is on that list, and in Nanosyntax to checking whether there is a lexicalization for the entire structure involving the category head and its complement. If the query finds an idiomatic lexicalization, it is realized. Else, the relevant markedness hierarchies are computed to determine the aggregate degree of markedness, which is then mapped onto the markedness hierarchy of the available realizations. This determines the lexical realization of the theme vowel.

The paper is organized as follows. Section 2 introduces SC ThVs, section 3 introduces the main effects of verbal affixation in SC, and section 4 describes the source of our quantitative

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<sup>4</sup> In section 5, we also discuss triples involving the same base with different ThVs, where the opposition in scalarity is consulted first, so the non-scalar one realizes  $\langle a, a \rangle$ , and its minimal par, the scalar unbounded verb,  $\langle i, i \rangle$ . The third member, usually a scalar bounded verb, realizes a third ThV, typically  $\langle \emptyset, e \rangle$ . We also consider the possibility that ThVs are added one onto another rather than being in competition, with a similar effect.

insights. Section 5 presents and discusses the quantitative data about the bases which may combine with more than one theme, specifically with the two most wide-spread among them, <i, i> and <a, a>. Section 6 outlines the quantitative distribution when all the unique combinations of a base and a ThV (not including the affixes) in the database are considered, and in section 7, the regularities concerning the operation of apophony are analyzed. Section 8 concludes.

## 2 SC ThVs

As is the case with many other grammatical notions, ThVs cannot be defined by one property. Rather, they stand for a set of different properties, which specify a spectrum ranging between the prototypical ThVs which instantiate all of these properties and the highly questionable ones which instantiate only a few. These properties include regular occurrence between the base and the inflection, realization by a single vowel, realization including a vowel, a set of available different realizations, a relatively large set of selected bases at least for some realizations, absence of systematic semantic effects, or of systematic semantic, structural or phonological conditioning. The last property has been particularly discouraging for linguists to include these items in the modelling of grammar.

As briefly announced above, a typical SC ThV has two distinct realizations, conditioned by the verbal form. One of the two realizations combines with the base to build what is referred to as the present tense stem, the stem which takes the endings for the present tense, the imperative, the present adverbial participle and for some verbs also the imperfectum and/or the passive participle. The other realization combines with the base to build the infinitival stem, the one that takes the endings for the infinitive, the aorist, the active participle, the past adverbial participle, and for some verbs also the imperfectum and/or the passive participle. **Table 2** illustrates the ThV <a, je>, which forms both the imperfectum and the passive participle from the infinitival stem, and **Table 3** illustrates a verb with the theme <e, i>, which builds the passive participle from the present tense stem, and the imperfectum from both, depending on the variety.

a) The infinitive stem									
<i>a</i>	AorSg	AorPl	IpfSg	IpfPl		Inf	ActP	PstAdvP	PassP
1	pis-a-h	pis-a-smo	pis-a-ah	pis-a-asmo		pis-a-ti	pis-a-l	pis-a-vši	pis-a-n
2	pis-a-Ø	pis-a-ste	pis-a-aše	pis-a-aste					
3	pis-a-Ø	pis-a-še	pis-a-aše	pis-a-ahu					

(Contd.)

b) The present tense stem						
<i>je</i>	PrsSg	PrsPl	ImpSg	ImpPl		PrsAdvP
1	pis-je-m	pis-je-mo	/	pis-je-imo		pis-je-u-ći
2	pis-je-š	pis-je-te	pis-je-i	pis-je-ite		
3	pis-je-Ø	pis-je-u	/	/		

**Table 2:** a verb with the theme < a, je >, illustrated with the verb *pisati* ‘write’

a) The infinitive stem <sup>5</sup>								
<i>e</i>	AorSg	AorPl	%IpfSg	%IpfPl	Inf	ActP	PstAdvP	
1	vol-e-h	vol-e-smo	vol-e-ah	vol-e-asmō	vol-e-ti	vol-e-l	vol-e-vši	
2	vol-e-Ø	vol-e-ste	vol-e-aše	vol-e-aste				
3	vol-e-Ø	vol-e-še	vol-e-aše	vol-e-ahu				
b) The present tense stem								
<i>i</i>	PrsSg	PrsPl	ImpSg	ImpPl	%IpfSg	%IpfPl	PrsAdvP	PassP
1	vol-i-m	vol-i-mo	/	vol-i-imo	vol-i-ah	vol-i-asmō	vol-i-e-ći	vol-i-en
2	vol-i-š	vol-i-te	vol-i-i	vol-i-ite	vol-i-aše	vol-i-aste		
3	vol-i-Ø	vol-i-e	/	/	vol-i-aše	vol-i-ahu		

**Table 3:** a verb with the theme < e, i >, illustrated with the verb *voleti* ‘love’.

Taking a more restrictive view of ThVs, in particular, excluding those morphological units that show systematic semantic or syntactic effects and are realized in the infinitive stem by phonological material richer than a vowel, such as the denominal verbal suffix *-ov*, the imperfectivizing suffixes *-iv* and *-av* or the semelfactive suffix *-n(u)* (see Simonović et al. 2021 for

<sup>5</sup> The percentage sign is used in the tables to mark that certain forms exist in the grammars of a subset of speakers only, mostly subject to geographic and social variation. The segments that are struck through are not visible at the surface, and we remain agnostic as to the mechanism that leads to their absence in the surface forms. As pointed out by an anonymous reviewer, this deletion is not systematic, as it sometimes targets the theme and sometimes part of the inflection. This points in the direction of a realizational account for these facts – but this goes beyond the aims of the present paper. In particular, in the current section, the goal is to present the empirical facts in pure descriptive terms, aiming for as little exceptions as possible.



a detailed discussion and analysis, also e.g. Łazarczyk 2010; Taraldsen Medová & Wiland 2019 for analyses of *-n(u)* as a sequence of the semelfactive suffix and a theme), there can be observed eight different themes in SC.<sup>6</sup> These are given in **Table 4**, each with a representative example.

<i>Theme</i>	<i>member-verb (Inf, Pres1Sg)</i>
< a, e >	greb-a-ti, greb-e-m ‘scratch’
< Ø, e >	bra-ti, ber-e-m ‘pick’
< i, i >	ljub-i-ti, ljub-i-m ‘kiss’
< e, i >	vol-e-ti, vol-i-m ‘love’
< a, i >	trč-a-ti, trč-i-m ‘run’
< e, e >	sm-e-ti, sm-e-m ‘dare’
< a, je >	pis-a-ti, pis-je-m ‘write’
< a, a >	pad-a-ti, pad-a-m ‘fall’

**Table 4:** Themes attested in SC.

### 3 Other verbal morphology

The goal of this section is to show how other verbal morphology influences the morphosyntactic and semantic properties of the verb, thus potentially overriding the contribution of the theme. This is meant to lead to a better understanding of the reasons why we focus on the simplest available combinations, but also to shed more light on the Slavic, in this case SC verbal morphology.

Slavic verbs are characterized by a strictly layered set of morphological elements that trigger syntactic and semantic effects concerning argument structure and aspect. The prototypical simple Slavic verb is broadly assumed to be imperfective, atelic and unspecified for a result or other kind of culmination, as in (2a). It derives a perfective telic verb by taking a lexical prefix (by virtue of which it also receives a specification of result) as in (2b), a superlexical prefix as in (2c) (a superlexical prefix is a prefix which expresses a meaning related to the quantity of the event rather than the result in the narrow conventional sense of Romanova 2004; Svenonius 2004a; b, as in (2c, f), respectively; but see Arsenijević 2007; Žaucer 2009 for a resultative analysis of superlexical prefixes) or the semelfactive suffix, as in (2d). The verb derived in this way can be

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<sup>6</sup> We assume a higher relevance of the infinitival stem, as it is universally phonologically lighter or equal to the present tense stem, and if a ThV survives in derived forms – the surviving one is almost exclusively the infinitival stem realization.

imperfectivized again by changing the theme or taking a suffix (Simonović et al. 2021 argue that the imperfectivizing suffixes are ThV sequences, thus reducing affixal imperfectivization to ThV addition), resulting in what is traditionally referred to as secondary imperfectives, as in (2e). Finally, not just simple, but also secondary imperfectives can be perfectivized by a superlexical prefix, as in (2f).

- (2) a.  $Pi^i-\emptyset-o$  je čaj.  
 drink-THV-PTCP AUX tea.ACC  
 ‘He was drinking tea.’
- b.  $Od-pi^i-\emptyset-o$  je čaj.  
 from-drink-THV-PTCP AUX tea.ACC  
 ‘He took a sip from the tea.’
- c.  $Po-pi^i-\emptyset-o$  je čaj.  
 over-drink-THV-PTCP AUX tea.ACC  
 ‘He drank all the tea.’
- d.  $Pi^i-nu-\emptyset-o$  je čaj.  
 drink-SUFF-THV-PTCP AUX tea.ACC  
 ‘He took a (small) sip of the tea.’
- e.  $Od-pi^i-a-o$  je čaj.  
 from-drink-THV-PTCP AUX tea.ACC  
 ‘He was taking a sip /sips from the tea.’
- f.  $Iz-od-pi^i-a-o$  je čaj.  
 out-from-drink-THV-PTCP AUX tea.ACC  
 ‘He took sips from the tea to its exhaustion.’

As the ThVs sit relatively low in the structure, all the layers of affixation project on top of them, and may alter any potential contribution made by the themes – as manifested in the contrast between (2a) and (2b–f). Moreover, with each suffix, an additional ThV is inserted (compare (2d, f)), making it unclear whether it is the suffix or the theme that introduces the additional meaning (Simonović et al. 2021 offer a simple resolution of this issue). The critical examples therefore are those where no affixal material is added, or when an affixless form is not attested – where the least possible morphological material is involved, such that it does not introduce a ThV of its own. This restricts our interest to verbs consisting only of a root, a ThV and the inflection, or in the absence of such a verb for a particular root – to those involving at most one additional prefix.

We analyzed the excerpted verbs of the above type for any correlations between aspectual properties and ThVs. The view that the theme carries semantic or syntactic content predicts that themes will show uniform effects with all the bases they combine with. The view that the regularities emerge from the interaction between the markedness hierarchy of the themes on the

one hand and various semantic and phonological markedness hierarchies related to the verbal base on the other predicts rather tendential effects, which are stronger among minimal pairs than with roots that only ever take one ThV, because effects of competition are stronger when it is immediate than when obtains in different contexts.

#### 4 The empirical material and the first quantitative insights

Besides the common sources of empirical data, including previous literature, corpora and grammaticality judgments, the research reported includes quantitative insights from the Annotated Database of the Western South Slavic Verbal System (WeSoSlav, Arsenijević et al. 2022). The database consists of 5300 SC and 3000 Slovenian verbs retrieved from the srWac, hrWac, bsWac and meWac corpora for SC (Ljubešić & Klubička 2014) and from the Slovenian National Corpus FidaPLUS for Slovenian (FidaPLUS 2000, <http://www.gigafida.net/>). The verbs are selected based on frequency: the top 3000 highest frequency verbs from each of the corpora are included and annotated. As srWac, hrWac, bsWac and meWac are corpora of different SC varieties, the SC database contains the union of each of the 3000 verbs from the four corpora. Different shapes that the same verbs have in two or each of the varieties (e.g., ekavian, ijekavian, ikavian versions or those emerging from using different suffixes to adopt borrowed verbs or to imperfectivize native ones) were introduced as separate entries, and annotated as variants of one verb.<sup>7</sup> Each verb is annotated for a fixed set of over 40 different properties, including frequency, lexical and grammatical aspect as verified by the selected tests, argument structure (taking accusative, genitive, dative, PP, clausal arguments; reflexivity), the characteristic morphemes (the root, prefixes, suffixes), their special properties (e.g. root-allomorphy), prosodic characteristics (position of the high tone, long syllables), ThVs and others.

In the present investigation, only the SC part of the database was used, with the purpose of determining the quantitative properties of significance for the research such as the relative sizes of various relevant classes of verbs, but also (nearly) exhaustive lists of verbs in the classes under investigation and their aspectual and other properties.

As the database includes all the verbs, selected only by frequency, and our research is intended to focus on root verbs, we did not use the entire database, but had to excerpt from it only root verbs, i.e. the set of smallest verbs such that each root-theme combination attested in the database is represented in it. Among the 5300 SC verbs in the database, we attest 1054 different unique combinations of a base and a theme (not counting suffixed verbs, i.e. those that

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<sup>7</sup> For instance, the borrowed root *reform* was integrated in the western varieties by the suffix *-ir*, yielding *reformirati* ‘to reform’, and in the eastern by the suffix *-is*, yielding *reformisati* ‘to reform’. These two verbs, *reformirati* and *reformisati*, are annotated as two variants of the same verb, which enables to treat them as one verb for those quantitative computations for which it figures as one, and as two verbs in the others. Since these variants almost exclusively concern verbs that involve suffixes, they did not bear any relevance for the present study.

potentially contain more than one theme). In some cases, such combinations present a verb, i.e. they take inflection to derive different verbal forms, as in (3a). In others, they only exist if combined with an additional prefix, as in (3b).

- (3) a. (ob-)bra-Ø-ti  
 /obrati/  
 around-pick-THV-INF  
 ‘pick, harvest’
- b. \*(od-)ves-Ø-ti  
 /odvesti/  
 from-drive-THV-INF  
 ‘drive away’

In filtering out the derived, hence doubled combinations, we considered apophony as in (4b) (including the lengthening of the final syllable of the base as in (4d)) as a suffix and hence counted bases with apophony to be derived from the forms without apophony. We based our decision on the fact that the apophony corresponds to specific semantic and morphosyntactic effects which are otherwise triggered by suffixes. In addition, the verbs with a changed ThV that systematically behave as derived imperfective forms (evidenced by the fact that for every prefixed version there is a corresponding imperfective verb with the same prefix, as in (4f)) are also counted as including an additional ThV (see the glosses in (4f)), hence as more complex than their corresponding perfective verb (see also Simonović et al. 2021). Although such verbs were not included in the set of simple verbs discussed regarding minimal pairs, in section 7, we turn exactly to the pairs between a verb of one of these two classes (apophony and added themes) and its simple counterpart as in (4a–f), as they also show some relevant regularities that are informative regarding our central question.

- (4) a. pre-lom-i-ti  
 /prelomiti/  
 across-break-THV-INF  
 ‘break’ (perf)
- b. pre-lam-a-ti  
 /prela:mati/  
 across-break-THV-INF  
 ‘break’ (imperf)
- c. pre-gled-a-ti  
 /pregledati/  
 across-watch-THV-INF  
 ‘inspect’ (perf)

- d. pre-gle:d-a-ti  
/pregle:dati/  
across-watch-THV-INF  
'inspect' (imperf)
- e. u-pad-∅-ti  
/upasti/  
in-fall-THV-INF  
'fall in' (perf)
- f. u-pad-∅-a-ti  
/upadati/  
in-fall-THV-THV-INF  
'fall in' (imperf)

**Table 5** gives the share of each ThV in the 1054 attested unique combinations of a base and a theme, showing that the class <i, i> is by far the largest, followed by the class <a, a>, while the other classes are relatively small.

<i, i>	<a, a>	<∅, e>	<a, je>	<e, i>	<a, i>	<e, e>	<a, e>	defective	sum
601	255	58	57	45	22	10	4	2	1054
57,02%	24,19%	5,50%	5,41%	4,27%	2,09%	0,95%	0,38%	0,19%	100%

**Table 5:** Sizes of the theme classes among unique verbal stems.

Due to the fact that class <a, a> is highly represented among the verbs which contain a suffix, in the pull of all the 5300 verbs, i.e. counting also morphologically complex verbs, the number of <a, a> verbs is greater than the number of <i, i> verbs (1702 to 1603, respectively). For the same reason, i.e. a common occurrence with a suffix, class <a, je> too shows a relative increase when all verbs count (1021 verbs). One analytic option is hence to treat the themes <a, a> and <a, je> as predominantly restricted to suffixes, with the occurrences in other environments either involving a null suffix or being listed (i.e. indexed) in the lexicon. To test this quantitatively, we took the most generous approach, i.e. we counted as suffixed not only all the verbs which show an overt suffix as in (5a), but also:

- all the verbs with the original theme contracted with the base as a palatalizing element and an additional theme added, as in (5b),
- all the verbs displaying the apophony (which may be treated as a realization of the imperfectivizing suffix), as in (5c),

- the verbs displaying the prosodic lengthening of the final syllable of the base as in (5d), as it can be seen as a form of apophony,
- or even just the verbs where the <a, a> acts semantically as a secondary imperfective version of the <i, i> verb, and the base ends on a (potentially) soft consonant, which may be analyzed as underlyingly containing the theme <a, a> on top of the theme <i, i> (cf. Arsenijević 2020; Simonović et al. 2021), as in (5e),
- all the verbs clearly derived from a noun or an adjective even if they show no suffix (suffixes typically do figure in the deadjectival and denominal derivation of verbs) as in (5f), where the nominal diminutive suffix indicates that the verb is not derived from a root.

(5)	a.	u-po-treb-i-ti, /upotre:biti/ in-over-need-THV-INF 'use' (perf) : u-po-treb-i-av-a-ti, /upotrebλa:vati/ in-over-need-THV-SUFF-THV-INF 'use' (imperf)	u-po-treb-i-m /upotre:bi:m/ in-over-need-THV-PRS.1SG  u-po-treb-i-av-a-m /upotrebλa:va:m/ in-over-need-THV-SUFF-THV-PRS.1SG		
	b.	o-stav-i-ti, /ostaviti/ of-put-THV-INF 'leave' (perf)	o-stav-i-m /ostavi:m/ of-put-THV-PRS.1SG	:o-stav-i-a-ti /ostavλati/ of-put-THV-THV-INF 'leave' (imperf)	o-stav-i-a-m /ostavλa:m/ of-put-THV-THV-PRS.1SG
	c.	u-kroj-i-ti, /ukrojiti/ in-tailor-THV-INF 'tailor in' (perf)	u-kroj-i-m /ukroji:m/ in-tailor-THV-PRS.1SG	: u-kra:j-a-ti, /ukra:jati/ in-tailor-THV-INF 'tailor in' (imperf)	u-kra:j-a-m /ukra:ja:m/ in-tailor-THV-PRS.1SG
	d.	po-mer-i-ti, /pomeriti/ over-move-THV-INF 'move' (perf)	po-mer-i-m, /pomeri:m/ over-move-THV-PRS.1SG	: po-me:r-a-ti, /pome:rati/ over-move-THV-INF 'move' (imperf)	po-me:r-a-m /pome:ra:m/ over-move-THV-PRS.1SG
	e.	u-dar-i-ti, /udariti/ in-hit-THV-INF 'hit' (perf)	u-dar-i-m /udari:m/ in-hit-THV-PRS.1SG	: u-dar-a-ti, /udarati/ in-hit-THV-INF 'hit' (imperf)	u-dar-a-m /udara:m/ in-hit-THV-PRS.1SG
	f.	devoj-k-a girl-DIM-NOM.SG 'girl'	: devoj-k-i-ti, /devo:jtʃiti/ girl-DIM-THV-INF	devoj-k-i-m /devo:jtʃi:m/ girl-DIM-THV-PRS.1SG	

Having eliminated every verb that gives any ground to an analysis involving a suffix, even if invisible, we are left with 100 unique combinations of a base and the theme <a, a> without empirical ground to be analyzed with a (zero) suffix, i.e. around 10% of all the unique combinations of a root and a theme. We consider this sufficient to eliminate the analysis on which this theme is limited to suffixes.

To achieve a better insight in the possible specifics of ThVs, motivated by the tendency of the theme <a, a> to occur in imperfective environments, as well as an observable tendency of the theme <i, i> to have scalar interpretations (Arsenijević & Milosavljević 2021), we first performed explorative research on these two themes. The focus on these two themes was additionally supported by their significantly higher productivity (based on frequency and derivation of novel verbs) in comparison with others. The explorative research consisted in a quantitative analysis of the sets of verbs taking each of these themes within the WeSoSlaV for a range of properties such as grammatical and lexical aspect, the likelihood to involve a prefix, a suffix, root allomorphy, to select an accusative or a reflexive argument and a few more. The preliminary investigation (Arsenijević & Milosavljević 2021; Arsenijević 2021a) was approximative in several ways, among them in including all the prefixed and suffixed variants of each minimal combination of a root and a theme, and in including the annotation of verbs for lexical aspect, which turned out to be undefined for a number of verbs, hence no definite answers could be based on it. However, it generally confirmed that the two themes do show different tendencies on a number of properties, mainly pointing in the direction of aspect.

In the rest of this paper, we have two goals. One is to perform a detailed investigation of the two themes looking at each different base that takes one or both of them with a focus on the potential regularities that they display, and to discuss the consequences of the findings for the general view of ThVs. The other goal is, if different regularities are confirmed for the two themes, to test two possible views at the differences, both of which take the ThV to realize the category feature [v], but with different takes on what distinguishes the different themes.

One view is that ThVs are distinguished by the syntactic features that they carry. Driven by the result of the analysis, we end up formulating the hypothesis that <i, i> realizes the features [v] and [SCALE], while the theme <a, a> realizes only the feature [v]. Alternatively, one theme is unspecified, while the other is restricted to occur with light items, in particular with verbal suffixes (this may be formally modelled by the lack of the category feature in the latter, due to which it seeks to combine with verbalizers).

The other view is that all the themes only carry the formal feature of the lexical category [v]. They are distinguished only in terms of their markedness, which maps with the hierarchies of markedness among the different semantic properties the verbs display, thus resulting in the observed tendencies. As the hierarchy of ThVs maps with a range of other properties, whose values also form hierarchies, the realization of the ThV is a matter of resolution of a range of

constraints, rather than being uniquely determined by one property. Each particular property individually then shows a tendency rather than a categorical mapping.

To minimize the possibility that the effects attested in ThV realization are due to various affixes, we focused on the simplest available combinations, i.e. those involving only a root and a theme, or in cases where such combinations do not figure as verbs without the addition of an affix – the semantically most neutral among the prefixed variants of the combination. Especially relevant for our research were those cases where the same base combines with more than one theme, because the markedness view predicts stronger tendencies in immediate competition than between different bases.

## 5 Semantic contrasts in minimal pairs

In this section, we focus on those roots that may combine with two different themes and discuss the insights in light of the two analyses outlined in section 1. The contrasts involve the properties of scalarity and boundedness. We adopt the traditional division of Slavic verbs into perfective, imperfective and biaspectual, yet we assume with Borer (2005), Łazarczyk (2010), Arsenijević (2022), Milosavljević (2022a), that the relevant notion for this traditional classification is actually telicity, i.e. boundedness of the verbal predicate. On our view, traditional perfective verbs are singular bounded event predicates, denoting maximal event stages in the sense of Filip & Rothstein (2006); Filip (2008), and all the other verbs are unspecified for telicity, establishing the unbounded interpretation in terms of antipresupposition (the fact that the speaker did not use a bounded predicate triggers the inference that such a meaning was not intended).<sup>8</sup> For traditional imperfective verbs without overt evidence of morphological derivation from a perfective counterpart, we use the term *simple imperfectives*, and for those that are arguably derived from a perfective verb – the term *secondary imperfectives* (the operation deriving them is then *secondary imperfectivization*).<sup>9</sup>

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<sup>8</sup> Closely related to our approach are also works analyzing Slavic perfectivity and imperfectivity as number in the verbal domain, where perfective verbs denote singular predicates, while imperfective verbs, just as plural in the nominal domain (in the sense of Sauerland 2003), are un(der)specified for number (e.g. Kagan 2008; 2010; Klimek-Jankowska & Błaszczak 2021).

<sup>9</sup> Hence, under the approach that we adopt in this paper, Slavic perfective and imperfective verbs do not stand for the grammatical (viewpoint) aspect defined in terms of containment relations between the Event Time (ET) and the Reference Time (RT) (with imperfective viewpoint arising when RT is properly included in ET interval, and perfective viewpoint standing for ET being contained within RT, cf. Reichenbach 1947; Klein 1994; 1995; Bhatt & Pancheva 2005; Łazarczyk 2010), as proposed e.g. in Pereltsvaig (2005), Borik (2006), among many others. A problem with such a view of Slavic imperfective and perfective verbs is that the grammatical/viewpoint aspect is established at the clausal level, since the relation between ET and RT crucially depends on finiteness (see Klein 1994; 1995; Tatevosov 2018), while the perfective/imperfective distinction in Slavic is encoded already in the verbal stem, hence within the lexical/vP/VP domain. Moreover, in some Slavic languages (Bulgarian, Old-Church Slavonic, SC), there are also specialized grammatical forms for the grammatical aspect (e.g. aorist vs. imperfectum) that cut across perfective and imperfective verbs (see Łazarczyk 2010). This is why some authors argue for divorcing the grammatical aspect from the Slavic verb and its morphology (Klein 1995; Łazarczyk 2010; Tatevosov 2011; 2015; 2018; Filip 2017; Mueller-Reichau 2020, a.o.).



Following the argumentation in Filip & Rothstein (2006); Filip (2008); Kagan (2016a; b); Milosavljević (2022b), a.o., we take that all bounded predicates are scalar, irrespective whether they involve a scalar *process* component, because they minimally involve a scalar interval between the initial and the final bound of the eventuality as described by the predicate (i.e. between the pre-culmination and the culmination state of affairs). In addition to this, we took an unbounded verbal predicate to be scalar if it denotes an event of scalar change, where a scale is an ordered set of degrees along a particular dimension, e.g. height, temperature, cost (Rappaport Hovav & Levin 2010: 28; see also Hay et al. 1999; Kennedy & Levin 2008; Beavers & Koontz-Garboden 2012; 2017; Rappaport Hovav 2014, a.o.). Typical scalar verbs are *grow*, *freeze*, *cool*, *empty*, *ascend*, etc. In terms of Harley (2005), such verbs get their names based on the relevant scalar property (or Result as the highest included degree), as opposed to non-scalar verbs, which are most typically manner verbs, with the base denoting the manner component (e.g. *run*, *laugh*, *roll*). Among productive ThVs, scalar verbs in SC most often take the ThV <i, i>, e.g. *led-i-ti* ‘freeze’, *hlad-i-ti* ‘cool’, *prazn-i-ti* ‘empty’. One way to diagnose scalar verbs is to look whether their roots/bases encode only the scalar/result component, without any commitment to a particular manner (cf. Harley 2005; Rappaport Hovav 2014) – with their meaning paraphrasable as ‘became BASE-like’/‘become more base-like than at the beginning of the event’ (e.g. *hlad-i-ti se* ‘cool-THV-INF REFL’ = become cool(er)) or ‘make base-like’/‘make more base-like than at the beginning of the event’ (e.g. *prazn-i-ti* ‘empty-THV-INF’ = make empty/emptier). Scalarity is tightly linked to telicity and resultativity, i.e. there is an inherent affinity of scalar change verbs to telicity (as extensively argued e.g. in Rappaport Hovav 2014). Relatedly, the final state associated with a scalar verb is distinct from the initial state (Hay et al. 1999; Beavers & Koontz-Garboden 2017: 852).<sup>10</sup> While these properties are straightforwardly manifested by perfective, i.e. bounded verbs in SC, they are more difficult to verify on unbounded (imperfective) scalar verbs, but certainly possible. Recall that we take the predicates described as unbounded/atelic to actually be unspecified for boundedness/telicity, i.e. in principle compatible with bounded/telic readings. To be realized, this compatibility, however, must be licensed by scalarity: non-scalar unspecified predicates, without further measures being taken (such as added source, path or goal specifications or scalar modifiers), can only receive strictly unbounded interpretations. Traditional imperfectives thus can only receive a bounded/telic interpretation (in iterative contexts) if they are scalar, which is evidenced by their compatibility with the (telicity-diagnosing) *in*-phrase

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<sup>10</sup> A scale relevant for computing telicity can be brought about by the verbal base, as in the case of degree achievements, but also by the direct object (in the case of incremental theme verbs), or a path phrase in motion verbs, as shown e.g. in Hay et al. (1999); Kennedy (2012); Rappaport Hovav (2014); Kagan (2016a). One typical example including the direct object is *eat a plum* (discussed in Hay et al. 1999), where the affected argument undergoes a scalar change along the volume/extent property provided by the object: the event unfolds incrementally and is over once the plum is fully consumed. However, note that even a minimal change in a volume property (i.e. the consumption of the plum) is enough for a scalar change to emerge. In the present paper, relevant cases are those in which a scale is contributed by the verbal base.

(i.e. its SC counterpart *za*-phrase), as illustrated by the contrast between (6a) and (6b).<sup>11</sup> In (6a), the result of each subevent is such that the theme argument reaches a certain (contextually specified) degree of the property denoted by the verb. Note that imperfective scalar verbs are also perfectly compatible with the progressive aspectual interpretation, with a verbal predicate modified by the (SC counterpart of) *for*-phrase, as in (6c). The scalar nature of the verb in this latter context is confirmed by the fact that the process of filling a barrel must result in the state of the barrel being filled to a degree different from that at the beginning of the event. Summing up, all bounded/telic verbal expressions (Slavic perfective verbs) are scalar, some unbounded/atelic verbal expressions (Slavic imperfective verbs) too are scalar, and other unbounded/atelic ones are non-scalar. Telicity is bounded scalarity (scalarity with bounded intervals), and unbounded scalar, as well as non-scalar predicates are atelic, i.e. unspecified for telicity. An additional property that differentiates scalar from non-scalar verbal predicates is their compatibility with adverbs like *gradually* or *abruptly*. As suggested in Piñon (2000) and Rappaport Hovav (2014), the adverbial *gradually* (or its counterparts in other languages) targets the scalar property denoted by the verb itself, as in (6d). It can be used with non-scalar, manner verbs like *trčati* ‘run’ in (6e), but only in the presence of some other constituent that contributes/forces a gradable property.

- (6) a. Milan je celo jutro punio<sup>IMPERF</sup> buriće vinom za  
 Milan.NOM AUX whole morning.ACC filled barrels.ACC wine.INS in  
 tri minuta.  
 three minutes  
 ‘Milan filled barrels with wine in three minutes the whole morning.’  
 (Result: each barrel from a contextually specified set of barrels is filled/fuller  
 with wine.)
- b. \*Milan je celo jutro prskao<sup>IMPERF</sup> buriće vinom za  
 Milan.NOM AUX whole morning.ACC sprayed barrels.ACC wine.INS in  
 tri minuta.  
 three minutes  
 ‘Milan sprayed barrels with wine in three minutes the whole morning.’  
 (No result available.)
- c. Milan već satima puni<sup>IMPERF</sup> bure vinom.  
 Milan.NOM already hours.INS fills barrel.ACC wine.INS  
 ‘Milan has been filling the barrel with wine for hours.’
- d. Milan je postepeno punio<sup>IMPERF</sup> bure vinom.  
 Milan.NOM AUX gradually filled barrel.ACC wine.INS  
 ‘Milan gradually filled the barrel with wine.’

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<sup>11</sup> Non-scalar (manner) verbs can also be used as telic, but in those cases the relevant property is usually brought about by an additional constituent: e.g. the verb *trčati* ‘run’ can be used in telic contexts only when provided with a path argument (e.g. *trčati maraton* ‘run a marathon’).

- e. Milan je postepeno trčao<sup>IMPERF</sup> \*(sve brže i brže).  
 Milan.NOM AUX gradually ran all faster and faster  
 ‘Milan gradually ran faster and faster.’

As expected from the overall sizes and productivity of ThV classes, the largest group of roots open for two different themes combine the two most productive themes,  $\langle i, i \rangle$  and  $\langle a, a \rangle$ . We have identified 34 roots which take both themes  $\langle i, i \rangle$  and  $\langle a, a \rangle$  (some of them additionally take a third one). Each of them displays a semantic difference between the alternates with different themes, and all the contrasts established can be classified in one of the following three types.

Type 1: the verb with the theme  $\langle i, i \rangle$  is perfective, i.e. bounded, and the verb with the theme  $\langle a, a \rangle$  is not, as in (7). Typically, the latter, at least semantically, acts as the secondary imperfective of the former.

- (7) a. s-prem-i-ti  
 /spre:miti/  
 with-prepare-THV-INF  
 ‘prepare’ (perf)
- b. s-prem-a-ti  
 /spre:mati/  
 with-prepare-THV-INF  
 ‘prepare’ (imperf)
- c. bac-i-ti  
 /ba:tsiti/  
 throw-THV-INF  
 ‘throw’ (perf)
- d. bac-a-ti  
 /batsati/  
 throw-THV-INF  
 ‘throw’(imperf)

Type 2: the root combines with three themes:  $\langle \emptyset, e \rangle$ ,  $\langle i, i \rangle$  and  $\langle a, a \rangle$ . The verb with the theme  $\langle \emptyset, e \rangle$  is perfective, i.e. bounded, the one with the theme  $\langle i, i \rangle$  is its secondary imperfective, hence unbounded, and the one with the theme  $\langle a, a \rangle$  is also imperfective, hence unbounded, but has a meaning that involves unstructured pluractionality and/or lack of scalarity. The  $\langle \emptyset, e \rangle$  member of such triples by a rule requires a prefix, which suggests the possibility, in a similar fashion as Holaj (2018) and in full accordance with Simonović et al. (2021), that both  $\langle i, i \rangle$  and  $\langle a, a \rangle$  are added on top of the ThV  $\langle \emptyset, e \rangle$  as reverbalizers which neutralize

the bounded interpretation of the original ThV, one adding scalarity, and the other not.<sup>12</sup> This is compatible with the view that the two ThVs in focus are productive while  $\langle \emptyset, e \rangle$  is inherited as idiomatically stored with some bases (e.g. where the availability of three interpretations favored its preservation, or where phonology supported it). This is illustrated in (8).

- (8) a. \*(do-)nes- $\emptyset$ -ti  
       /done:ti/  
       to-carry-THV-INF  
       ‘bring’ (perf)
- b. (do-)nos-i-ti  
       /donositi/  
       to-carry-THV-INF  
       ‘bring / carry’ (imperf)
- c. (\*do-)nos-a-ti  
       /dono:sati/  
       to-carry-THV-INF  
       ‘carry around’ (imperf)

Type 3: The base takes the themes  $\langle i, i \rangle$  and  $\langle a, a \rangle$ , and both derived verbs are imperfective, hence unbounded. The  $\langle a, a \rangle$  member is always non-scalar. The  $\langle i, i \rangle$  member may be scalar, as in (9a), where it derives a transitive verb denoting the scalar process of causing someone to be more miserable – as opposed to the unergative manner verb with  $\langle a, a \rangle$ , or non-scalar, like the verbs in (9c, e), which denote a non-scalar action specified for manner. When both verbs are non-scalar in the strict sense (i.e. the scale is not contributed by the verb base alone), the  $\langle a, a \rangle$  member of the pair is interpreted as less directed, as in (9d), or as pluractional, as in (9f). We take that non-directedness and pluractionality emerge as prototypical non-scalar interpretations,<sup>13</sup> as an effect of the mapping the marked theme  $\langle a, a \rangle$  to the unmarked interpretation of non-scalarity.

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<sup>12</sup> The approach with themes containing each other, if radically implemented (including Holaj’s (2018) containment of  $\langle i, i \rangle$  in  $\langle a, a \rangle$ ), opens a particularly interesting avenue for the feature-based analysis. One could argue that the theme  $\langle \emptyset, e \rangle$  is unspecified (it carries no features), the theme  $\langle i, i \rangle$  has the feature [+scale], and the theme  $\langle a, a \rangle$  additionally the feature [-scale], i.e. its specification is [[+scale] -scale]. Assuming that in result,  $\langle a, a \rangle$  is strictly non-scalar, since non-scalarity is assigned higher, this approach faces the same problems of the existence of non-scalar  $\langle i, i \rangle$  verbs and scalar  $\langle a, a \rangle$  verbs, discussed in section 6. If, however, the specification can be taken as neutralization to unspecifiedness, a possibility for a strong analysis emerges which avoids the latter problem. This class’s tendency for non-scalar verbs would come from strong antipresupposition (the avoidance of the less marked  $\langle i, i \rangle$  ThV infers that a scalar component was not intended to be communicated, rendering  $\langle a, a \rangle$  effectively non-scalar), but the ThV is in principle compatible with scalar meanings. The problem of non-scalar  $\langle i, i \rangle$  verbs remains. We leave the exploration of this analytic possibility for future research.

<sup>13</sup> This implies that, as pointed out by an anonymous reviewer, the notion of scalarity is itself scalar. One possible way to formally implement this idea is offered by Kagan (2016a: ch. 7), who shows, analyzing prefixes in Russian in terms of scalarity, that different types of scales are subject to hierarchies: for instance, when a given verbal stem is poten-

- (9) a. jad-i-ti  
/ja:diti/  
misery-THV-INF  
'grieve (someone)'
- b. jad-a-ti  
/jadati/  
misery-THV-INF  
'lament' (repeated actions)
- c. trag-i-ti  
/tra:ʒiti/  
trace-THV-INF  
'search, request' (directed action)
- d. trag-a-ti  
/tragati/  
trace-THV-INF  
'be on the search' (non-linear)
- e. gnjur-i-ti  
/gɲu:r-i-ti/  
dive-THV-INF  
'dive' (singular, directed motion)
- f. gnjur-a-ti  
/gɲu:r-a-ti/  
dive-THV-INF  
'dive' (repeated actions)

Recall from section 1 that our central question is whether a strong analysis can be formulated, on which different ThVs match different combinations of independently attested syntactic features, or a weaker analysis in terms of markedness-driven realization is more appropriate. Note also that in this section, we are discussing verbs sharing the base and thus eliminating the role of phonology of the base, as it remains constant among the competing verbs. Assuming that there are no other strong factors (which is not necessarily true), this enables us to observe the role of aspect in isolation from other effects.

We have illustrated three different types of contrasts. In all of them, the verb with the theme <a, a> is unbounded, which could support an account in terms of feature specification. In two

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tially associated with both the path and the volume scale, the path scale is ranked higher, and similar holds in the case of 'competition' between the property and the volume scales. While Kagan's approach is applied to prefixation, we believe that scale hierarchies are applicable in other domains as well, but we leave exact formalization of these hierarchies as applied to theme vowels for future research.

contrasts, this verb is additionally non-scalar. The verb in  $\langle i, i \rangle$  occurs twice as unbounded and once as bounded. Moreover, as unbounded, in one opposition it is a secondary imperfective, and in the other, it is additionally scalar.

A fitting analysis is to take that  $\langle a, a \rangle$  is unspecified, while  $\langle i, i \rangle$  is specified as scalar (i.e. it carries the feature [SCALE]). Where the verb is bounded, scalarity is a component of boundedness, and where it is unbounded – scalarity alone characterizes the verb in the relevant way. Directedness can also be modeled in terms of scalarity, since it entails a (literal or abstract/metaphorical) movement towards a goal, which is how scalarity emerges in e.g. motion verbs. This meaning component is indirect in the sense that it does not rely on the scalarity of the verb base alone, but must also include some sort of additional specification of the endpoint (e.g. by an PP complement) (see also Rappaport Hovav 2014 for a detailed discussion of similar cases in English). The unbounded and the non-scalar interpretation of the  $\langle a, a \rangle$  members of tuples come from the antipresupposition: if two themes are available, one of which has an additional restriction (scalarity), the use of the other signals that the additional restriction was not intended (Arsenijević 2018). This view would require the collapsing of all three sub-cases in (9) to scalarity, which is semantically not too far-fetched.

The problem with this account, however, is that the described distribution of semantic contrasts only obtains when the themes are directly contrasted, i.e. when they combine with the same root. The analysis in terms of features predicts that among roots that take only one theme, at the very least those with the theme  $\langle i, i \rangle$  will always be scalar (taking that the theme  $\langle a, a \rangle$  is simply unrestricted, it is not expected to follow any strong regularities). This issue is discussed in section 6.

The markedness analysis applies without any obstacles. Whenever there is a semantic opposition in scalarity, the scalar verb realizes  $\langle i, i \rangle$ , and the non-scalar one  $\langle a, a \rangle$ . When there are three verbs, the third one is bounded scalar, and realizes  $\langle \emptyset, e \rangle$ . When there are only two verbs and both are scalar, the bounded verb realizes  $\langle i, i \rangle$ , and the unbounded one  $\langle a, a \rangle$ . This is illustrated in Figures 1–4 and covers the patterns in (7–9).

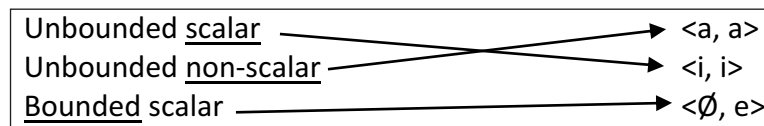


Figure 1: Markedness mapping 3 to 3.

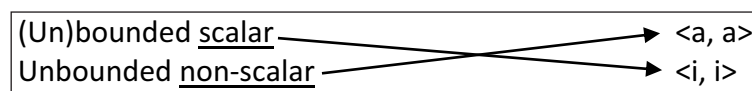


Figure 2: Markedness mapping 2 to 2 with the opposition in scalarity.



**Figure 3:** Markedness mapping 2 to 2 without opposition in scalarity.



**Figure 4:** Markedness mapping 2 to 2 with the opposition in directedness.

The question was raised by an anonymous reviewer why the mapping is reversed (we assume that the question is based on the generally accepted view that mappings controlled by markedness in language are typically such that the marked maps to the marked and the unmarked to the unmarked). However, when morphological markedness is involved, this is not necessarily the case (see for instance Sauerland 2008 for the nominal domain). We support this claim with the square in (10), where in the imperfectum, the third person is morphologically more marked than the first person, while in the aorist the contrast is reversed. Whatever markedness relation assumed between persons (and it is standardly assumed that first person is more marked than third), one contrast reverses the mapping.

- (10) a. gleda-h  
 watch-IPF.1SG  
 'I was watching'
- a'. gleda-še  
 watch-IPF.3SG  
 'he was watching'
- b. po-gleda-h  
 over-watch-AOR.1SG  
 'I threw a look'
- b'. po-gleda-Ø  
 over-watch-AOR.3SG  
 'he threw a look'

One may also consider the neuter gender in SC, which is semantically qualified as the unmarked (the complete absence of gender), but morphologically is marked (see Arsenijević 2017).

An anonymous reviewer raised the question how come not every root may combine with every theme, i.e. how come not every root derives verbs ranging across the entire spectrum of semantic options (i.e. regarding the property in focus: non-scalar, unbounded scalar and

bounded). As for the former, we follow the approaches by Arsenijević (2020); Simonović et al. (2021) in seeing the ThV system as reducible to a relatively small number of productive themes, likely only  $\langle i, i \rangle$  and  $\langle a, a \rangle$ . The remaining theme combinations are either altered phonological realizations of one of the productive ones, or remnants of an older system restricted to a limited number of idiomatically stored verbs. With how many themes a base will combine is then determined by the same properties that select the theme and eventual idiomatic storing of the verb which smuggles into the system the ThVs that are not any more productive. We take the approach of Borer (2005), where the generative capacity of syntax is actually much greater than we observe in linguistic data, but a large number of grammatical expressions are blocked by pragmatics, as they derive meanings which are either difficult or impossible to associate with our construct of the reality, or even to conceptually represent. We take that a number of combinations is blocked in this way. Moreover, there is a relatively large number of cases where the target meaning is both conceptually representable and associable with our experience of the reality, but it is expressed by another base, and hence either blocking emerges, or even the other realization involves not a different base, but an allomorph of the same base. Indeed, when one artificially derives non-existing verbs as in (11a', b'), these verbs do not sound ungrammatical, and one even has an idea that the former should involve some directed notion of watching (possibly accompanied by effecting the increase of some related quantity, and/or a stronger sense of singularity), i.e. that the latter should mean a multi-directional or pluractional randomly distributed ruining – but such events are not encountered as a natural class in our experience and therefore do not support the use of these verbs. A scalar notion of watching, a strongly directed watching, is something we can associate with the concept of staring. Yet, this meaning is realized by the verb in (11a''), which either blocks *glediti*, or is its allomorphic realization. A multidirectional or irregularly distributed ruining is not a concept that is associated with a natural kind of events in our conceptualization of the reality, and therefore this verb is strictly pragmatically filtered out.

- (11) a. gled-a-ti  
 watch-THV-INF  
 'watch'
- a'. #gled-i-ti  
 watch-THV-INF
- a''. bulj-i-ti  
 stare-THV-INF  
 'stare'
- b. ruš-i-ti  
 ruin-THV-INF  
 'ruin'



b'. #ruš-a-ti  
ruin-THV-INF

## 6 Semantic tendencies in the simplest, root+theme verbs

A crucial difference between the two approaches is in their predictions regarding the bases which are restricted to only one theme. If one theme carries any particular feature, then this feature is expected to show on all the compositionally built verbs with this theme, irrespective whether they stand in competition with verbs distinguished only by the theme vowel or not. If the realization of the ThV involves a resolution of a set of markedness hierarchies, bases taking only one ThV are expected to differ from those combining with more than one in the following way. Bases taking only one ThV do not form minimal tuples identical regarding the phonological properties. Therefore, the effect of the semantic markedness is weaker, as it needs to be interpolated with the phonological markedness. This view therefore allows that a number of verbs with higher degrees of semantic markedness are realized with ThVs of a higher degree of markedness, if the context is unmarked along other markedness dimensions. As we do not pretend on having identified all the relevant markedness dimensions, the testing of the prediction that other dimensions in such cases are unmarked is left for future research.

We already pointed out that directedness and singularity of action are likely indirect (weak) interpretive components emerging in semantic contexts where incremental scalarity is not encoded in the verb base alone, and are hence triggered by some additional properties, e.g. the goal of motion (in addition, note that singularity of unbounded predicates goes always either with scalarity or directedness, and is a weak effect also in this regard). Scalarity proper and boundedness are properties which are independently manifested as properties of verbal expressions. Of these properties, WeSoSlav is so far only annotated for whether the verb has an imperfective interpretation available, i.e. whether it can be interpreted as an unbounded predicate. Hence, in lack of an annotation of scalarity, we only quantitatively investigate the distribution of ThVs over the property of boundedness.

To investigate this distribution, we focus on root verbs, i.e. verbs without any affixes, because affixes, as already discussed, may overwrite the aspectual value, thus masking the potential effect of the theme, or if suffixal, they may introduce a new theme, thus introducing a complexity that is not easily controlled.<sup>14</sup> **Table 6** summarizes the share of verbs without an imperfective interpretation, hence bounded predicates, among root verbs per theme class.

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<sup>14</sup> Indicative is, however, that all suffixes except for *-n(u)* derive non-perfective verbs, which in our approach are all also unbounded, and none of them take the ThVs  $\langle i, i \rangle$  or  $\langle \emptyset, e \rangle$ . The suffix *-n(u)*, which derives perfective, hence bounded predicates, plausibly takes the ThV  $\langle \emptyset, e \rangle$  (Arsenijević 2020). This observation is compatible also with the strong hypothesis.

ThV	Total root verbs	Perfective root verbs	%
/, e	38	1	2.6%
a, a	197	0	0%
a, e	3	0	0%
a, i	17	0	0%
a, je	47	0	0%
e, e	2	0	0%
e, i	34	0	0%
i, i	339	26	7.7%

**Table 6:** Shares of verbs denoting bounded predicates among the root-verbs theme classes.

Root verbs in Slavic languages tend to be imperfective, hence can denote unbounded predicates (e.g. Arsenijević 2022; Milosavljević 2022a). Bounded predicates are an exception. Although class  $\langle i, i \rangle$  has the largest share of bounded predicates, this share is still below 10%, and over 90% of root verbs in this class are not of this semantic type. Still, 26 verbs denoting bounded predicates in this class out of 339, compared to only one out of the remaining 338 (as the sum of bases combining with all the other ThVs is 338) is an indication of a clear tendency – yet obviously not a rule.

While as already pointed out, the data from section 5 can be captured by an analysis in terms of features, where the theme  $\langle i, i \rangle$  carries the feature [SCALE], and the effect along the dimension of boundedness comes from the fact that boundedness subsumes scalarity (minimally, a scale is implied from the initial to the final bound of the eventuality, often also with a continuous interval of degrees between them). Quantification of the property of scalarity is hence needed to fully scrutinize the feature-analysis. So far, we have only annotated the  $\langle a, a \rangle$  verbs for this property, and found that this class systematically lacks scalarity. Eleven exceptions are found among the 255 unique combinations with this theme. Nine of these involve a comparative form of an adjective as the base (*boljš* ‘better’, *deblj* ‘fatter’, *gorš* ‘worse’, *jač* ‘strong’, *lakš* ‘lighter’, *lepš* ‘prettier’, *mekš* ‘softer’, *tež* ‘heavier’, *tiš* ‘quieter’), where arguably the scale component comes from the base, hence not from the theme (the respective meanings are ‘improve’, ‘fatten’, ‘worsen’, ‘strengthen’, ‘lighten’, ‘become more beautiful’, ‘soften’, ‘become heavier’, ‘become quieter’). Only two exceptions were without a comparative base: *ravn* ‘even’ and *mrš* ‘skinny’ (*ravnati* ‘flatten’, *mršati* ‘become skinny’). Still, both exceptions denote scalar notions, which presuppose a scale. Moreover, of the two exceptions, the latter is not straightforward because the

relevant verb *mršati* ‘to become skinny’, which involves only the root of the adjective without the adjectival suffix (the adjective is *mrš-av*, skinny-ADJ ‘skinny’) is preferred in the prefixed variants where it has a rather non-gradual interpretation (*omršati*, *smršati* ‘become skinny’). For the gradual meaning, including the imperfective uses, the version with the verb derived from the full positive of the adjective with the theme  $\langle i, i \rangle$  is preferably used: *mrš-av-i-ti*, skinny-POS-THV-INF ‘to get skinnier’.

However, a non-quantified inspection verifies a decent portion of root  $\langle i, i \rangle$  verbs without a prototypical scalar component such as *opštiti* ‘interact’, *misliti* ‘think’, *slutiti* ‘have premonition’, *visiti* ‘hang’, *mrziti* ‘hate’, *ličiti* ‘resemble’. It is hence clear without precise quantification that not all  $\langle i, i \rangle$  verbs have scalar interpretations. A quantitative investigation is still needed to determine the absolute and relative number of non-scalar  $\langle i, i \rangle$  verbs.

If the preliminary insight is quantitatively supported, i.e. if the share of non-scalar verbs in the  $\langle i, i \rangle$  class is too large to be considered idiomatic exceptions, then the following is the strongest generalization that can be made. If the verb has a scalar interpretation and the base does not contribute this component, the theme cannot be  $\langle a, a \rangle$ , but when the verb is not scalar – both themes are possible. Unless additional, purely formal features are stipulated, this generalization can hardly be captured in terms of realization of the feature [SCALE]. In Distributed Morphology (DM, Halle & Marantz 1993), if the theme  $\langle i, i \rangle$  is specified for realizing this feature, then it would be falsely predicted to never occur on a non-scalar verb. In Nanosyntax, comparative bases can be taken to realize a larger sequence, including the degree projection(s) (see De Clercq et al. 2022), leaving the theme to realize only the verbal category, hence compatible with the attested  $\langle a, a \rangle$  themes. Verbs involving the feature [SCALE] which is not realized by the base then realize the theme  $\langle i, i \rangle$ . The observation that a significant share of  $\langle i, i \rangle$  verbs have non-scalar interpretations (i.e. are states and non-linear processes) is fatal for it, as it predicts that all non-scalar predicates are realized with the theme  $\langle a, a \rangle$ .

Bases combining with only one theme, and hence the aggregate data too, favor the markedness analysis. This analysis is compatible with all the observations. The strong analysis falsely excludes non-scalar  $\langle i, i \rangle$  verbs, while properly accounting for the rest of the observations. We do not exclude that a modified version of the stronger analysis, with a more sophisticated analysis of ThVs and/or of scalarity (or a finer syntactic specification driving the realization of ThVs) may fit the data. Further research is necessary to establish the reliability of our conclusions.

## 7 Independent support for the role of markedness from apophony

Additional support for the role of markedness concerns apophony. As presented in (5c), apophony is one of the ways of marking secondary imperfectivization in SC, i.e. the operation whereby a perfective verb derives an imperfective verb while keeping exactly the same all the other



less marked to a more marked one. There are only two apparent exceptions, both from one and the same base form: one base-theme combination which changes with apophony from a more marked to a less marked theme (<a, a> to <i, i>: *prognati* to *progoniti* ‘banish’) and one which preserves the same theme (<a, a> to <a, a>: *prognati* to *proganjati* ‘banish’).

The two exceptions in fact collapse into one, because the perfective verb *prognati* is annotated as the aspectual pair of both imperfective verbs *progoniti* and *proganjati*. Observed as a chain *prognati* > *progoniti* > *proganjati*, the data actually show that in the only case where <a, a> is changed to <i, i> (*prognati* > *progoniti*), the system has come back to the more marked <a, a> class (*progoniti* > *proganjati*). The exact numbers are given in **Table 7**.

		Theme of the derived verb			
		<i, i>	<a, je>	<a, a>	Total
Theme of the base verb	</, e>	3	22	7	<b>32</b>
	<i, i>	0	4	28	<b>32</b>
	<e, i>	0	0	1	<b>1</b>
	<a, je>	0	0	1	<b>1</b>
	<a, a>	1	0	1	<b>3</b>
	Total	<b>4</b>	<b>26</b>	<b>38</b>	<b>68</b>

**Table 7:** Unique base-theme combinations undergoing apophony and those derived by it.

Apart from this one exception, a direct mapping can be specified, where morphological markedness of the base maps onto the morphological markedness of the ThV.<sup>15</sup>

## 8 Conclusion

We have quantitatively tested two possible modelling approaches to the realization of ThVs on the data from SC. The stronger approach is to differ them in terms of feature specification, and the weaker to determine their realization in terms of a resolution of multiple markedness hierarchies and the mapping of the resulting value onto the markedness hierarchy of ThVs. We identified scalarity, i.e. the feature [SCALAR], as the best candidate for the difference between the two

<sup>15</sup> Direct mapping can be taken to account also for the fact that bases including comparative morphology (and hence morphologically marked compared to those without it), discussed in section 6, take the marked ThV <a, a>. In this case, morphological markedness trumps semantic markedness (in having semantically marked scalar verbs realized with the morphologically marked ThV).

productive ThVs,  $\langle i, i \rangle$  and  $\langle a, a \rangle$ , such that the former has this feature and the latter not. The central difference targeted was that the stronger hypothesis predicted that non-scalar verbs will never realize the ThV  $\langle i, i \rangle$ . This prediction was confirmed among the verbs members of tuples distinguished only by the ThV. However, among verbs which do not enter such tuples, a number of verbs was identified which falsify the hypothesis. The observed difference between the two classes of verbs, as well as other generalizations, were in line with the weaker hypothesis in terms of markedness. The approach in terms of markedness was additionally corroborated by the facts on apophony. Without a further refinement of the stronger hypothesis at least, the weaker one wins. It correctly predicts that the correlations between ThVs and aspectual properties are tendencies, due to the effect of other relevant hierarchies, in particular of phonological markedness of the relevant segments and of the morphological markedness of the items involved, briefly also illustrated regarding apophony. This view correctly predicts that the tendencies will be stronger when other relevant properties are controlled for and the competition is direct, i.e. in tuples sharing the same base, and hence also the same phonological and other properties pertaining to the base. In such cases, also the relevant semantic oppositions are stronger, as they are not established only between the principled possibility that a verb be scalar or not, i.e. bounded or not, but also by the direct opposition between the two verbs in these properties. This approach is weaker both in making a weaker claim and in having nothing to say about the way scalarity, telicity or other properties that correlate with the ThVs are syntactically represented and morphologically realized.

The markedness view suggests that all verbal themes only carry the categorial feature [v]. Different ThVs are different realizations which can be specified idiomatically (for a limited set of bases), or determined at the phonological interface in terms of computing the degree of markedness of the context of realization of the ThV based on a set of markedness values across various relevant hierarchies and mapping it onto the markedness hierarchy of the available realizations. This computation results in each individual factor contributing to a tendency rather than yielding a categorial restriction or rule, in full analogy to the picture developed regarding the declension classes in the nominal domain in Arsenijević (2021b).

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## Abbreviations

1 = first (person), ACC = accusative, WeSoSlaV = Annotated Database of the Western Slavic Verbal System, AOR = aorist, AUX = auxiliary, ActP = active participle, DM = Distributed Morphology, DIM = diminutive, IMP = imperative, IMPERF = imperfective (aspect), INF = infinitive, INS = instrumental, IPF = imperfectum, NOM = nominative, SC = Serbo-Croatian, PassP = passive participle, PTCP – participle, PERF = perfective (aspect), PL = plural, POS = positive, PRS = present, PrsAdvP = present adverbial participle, PstAdvP = past adverbial participle, SG = singular, SUFF = suffix, THV = theme vowel.

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## Competing interests

The authors have no competing interests to declare.

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