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RESEARCH ARTICLE

Theme-vowel minimal pairs show argument structure alternations

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Abstract

This paper investigates correlations between theme vowels and argument structure in Serbo-Croatian. Specifically, we focus on two different theme vowels, *-i-* and *-ova-*, isolating 'minimal pairs', that is cases where the same base combines with the two theme vowels to derive different verbs. Starting from two online corpora of Serbo-Croatian, we created a comprehensive list of *-i-*/*-ova-* minimal pairs. For all pairs in the list whose both members were attested at least 50 times in the corpora, we randomly selected 50 tokens per verb and annotated them for transitivity. A statistical comparison of *-i-* and *-ova-* verbs according to the proportions of transitive uses was carried out. The findings show that *-i-* verbs are much more likely to be used transitively than *-ova-* verbs. This finding corroborates the view that theme vowels are associated with argument structure properties and challenges the idea that they are universally 'ornamental' pieces of morphology without syntactic/semantic import. Based on these and supplementary (non-corpus) data, we claim that *-i-* derives transitives and unaccusatives, while *-ova-* derives unergatives. We propose a model couched in Distributed Morphology whereby these two theme vowels are treated as instantiations of different 'flavors of *v*'.

1. Introduction

The status of theme vowels has become one of the more contentious issues in syntactocentric approaches to morphology, such as Distributed Morphology (DM) (Halle & Marantz 1993) and Nanosyntax (Starke 2009; Caha 2009). Under the assumption that each individual morpheme is introduced by a dedicated projection/set of projections, theme vowels, like any other morpheme, are expected to give rise to particular semantic and syntactic effects. However, in mainstream morphological literature, both traditional and generative, theme vowels are typically assumed to be purely morphophonological markers signaling conjugation class membership (cf. Anderson 1992; Aronoff 1994; Halle & Marantz 1993; Oltra Massuet 1999, 2020). If this is true, theme vowels constitute a morphological 'anomaly', in the sense of being discernible morphophonological units without syntactic or semantic content. This line of thinking is formalized by assuming that theme vowels are inserted post-syntactically (see Oltra

Massuet 2020 for an overview). In contrast to this view, which has also found its proponents in DM, there is an opposing perspective, whereby theme vowels, in fact, do carry syntactic/semantic information. In nanosyntactic and related work on Slavic, there is a widely held view that theme vowels are associated with argument structure properties (e.g. Jabłońska 2004, 2007; Taraldsen Medová & Wiland 2018, 2019). In DM literature, it has also been recognized that, at least in some cases, different theme vowels discriminate between unaccusatives and transitives (Marvin 2002; Arsenijević 2020).[1] Fábregas (2018) provides an implementation of this intuition by assuming that theme vowels are light verbs, and theme vowel differences correspond to different *v* heads or 'flavors of *v*' (Folli & Harley 2005). Finally, some authors (Matushansky 2021; Simonović & Mišmaš 2022; Kwapiszewski 2022, who credits a related approach of Czaykowska-Higgins 1998) have argued that Slavic theme vowels do not form a homogenous category but can be divided into genuine verbalizers and ornamental morphemes.

Against the backdrop of the opposing views regarding the nature of theme vowels, we undertake an empirical, quantitative study aimed at discriminating between the predictions of the two competing sets of accounts, focusing on 'minimal pairs', that is, pairs where the same base combines with two different theme vowels. As previously observed for Serbo-Croatian (SC), the two verbs in such pairs tend to exhibit different argument structure properties (Milićević 2004; Arsenijević 2020). This state of affairs is predicted under the syntactocentric view of theme vowels but difficult to account for, assuming that theme vowels are purely ornamental markers of conjugation class membership. We focus on pairs with theme vowels *-i-* and *-ova-*, such as the one illustrated in Example (1). In this pair, we observe that the verb with the theme vowel *-i-* is a transitive change-of-state verb, whereas its *-ova-* counterpart is an intransitive, unergative verb.

Example 1

(1) (a) mir-i-ti
peace-I-INF
'reconcile / appease'
(b) mir-ova-ti
peace-OVA-INF
'rest (e.g. in order to recover from an illness)'

[1] An anonymous reviewer points out that in some traditional accounts, formatives that distinguish between valence classes (e.g. intransitives vs. transitives) are not counted as theme vowels at all. However, the works we are referring to here (Marvin 2002; Arsenijević 2020) base their claims on cases such as (i), where the argument structure distinction can only stem from the difference in the formative that has to be counted as a theme vowel under any analysis. The verb in (ia) is an unaccusative verb with the theme vowel *-e-*, and in (ib), we find a transitive verb with the theme vowel *-i-*. Assuming that theme vowels are by definition not associated with argument structure or valence classes would force one to claim that *-i-* and *-e-* are not theme vowels in Serbo-Croatian (SC) at all, which is a major issue because these two vowels along with the vowel *-a-* are among the most frequent theme vowels in the language (see Table 1). Alternatively, one could claim that *-i-* and *-e-* are not theme vowels only in those uses where they do show argument structure effects (as in (i), for instance), but doing so would make the definition of theme vowels circular and any claim about them unfalsifiable.

(i) (a) List hartije je postepeno bel-e-o na suncu.
sheet paper aux gradually white-E-PST.M on sun
'The sheet of paper gradually whitened in the sun.'
(b) Petar je satima bel-i-o list hartije.
Petar AUX hours white-I-PST.M sheet paper
'Petar was whitening a sheet of paper for hours.'

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Before moving on, a caveat is in order regarding the status of *-ova-* as a theme vowel. We follow the host of the syntactocentric literature on Slavic theme vowels in counting *-ova-* (which alternates with *-uje-* in most finite forms, e.g. *mir-uje-m* 'I rest') as a single theme vowel (see, e.g. Svenonius 2004; Jabłońska 2004; Taraldsen Medová & Wiland 2019).[2] An additional argument for considering *-ova-* as a theme vowel in Serbo-Croatian lies in the fact that in certain uses, it is in competition with another much more clearly vocalic formant: *-a-*. A prime example is the regional variation within SC in the selection of the formant used in loanword integration in current contact with English. Eastern SC uses *-ova-*, whereas Western SC uses *-a-*, for example, *lajk-ova-ti* versus *lajk-a-ti* 'to like (on a social network)' (see also Simonović 2015: 201–220). The two affixes do not show any semantic or syntactic differences. Generally, *-a-*/*-ova-* pairs both within and across varieties are perfectly synonymous and available for a denominal analysis. This is also clear for the few cases where both *-a-* and *-ova-* are possible in the same variety, for instance, *guglati* and *guglovati* 'to google' in Eastern SC (only the former in the West). A native example is *glasati* and *glasovati* 'to vote' (the nominal base being *glas* 'vote') in Western SC (only the former in the East), whereby *glasovati* is favored by prescriptivists (see Starčević, Kapović & Sarić 2019: 321 for a discussion).

Returning to the main issue, the syntactic view of theme vowels predicts the correlation between theme vowels and argument structure properties illustrated in Example (1) to hold in the entire set of such minimal pairs in SC, while the traditional view and its DM descendants make no such prediction. In fact, on the latter view, such correlations would have to be ascribed to some external factor explaining the link between conjugation class membership and argument structure. Therefore, showing that there is a correlation between theme vowels and argument structure would not constitute an outright falsification of the traditional view, but it would, nonetheless, add to the empirical grounding of the syntactic view of theme vowels, which is already conceptually preferable, since it does not involve ascribing a special status to theme vowels.

The remainder of the paper is organized as follows: in Section 2, we present an overview of the generative literature on the status of theme vowels, observing the existence of two opposing views. We further explain why focusing on 'minimal pairs' of verbs differing only in their theme vowels represents a suitable testing ground for the different predictions stemming from these accounts. Section 3 describes the methodology that we employed to test these predictions. In Section 4, we present the results, which support the syntactic view. Section 5 offers a DM-based implementation of our findings in the form of an assumption that *-i-* is an exponent of either inchoative v[BECOME] or a more complex

[2] Traditional analyses of SC consider *-ova-* (which alternates with *-uje-* in the present tense) as a conjugational class marker. The same is true of the morpheme *-iva-* (also alternating with *-uje-* in the present tense), which has the function of a secondary imperfectivizer. In Barić, Lončarić, Malić, Pavešić, Peti, Zečević & Znika (1997: 235), *ova*-verbs and *iva*-verbs are grouped together and constitute one of the seven conjugational classes. In defining this class, Barić et al. (1997) explicitly refer to these two suffixes. The same classification into seven conjugation classes is encountered in Silić & Pranjković (2007: 48) and Čirgić, Pranjković & Silić (2010: 113–114). The allomorphy between the infinitive and present-tense forms plays a crucial role in classifying the whole morpheme as a conjugation class marker since verbalizers and secondary imperfectivizers which don't display allomorphy are not classified as separate conjugation-class markers. The verbalizer *-ira-* and the secondary imperfectivizer *-ava-* are cases in point. Verbs derived with these suffixes are classified as belonging to the same conjugation class as all other verbs which have theme vowel *a* in both infinitive and present tense forms. On the other hand, standard grammars never classify *ova*-verbs or *iva*-verbs as belonging to the conjugational class a/je.

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transitive head v[BECOME]+v[CAUSE] while *-ova-* is an exponent of the unergative v[DO]. In this section, we also raise the issue of the status of the base, suggesting that *-i-* attaches to roots while *-ova-* may actually not be an atomic theme vowel, as is (implicitly) assumed in some traditional grammars (see Footnote 2), but a combination of the nominalizing head *-ov-* and the theme vowel *-a/je-*.[3] We offer both syntactic and phonological arguments in favor of this analysis. Section 6 concludes the paper and discusses the prospects for further research.

2. Background

The recent formal literature on theme vowels can roughly be divided into two camps.[4] On the one hand, there are researchers who follow the traditional view that theme vowels do not interact with syntax and semantics in any meaningful way and treat theme vowels as 'ornamental' elements, serving as signals of conjugation class membership. These authors assume that theme vowels are inserted at Phonological Form (PF) to satisfy some morpho-phonological requirement. We refer to this approach as 'the received view'. In contrast, there is a growing body of literature based primarily on Slavic languages, where the assumption is that theme vowels do interact with syntactic structure (argument structure, in particular). We will call this line of research 'the syntactic view'. In this section, we will outline the basic arguments of these two perspectives.

[3] It should be noted, however, that even if the right segmentation eventually turns out to be *-ov-* + *-a/je-*, which we suspect may very well be the case, this does not affect the main argument of our paper that theme vowels, when combined with different roots/bases, show significant correlations with the argument structure, since our pairs would still include different theme vowels (*a/je* vs. *i/i*).

[4] Cognitive-linguistic approaches analyze theme vowels as conjugational class markers (e.g. Nesset 2000; Jelaska & Bošnjak Botica 2012, 2019; Bošnjak Botica & Jelaska 2015, and references therein). Roughly, prototypical members of a category are 'central' members, sharing the greatest number of properties, while marginal members share only a few properties with the more typical ones. Prototypical members are typically default, that is, the ones that subjects invoke in the absence of indications to the contrary and are typically the most frequent (Taylor 2019). Analyzing unidirectional versus non-directional motion verbs in Russian, Nesset (2000) proposes that both verbal forms and verbal meanings are organized in terms of prototypes: non-directional motion verbs are expressed by a more typical morphological form (i.e. conjugational class) than their directional counterparts. At the same time, non-directional meaning is more typical than the unidirectional one. He argues that, more generally, form and meaning are related in terms of iconicity in that prototypical forms map to prototypical meaning and non-prototypical forms to non-prototypical meaning. Specifically, conjugational classes in Russian form a hierarchy which extends from the productive and common classes to the smallest, non-productive classes. Motion verbs then always appear in pairs such that the non-directional member of the pair is higher up in the conjugational hierarchy (Nesset 2000: 108–109).

In a series of papers, Jelaska & Bošnjak Botica (2012, 2015, 2019, and references therein) use the notion of prototype to analyze Croatian theme vowels and conjugation classes. The basic idea is that conjugational types are represented as fuzzy sets containing concepts, with the properties of each concept contributing to their representativeness within the category. Each class is a category organized around a phonological form (the thematic vowel in the present tense) and can have subcategories, for example, verb types, depending on their infinitive form. Each type is also viewed as a category, organized into verb subtypes, which also display different degrees of membership (Bošnjak Botica & Jelaska 2015: 12). The classification of verbs into classes, types, and subtypes is based on different semantic and grammatical properties, such as the verbal aspect (imperfective vs. perfective), the argument structure (e.g. intransitive vs. transitive, unaccusative vs. unergative), the 'category' of the root/base (e.g., adjectival vs. non-adjectival bases), the lexical/aktionsart class (e.g., stativity, inchoativity), etc. (for specific examples, see, e.g. Bošnjak Botica & Jelaska 2015: 19–20).

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2.1. The 'received view'

We use the label the 'received view' to convey the fact that this line of thinking has been inherited from traditional grammar, but it finds its proponents in various contemporary theoretical approaches. In fact, the main empirical claims and reasoning of the traditional grammar play a central role in these contemporary approaches. Here, we will outline Aronoff's (1994) rendition of this broader argument and then explain how it has been implemented in other approaches such as DM (Halle & Marantz 1993) or A-Morphous Morphology (Anderson 1992).

Aronoff (1994) famously argues for the existence of an autonomous module of grammar in charge of morphology. He cites the insertion of theme vowels as one of the examples of purely morphological operations, which have no impact on syntax and semantics. Drawing on data from Latin, he presents three main arguments in support of the position that theme vowels are phonological markers of conjugation class membership. Specifically, Aronoff's (1994) argument is directed against the assumption that theme vowels derive verbs in Latin. The first argument that he puts forth stems from the fact that such an assumption would entail that only a handful of Latin verbs are underived. In other words, if theme vowels derive verbs, then there would be just a few verbs that would stand out as exceptions to the generalization that Latin verbal lexemes are basically complex verbalizations.

Secondly, Aronoff (1994) argues that treating theme vowels as verbalizing suffixes would run into an issue of the lack of clearly identifiable semantic contribution. Namely, Latin has other suffixes that are typically treated as verbalizing suffixes, like the English suffix *-ize*, and these suffixes are associated with relatively clear semantics in Table 1. On the other hand, the most prominent function of theme vowels seems to be to determine the conjugation class of the verb, and there is no similar semantic concept that could be associated with them.

Aronoff (1994)'s third, and most important, argument against treating theme vowels as verbalizers comes from the way in which they combine with (other) verbalizers. As shown in Table 1, theme vowels are not in complementary distribution with (other) verbalizing suffixes. Instead, typical verbalizers precede theme vowels. This pattern of co-occurrence of theme vowels and verbalizing suffixes is problematic for the view that theme vowels are just another type of verbalizers since there are no Latin verbs that consist only of a stem/root and the verbalizing suffix without the theme vowel. This would imply that the suffixes that are normally considered to be verbalizers in Latin are only parts of more complex verbalizers consisting of a meaningful component and a theme vowel. The problem is aggravated by the fact that theme vowels can occur without the typical, meaningful verbalizers.

Taken together, these three arguments compel Aronoff (1994) to conclude that theme vowels should not be treated as verbalizers. Instead, he opts for the view that their function is

Table 1. The distribution of verbalizers and theme vowels in Latin

suffix	theme vowel	meaning	example verb	glos
-ur-	-ī-	Desiderative	esurire	'be hungry'
-it-	-ā-	Iterative	visitare	'see often'
-sc-	-ē-	inceptive	calescere	'get warm'
-ess-	-e-	intensive	capessere	'seize'
				(Aronoff 1994: 46)

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to satisfy a purely morphological well-formedness requirement and determine the conjugation class of the verb.

The assumption that theme vowels are bereft of semantic and syntactic contributions underlies the foundational work in DM and arguably represents the dominant view in this framework. Halle & Marantz (1993: 135) are explicit about their assumption that theme vowels in languages such as Latin, Latvian, Spanish, or Russian are semantically empty formatives. Since theme vowels do not affect the semantics, Halle & Marantz (1993) argue, it is natural to postulate that they are inserted post-syntactically (i.e. in a part of the grammar in charge of morphological structure). Similarly, Embick & Halle (2003) cite theme vowels as an example of Late Insertion in DM, motivating the existence of a post-syntactic module responsible for morphology. Specifically, they assume that theme vowels are inserted into *v* nodes of derived verbal lexemes in order to satisfy language-specific morphophonological requirements (see also Arregi 1999; Oltra Massuet 1999, 2020). This mainstream view of theme vowels in DM has also been applied to Slovenian in Marvin (2002).

Like in the case of DM, the assumed lack of semantic and/or syntactic contribution of theme vowels is an exemplary piece of evidence for the core claims of Anderson's (1992) A-Morphous Morphology. Anderson (1992: 53) cites theme vowels as primary examples of empty morphs 'or subparts of a form that lack any content whatsoever'. For him, the linguistic reality of empty morphs is significant because it motivates the existence of a morphological module called Morphosyntactic Representation (MSR), which is separate from syntax and acts as an interface between syntax and word formation rules. MSR is, thus, capable of manipulating linguistic structures at the phonological level without affecting their meaning.

Taking a broader look at the argumentation behind what we call 'the received view', one can observe that its basic thrust hinges upon the assumed lack of semantic and/or syntactic contribution of theme vowels. Aronoff's (1994) objection that treating theme vowels as verbalizers would mean that virtually all Latin verbs are derived, for example, is totally incompatible with the basic postulates of DM, where *all* content words are assumed to be derived from categoriless roots combined with categorizing functional projections. Moreover, Lowenstamm (2014) and related proposals that all derivational affixes are roots would explain why there are no Latin verbs consisting only of the traditional verbalizing suffix and the roots/base *modulo* the assumption that theme vowels are phonological instantiations of the categorizing *v* head (see Fábregas 2018). What is left, then, is the issue of the apparent lack of a discernible syntactic and/or semantic contribution of theme vowels. If evidence of the association between theme vowels and syntactic and/or semantic characteristics were to emerge, the issue could disappear.

2.2. 'The syntactic view'

In view of the lack of clear indications regarding the syntactic and semantic contribution of theme vowels in Latin (and in Romance more broadly, but see Kastner & Martin 2021 for French[5]), it is interesting to observe that the link between a given theme vowel and a

[5] Kastner & Martin (2021) report an experimental study comparing French Group 1 (e.g. *long-er* 'go along') and Group 2 verbs (e.g. *maigr-ir* 'get thin(ner)'). These are traditionally considered as belonging to different conjugational classes and/or having different theme vowels. Participants were presented with a two-alternative forced choice task between verbal forms belonging to the two classes derived for wug-adjectives. The contexts were

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Table 2. The morphosyntactic and semantic properties of theme vowels in Polish (Jabłońska 2004: 364)

Verbalizer	Root insertion	Properties
-i-	high (inside *v*)	unergative/transitive syntax
-aj-	high (inside *v*)	unergative/transitive syntax
-n- semelfactive	high (inside *v*)	unergative/transitive syntax + punctual
-ej-	low (inside *v*)	unaccusative syntax
-n- inchoative	low (inside *v*)	unaccusative syntax

particular argument structure property (or set of properties) is virtually taken for granted in Nanosyntactic literature and related work, which is often based on Slavic data (Jabłońska 2004, 2007; Taraldsen Medová & Wiland 2018, 2019; Caha, De Clercq & Vanden Wyngaerd 2023).[6] The lack of an autonomous component dedicated to morphology in the architecture of Nanosyntax removes the possibility of Late Insertion (Starke 2009; Caha 2009), thus precluding the analysis whereby theme vowels are purely phonological markers of conjugation class membership. In that sense, part of the motivation for the departure from the 'received view' in Nanosyntax could be theory internal. However, these works usually come with quite articulated proposals regarding the precise semantic and syntactic effects contributed by different theme vowels. Consider the proposal in Table 2 from Jabłońska (2004: 364) for Polish, building on Rubach (1984).

Jabłońska (2004), as replicated in Table 2, provides a very precise set of claims about the correlations between different theme vowels (left-hand column) and argument structure properties (right-hand column) as well as a syntactic differentiation between the two sets of theme vowels based on their attachment sites ('high'/inside *v* vs. 'low'/inside *v*).

The observation that theme vowel differences are associated with argument structure differences is also present in the literature on South Slavic and outside the Nanosyntactic framework (Marvin 2002; Milićević 2004; Arsenijević 2020; Simonović & Mišmaš 2022). For instance, in the 'minimal pair' of verbs in footnote 1 repeated here as Example (2), the unaccusative version Example (2a) comes with the theme vowel *-e-*, whereas its causative, transitive counterpart Example (2b) contains the theme vowel *-i-*.[7]

set up to force the C(hange)o(f)S(tate) versus Activity reading. The authors concluded that the CoS/Activity distinction is a strong predictor of participants' choice: *-ir* is preferred in CoS, whereas *-er* is preferred in Activities. The authors eventually concluded that the CoS component in Group 2 comes from the semantics of the morpheme *i(s)* and that conjugation classes as such do not exist in French, which is (moving toward) an athematic system.

[6] For a related view within the Cartographic approach, based on Russian data, see Dyachkov (2021).

[7] Similarly, Arsenijević & Milosavljević (2021) and Milosavljević & Arsenijević (2022) found significant differences between theme vowels *-a-* and *-i-* in Serbo-Croatian. These differences mostly concern the event structure (aspect, boundedness, scalarity), which is often based on different argument structure. For instance, in the pair in (ii), with the same root *trag* 'search', the *i*-counterpart (iia) expresses a directed, linear action, with the verb obligatorily taking the accusative complement, whereas in (iib), the *a*-variant expresses a non-linear, undirected action, and the verb is intransitive (typically combined with the *za*+Instrumental PP). Arsenijević & Milosavljević

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Example 2

(2) (a) List hartije je postepeno bel-e-o na suncu
sheet.NOM paper.GEN AUX gradually white-**e**-PST.M on sun.LOC
'The sheet of paper gradually whitened in the sun.'

(b) Petar je satima bel-i-o list hartije
Petar.NOM AUX hours.INS white-**i**-PST.M sheet.ACC paper.GEN
'Petar was whitening a sheet of paper for hours.'

Based on such cases, one can plausibly assume that there is at least some link between theme vowels and argument structure.

The idea of treating theme vowels as verbalizers or 'light verbs' has recently found some support in the DM literature. Fábregas (2018) assumes that theme vowels (in Spanish) are essentially exponents of different 'flavors of v' (Folli & Harley 2005) or 'light verbs' such as BE, DO, etc. This account produces an explanation for the puzzling lack of theme vowels inside the lexical exponents of light verbs in various languages (for related approaches, see also Fábregas 2022 for Spanish; Grestenberger 2022 for Ancient Greek). The syntactic reality of theme vowels and/or conjugation classes has also been reported for non-Indo-European languages. For instance, Kouneli (2022: 1) argues that in Kipsigis (Nilotic; Kenya) 'there is a close (historical or synchronic) connection between conjugation classes and transitivity'.

There is also a growing body of studies that report on strong correlations between theme vowels and lexical (inner) and/or grammatical (outer) aspect. For instance, Gribanova (2015) analyzes the theme vowel *-a-* in Russian as associated with the realization of the features on the Asp head. Grestenberger (2021) provides argumentation from the history of Greek for a connection between theme vowels and lexical aspect. Arsenijević & Milosavljević (2021) propose that the theme vowel *-i-* in SC carries the feature [SCALE], which is considered crucial in deriving telicity in some approaches (e.g. Hay, Kennedy & Levin 1999). They observe differences among theme vowels with respect to telicity, grammatical aspect, and/or singular/plural interpretations of predicates. The connection between themes and aspect is also documented by Okumuş, Öztürk & Demirok (2021), who argue that theme vowels in Şavşat Georgian simultaneously mark both inner and outer aspect.

A common issue in this line of research ('the syntactic view') is that strong correlations between argument structure properties and theme vowel differences seem to occur only sporadically (typically in 'minimal pairs' such as Example (2)), and when the entire set of verbs in the language is considered, they do not appear very strong. However, the weakness of these correlations might be due to certain confounding factors that can alter argument structure properties. For instance, prefixes seem to be able to alter argument structure in Slavic, as illustrated in Example (3).

(2021) show that verbs with *-a-* and *-i-* systematically differ in minimal pairs regarding the event structure, whereas beyond minimal pairs, the difference is not categorical but significant tendencies can still be observed.

(ii) (a) traž-i-ti (< trag-i-ti) nešto/nekog
search-I-INF something/someone.acc
'search, request' (directed action)

(b) trag-a-ti (za nečim/nekim)
search-A-INF for something/someone.ins
'be on the search' (non-linear)

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Example 3

(3) (a) Vanja pis-a-l *Russian*
Vanja write-A-PST.M
'Vanja was writing.'
(b) Vanja pis-a-l pis'mo
Vanja write-A-PST.M letter
'Vanja was writing a/the letter.'
(c) *Vanja na-pis-a-l
Vanja PFV-write-A-PST.M
'Vanja wrote down.'
(d) Vanja na-pis-a-l pis'mo
Vanja PFV-write-A-PST.M letter.
'Vanja wrote down a/the letter.' (from Basilico 2008: 1716–1739)

In SC, for instance, a prefix can turn an unaccusative verb into a transitive one (Example (4)).

Example 4

(4) (a) Ivan je lud-e-o *SC*
Ivan AUX mad-**E**-PST.M
'Ivan was going mad.'
(b) Marija je iz-lud-e-la Ivana
Marija AUX PFV-mad-**E**-PST.F Ivan
'Marija made Ivan crazy.'

The theme vowel *-e-* that we see with an unaccusative verb in Example (4a) appears in a transitive environment in Example (4b). However, this could be due to the prefix, and the theme vowel could still carry the same semantic/syntactic contribution that it did in Example (4a).

In sum, the apparent association between theme vowels and argument structure properties could be blurred by the introduction of additional elements (e.g. prefixes) that affect argument structure. For that reason, the most suitable way of investigating the links between theme vowels and argument structure is by controlling for these potential confounds.

The two theme vowel classes that we focus on in this study (***-i-*** and ***-ova-***) do not show strong evidence of a clear link with argument structure properties before the potential confounding factors are removed from the picture. These two theme vowel classes represent a subset of the total of 13 classes that exist in SC. Table 3 provides the complete list of theme vowel classes in SC together with the quantitative data regarding their frequency among unprefixed verbs as expressed by the total number of unprefixed verbs with each theme vowel in the database of SC verbs consisting of 5,300 different verbal lexemes developed by Arsenijević, Gomboc Čeh, Marušič, Milosavljević, Mišmaš, Simić, Simonović & Žaucer (2024) (see also Arsenijević 2020). The percentage values accompanying the absolute figures for each class signify the proportion of each of the classes in the prefixless sample. The classes that we focus on (***-i-*** and ***-ova-***) are given in boldface.

Table 3 shows that the *-i-* class derives 366 unprefixed verbal lexemes comprising 23% of the total number of verbs in the prefixless sample. The *-ova-* class consists of 187 different unprefixed verbs, or 12% of the entire prefixless sample. These figures demonstrate that the

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Table 3. Theme vowels across prefixless verbs in SC (based on annotated data from Arsenijević et al. 2024)

Ø, e	brati, berem 'pick' grebati, grebem	36 (2.3%)	i, i	ljubiti, ljubim 'kiss'	366 (23.1%)
a, e	'scratch'	5 (0.3%)	a, a	padati, padam 'fall'	659 (41.5%)
e, e	smeti, smem 'dare'	3 (0.2%)	e, i	voleti, volim 'love'	57 (3.6%)
nu, ne	trunuti, trunem 'rot'	92 (5.8%)	a, i	trčati, trčim 'run'	26 (1.6%)
Ø, ne	pasti, padnem 'fall'	13 (0.8%)	a, je	pisati, pišem 'write'	139 (8.8%)
ova, uje	**kovati, kujem 'forge'**	**187 (11.8%)**	va, je	pljuvati, pljujem 'spit'	2 (0.1%)
iva, uje	kazivati, kazujem 'narrate'	2 (0.1%)	TOTAL		1587

-i- class and the *-ova-* class are the second and the third largest class of theme vowels among the unprefixed verbs.

The database developed by Arsenijević et al. (2024) is also coded for parameters pertaining to argument structure properties (e.g. the ability to take an accusative case complement, passivisation, etc.), enabling us to examine the correlations between these properties and membership in different theme vowel classes. Such a comparison does not reveal significant differences. Both *-i-* and *-ova-* verbs seem to be able to derive verbs belonging to all major argument structure classes. Table 4 provides illustrations for both *-i-* and *-ova-* verbs deriving causative transitives, non-causative transitives, unergatives, and unaccusatives.

A preliminary quantitative analysis of the data in Arsenijević et al. (2024) revealed no evidence of a correlation between argument structure properties and theme vowels under investigation. Table 5 summarizes the results of the quantitative comparison between *-i-* and *-ova-* verbs with respect to two parameters pertaining to transitivity. The middle column shows the percentages of verbs that require an obligatory accusative-case-marked object in the two theme vowel classes, and the rightmost column displays the portions of the verbs in each theme vowel class that can be combined with an accusative case-marked object which is not necessarily obligatory in all the uses of this verb. These values show no statistically significant differences.

Our intention to disentangle the effect of theme vowels on argument structure from all other factors guided our decision to investigate the two theme vowels in 'controlled' environments, that is, 'minimal pairs' of verbs, differing only in their theme vowel, as in Example (5).

Example 5

(5) (a) strah-**i**-ti (realised as straš-i-ti [straʃiti])
fear-**I**-INF
'frighten'

(b) strah-**ova**-ti
fear-**OVA**-INF
'fear'

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Table 4. Theme vowels across verbs belonging to different argument-structure types

i, i causative transitive	mir-i-ti (koga) peace-**i**-INF (someone) 'to reconcile someone'
i, i non-causative transitive	mol-i-ti (koga) beg-**i**-INF (someone) 'to beg someone (for something)'
i, i unaccusative	cur-i-ti leak-**i**-INF 'to leak'
i, i unergative	pilj-i-ti stare-**i**-INF 'to stare'
ova, uje causative transitive	legaliz-ova-ti (nešto) legalize-**ova**-INF (something) 'to legalize (something)'
ova, uje non-causative transitive	bojkot-ova-ti (nešto) boycott-**ova**-INF (something) 'to boycott (something)'
ova, uje unaccusative	napred-ova-ti forward-**ova**-INF 'to make progress'
ova, uje unergative	let-ova-ti summer-**ova**-INF 'to spend the summer'

Table 5. Summary of the quantitative analysis based on the data from Arsenijević et al. (2024)

	acc_obligatory	acc_possible
i, i	60.4% (221/366)	65.6% (240/366)
ova, uje	66.3% (124/187)	70.1% (131/187)

The two verbs in Example (5) differ in their argument structure properties, and, as we will show below, in a typical way. The verb in Example (5a) with the theme vowel *-i-* is a transitive verb taking an obligatory accusative-case-marked object, while the one in Example (5b) with the theme vowel *-ova-* is an intransitive verb that exhibits syntactic properties of unergatives. In addition to the presence of the volitional component in the semantics of the verb in Example (5b), it also derives impersonal passives as illustrated in Example (6), which in SC is a general characteristic of unergatives but not of unaccusatives (Example (6b)) (Aljović 2000).

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Example 6

(6) (a) Nekada je strah-ova-n-o da imaju visok *unergative*
once AUX fear-OVA-PASS.PTCP-N that have high
holesterol ali cela jaja se vraćaju.[8]
cholesterol.ACC but whole eggs.NOM SE return.PRS.3.SG
'Once it was feared that they are high in cholesterol but whole eggs are coming back.'

(b) *U tom krevetu je
in that bed AUX
umr-(e)-n-o/umr-(e)-t-o *unaccusative*
die-(E)-PASS.PTCP-N/die-(E)-PASS.PTCP-N
Intended: 'someone has died in this bed'

Such 'minimal pairs' of verbs allow for a direct test of the hypothesis that different theme vowels correlate with different argument structure properties. The relevance of 'minimal pairs' or combinations of roots with different theme vowels has been discussed in the literature (Svenonius 2004: 181–185; Milićević 2004; Romanova 2004; Gribanova 2013: 131–133, 2015; Kagan 2016: 33). However, there have been no quantitative and comprehensive analyses so far.

2.3. Aims and research questions

Our research question is whether there is a link between argument structure properties and theme vowels. It stems from (i) the debate about the (lack of) clearly identifiable syntactic/semantic contribution of theme vowels to verbal derivations and (ii) a series of proposals about the various confounding factors that could blur the association between argument structure and theme vowels. If the authors who argue that theme vowels are associated with argument structure properties are correct and data such as Example (5) are representative of a more general pattern, we hypothesize that an exhaustive comparison of all pairs of verbs differing only in the theme vowel (*-i-* vs. *-ova-*) will reveal a correlation between theme vowels and argument structure properties. More specifically, we predict that there will be a statistically significant difference such that *-i-* verbs will have a higher proportion of transitive uses than *-ova-* verbs. On the basis of the distinction in Example (6), we also hypothesize that *-ova-* verbs, when intransitive, will be more likely to derive participial *-n/-t* forms (a diagnostic of unergativity), as opposed to intransitive *-i-* verbs, which tend to be unaccusative.

3. Method/procedure

In this section, we describe the methodology of the present study. We compare the argument-structure properties of two different theme vowels (*-i-* and *-ova-*) in what we call 'minimal pairs' of verbs, that is, pairs of verbal lexemes that consist only of the root/base and one of these two theme vowels. Prefixed verbs were not considered because of their confounding effects on argument structure.

[8] Source: https://topzdravlje.rs/zdrava-hrana-za-mrsavljenje/.

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As a starting point in our data collection, we set out to assemble a maximally exhaustive initial list containing *-i-*/*-ova-* minimal pairs. We started from two online corpora of SC, Croatian Web Corpus (hrWaC), and Serbian Web Corpus (srWaC) (Ljubešić & Klubička 2014). From the two corpora, we extracted all the verbs consisting of a root/base and one of the two theme vowels under investigation (*-i-* and *-ova-*) with more than four attestations.[9] Next, in cases where only one of the two options was found (i.e. where we only found a combination of a root/base and the theme vowel *-i-* or *-ova-* but not the other member of the potential 'minimal pair'), we conducted an informal preliminary survey based on grammaticality judgments to determine whether the missing option is potentially available. Where native speaker judgments suggested the missing option was possible, we looked for actual attestations of these missing items online. Only those verbs that could be independently attested in online usage were ultimately included in the initial list. The criteria for this initial list were quite inclusive, since we were concerned with obtaining a maximally exhaustive list. The only exclusion we made concerned the pair *kup-i-ti* 'buy.PFV'/*kup-ova-ti* 'buy.IPFV', which was a clear outlier in several respects. First, this pair was based on the bound root *kup*, while all the other pairs were based on roots/stems which were independently attested words. Second, all the verbs in our list are imperfective, and the perfective verb *kupiti* would be a clear outlier. Third, the verb *kup-ova-ti* 'buy.IPFV' is the only verb in the entire language where *-ova-* acts as an imperfectivizer. That this is a rather exceptional feature can be seen in the fact that prefixed versions of the perfective verb *kup-i-ti* follow the default secondary imperfectivization pattern with the suffix *-iva-* rather than *-ova-,* as in *za-kuplj-iva-ti* 'buy.IPFV', not: **za-kup-ova-ti,* from *za-kup-i-ti* 'rent.PFV'. We ended up with a list consisting of 66 'minimal pairs' or 132 verbs in total.

In order to test our hypothesis that theme vowel differences are associated with argument structure properties, we carried out a quantitative comparison using corpus data. We focused on those minimal pairs from the initial list in which both members had 50 or more tokens in hrWaC. In cases where one member of the pair did not reach 50 tokens, srWaC was consulted to obtain additional examples needed to reach the threshold of 50 tokens for each member of the pair. This narrowed down our set of verbs to 23 pairs (46 verbs). Next, we randomly extracted 50 attestations for each verb and annotated them for transitivity. This gave us a total of 1,150 corpus attestations of verbs with the theme vowel *-i-* and an equal number of attestations of verbs with the theme vowel *-ova-*. The sample was divided into three parts, and three annotators tagged the data independently using a unified set of criteria. An attestation was coded as transitive if it included an accusative case-marked object or the morpheme SE as a marker of reflexivity or anticausativity (the morpheme SE in its reflexive or anticausative use can only be combined with transitive verbs).[10] The numbers of transitive examples within the two groups of verbs (*-i-* and *-ova-* verbs) were subsequently compared. This means that the independent variable was categorial, and it had two values (*-i-* or *-ova-*), and the dependent variable was also a categorial variable *transitivity* as manifested in the presence or absence of an accusative case-marked object or the morpheme SE. This design allowed us to construct frequency tables cross-tabulating the two variables, and the significance was established using the χ^2 test.

[9] The Corpus Query Language (CQL) we used is [lemma=".*(ova|i)ti"].

[10] The morpheme SE also has the so-called 'lexical' version where it appears obligatorily with certain verbs (e.g. *diviti* ***se*** 'admire' is never used without SE). Since verbs that combine with the 'lexical' version of SE never occur without it, there was no difficulty in separating 'lexical' SE from reflexives and anticausatives as markers of transitivity.

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While the results of this corpus-based quantitative comparison constituted the main data contribution of our study, we also used the list of minimal pairs with *-i-* and *-ova-* and the authors' native speaker judgments to gain additional empirical insights that were not amenable to a strict corpus-based analysis. These supplementary insights allowed us to interpret our main findings and deliver a formal analysis. The additional properties that we were interested in were (i) the possibility of deriving a verbal passive and (ii) the possibility of deriving a passive participle or any of the so-called *-n*/*-t* forms. Feature (i) picks out transitives (i.e. eliminates unergatives and unaccusatives) while (ii) picks out transitives and unergatives (i.e. eliminates unaccusatives; recall Example (6)).

In order to obtain data regarding the availability of verbal passives and any passive participle *-n*/*-t* forms, we coded the verbs in our database on the basis of the three annotators' native speaker judgments, and in cases where judgments were inconclusive, we looked for independent attestations of the forms we were interested in srWaC, hrWaC, or on the web. A verb was coded as having a particular feature only if examples of such uses could be found in actual language use.

We were interested in these additional properties because strictly corpus-derived data regarding transitivity, while capable of revealing differences in the frequencies of transitivity uses, arguably were not rich enough to substantiate a formal analysis by theirselves. The kind of corpus data we were able to obtain could not yield certain distinctions that we deem important. For instance, some verbs are transitive in all their uses, meaning that they require an obligatory accusative-case-marked object (Example (7a)), whereas with purely intransitive verbs, objects are always blocked (Example (7b)).

Example 7

(7) (a) Petar je mir-i-o *(braću)
Petar.NOM AUX peace-I-PST.M brothers.ACC
'Petar reconciled his brothers.'

(b) Petar je mir-ova-o (*braću)
Petar.NOM AUX peace-OVA-PST.M brothers.ACC
'Petar rested.'

Some transitive verbs, however, can be used without an object in some cases, but then, the object is normally implied, and it can be overtly realized in other uses (Example (8a)).

Example 8

(8) (a) Petar je sud-i-o (utakmicu)
Petar.NOM AUX judge-I-PST.M match.ACC
'Petar refereed (the match).'

(b) Petar je sud-ova-o (*parnične postupke)
Petar.NOM AUX judge-OVA-PST.M litigation procedures.ACC
'Petar worked as a judge.'

The availability of verbal passives was, thus, significant because it picks out causative transitives. For instance, purely stative transitives cannot derive verbal passives (Example (9)). In that sense, verbs that pass these tests can immediately be treated as transitives, but those verbs that fail this test should not automatically be treated as intransitives.

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Example 9

(9) (a) Petar ima knjigu
Petar.NOM has book.ACC
'Petar has a book'.
(b) *Knjiga je ima-n-a od strane Petra
book.NOM is have-PASS.PTCP-F by side Petar.GEN
'*A book is had by Petar.'

The other additional feature (the availability of any passive participle *-n*/*-t* forms) was taken as a negative diagnostic for unaccusativity. As was pointed out in reference to the contrast in Example (8), following Aljović (2000), transitives and unergatives are able to derive impersonal passives. Unaccusatives, on the other hand, cannot derive these forms at all.

We used the χ^2 test to establish statistical significance for the differences regarding the availability of verbal passives and any passive participle forms between the two theme vowel classes under investigation.

4. Findings

In this section, we report on our main findings from the corpus study of transitivity patterns with *-i-* and *-ova-* verbs. We then supplement these results with our secondary findings regarding the availability of verbal passives and any passive participle forms with these verbs. The research question underpinning the latter set of findings was not concerned with questions of frequency (i.e. how frequent is a particular use of a given verb). Instead, it focused on the availability of such forms in general, and as a result, it was assessed by means of native speaker judgments corroborated, when in doubt, by independent attestations in the corpora or on the web.

4.1. Transitivity patterns with *-i-* and *-ova-* verbs

We observed a very strong correlation between theme vowel differences under investigation (*-i-* v. *-ova-*) and the frequency of transitive uses. The results are summarized in Table 6. Recall that our corpus investigation pertaining to this main hypothesis included 23 pairs (46 verbs) with more than 50 attestations in hrWaC, supplemented by examples from srWaC in cases in which the threshold of 50 attestations could not be reached in hrWaC alone. Table 6 shows that verbs with the theme vowel *-ova-* exhibited 214 examples

Table 6. Frequencies and proportions of transitive uses according to theme vowels

theme vowel	number of transitive examples	ratio of transitive examples	number of verbs with attested accusative objects	ratio of verbs with attested accusative objects
-ova-	214	0.186	10	0.43
-i-	702	0.61	19	0.82

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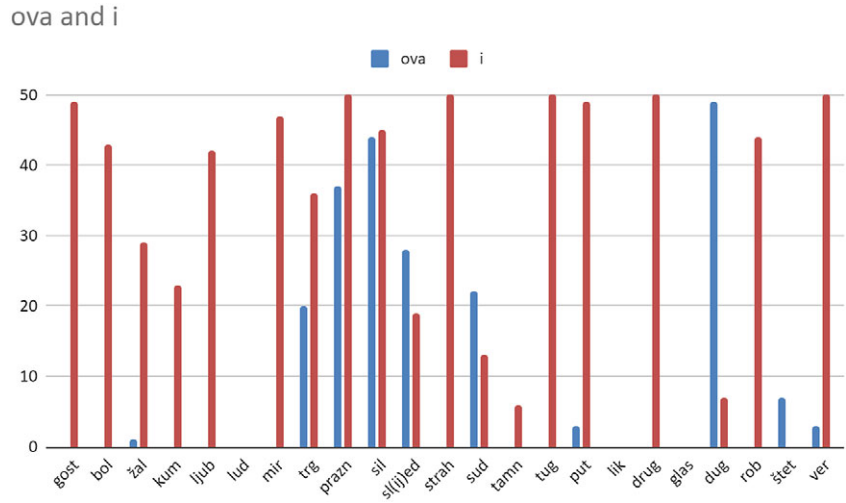

Figure 1. The frequencies of transitive uses according to minimal pairs.

of transitive uses in total, which amounted to 18.6% of the sample under investigation. On the other hand, 702 transitive uses (or 61%) were recorded for the verbs with the theme vowel *-i-*. This difference was shown to be statistically significant, χ^2 (1, n = 2,300) = 431.25, p<0.0001.[11]

Figure 1 provides a summary of the findings regarding the distribution of transitive examples according to individual minimal pairs of verbs under investigation. The red bars show the frequencies of transitive uses with *-ova-* verbs while the blue bars show the frequencies of transitive uses with *-i-* verbs. The x-axis is defined by individual minimal pairs with the common derivational base as the name of each bin. As is apparent from the graph, virtually all instances of transitive use with *-ova-* verbs come from four verbs: *dugovati* 'owe', *silovati* 'rape', *praznovati* 'celebrate', *sl(j)edovati* 'belong'.

4.2. The availability of verbal passives and passive participles with *-i-* and *-ova-* verbs

The findings for our supplementary research question regarding the availability of verbal passives and passive participles with *-i-* and *-ova-* verbs fit the general pattern observed with respect to transitivity. More than two-thirds of *-i-* verbs can derive verbal passives. On the other hand, only five *-ova-* verbs pass this test, χ^2 (1, n = 132) = 51.47, p<0.0001. When it comes to the availability of any passive participle *-n/-t* forms, all but one *-ova-* verbs have this form in their paradigms, whereas there are 10 *-i-* verbs that cannot derive passive participles, χ^2 (1, n = 132) = 7.12, p<0.01. Table 7 summarizes the results.

Note that many verbs do not follow the expected pattern. These exceptional cases are discussed in Section 5.2.3.

[11] To control for the potential interfering effect of frequency on our findings, we compared the mean frequencies of *-i-* and *-ova-* verbs in our sample. The mean frequency of *-i-* verbs was 18.16 per million, whereas *-ova-* verbs had an average frequency of 19.86. These average values were compared using a t-test, and the difference was not statistically significant (p=0.9)

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Table 7. Summary of the results for *i*/*ova*-pairs

	Verbal_passive	Any_n/t_form
-i-	0.69 (46/66)	0.85 (56/66)
-ova-	0.08 (5/66)	0.98 (65/66)

5. Discussion and DM formalization

The findings of this investigation speak strongly in favor of theme vowels being associated with argument structure properties, thus confirming our main hypothesis. In particular, we observed that a focus on minimal pairs (i.e. cases in which different theme vowels attach to the same base without any other interfering morphological material) reveals a strong link between theme vowel differences and transitivity. Everything else being equal, verbs with the theme vowel *-i-* are overwhelmingly more likely to be transitive than the verbs with the theme vowel *-ova-*. Nonetheless, it is not the case that there are no transitive *-ova-* verbs and intransitive *-i-* verbs. With regard to our supplementary findings, the data show that *-i-* verbs are more likely to derive verbal passives than *-ova-* verbs. However, when it comes to the availability of passive participle forms in general, *-ova-* verbs seem to be more productive because they systematically allow impersonal passives, which are impossible with some *-i-* verbs.

The pattern that emerges from these results is rather clear: the theme vowel *-i-* systematically derives transitive verbs, but it can also derive unaccusatives. The fact that the vast majority of these verbs combine with an accusative-case-marked internal argument, either obligatorily or in some of their uses, is a clear sign that these verbs are overwhelmingly transitive. Still, there is a notable proportion (15%) of them that cannot derive any passive participle forms, which is a diagnostic of unaccusativity. The examples in Example (10) illustrate the unaccusative uses of *-i-* verbs. All the verbs in Example (10) denote a (gradual) change of state. In that sense, it can be concluded that the theme vowel *-i-* correlates with the presence of an internal argument, a feature that unites causative transitives and unaccusatives.

Example 10

(10) (a) Izgledaš kao da si prvo **star-i-o** pa **mlad-i-o**
look.PRS.2.SG like COMP AUX first old-I-PST.M then young-I-PST.M
'You look as if you were first getting old and then getting young.'

(b) Prolazi jesen i (već) postepeno zim-i-∅
pass.PRS.3.SG autumn and already gradually winter-I-PRS.3.SG
'Autumn is passing away, and the weather is gradually becoming wintery.'

(c) Dok sam ja postepeno **gazd-i-o**, on je **siromaš-i-o**
while AUX I gradually boss-I-PST.M he AUX poor-I-PST.M
'While I was gradually becoming a boss, he was turning poor.'

When it comes to the theme vowel *-ova-*, our results motivate the conclusion that it systematically derives unergatives with only some lexicalized exceptions. Only a small minority of *-ova-* verbs pass our tests for transitivity, suggesting that these verbs are overwhelmingly intransitive. At the same time, there is only one *-ova-* verb that cannot derive any passive participle forms. Recall that the ability to derive passive participle forms

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distinguishes unergative intransitives from unaccusatives (Aljović 2000). Example (11) shows one minimal pair in which the *-ova-* verb can derive an impersonal passive, but the *-i-* verb cannot. In sum, *-ova-* verbs in our database are almost exclusively unergative.

Example 11

(11) (a) *Tamo je puno (štet-i-en-o→)štećeno
there AUX a lot damage-I-PASS.PTCP-N
Intended: 'There was a lot of damaging there'
(b) Tamo je puno štet-ova-n-o
there AUX a lot damage-OVA-PASS.PTCP-N
'One has suffered a lot of damage there.'

Summarizing our findings, we propose the generalization in Example (12).

Example 12

(12) (a) *The theme vowel -i- derives transitives and unaccusatives*
(b) *The theme vowel -ova- derives unergatives*

The generalization in Example (12), which emerges from our findings, is a strong confirmation of the hypothesis that theme vowels are associated with argument structure differences.

An approach that would treat theme vowels as purely ornamental conjugation class markers has no ready-made mechanisms to account for the correlations we have established. Such correlations are, in fact, completely expected on the view that sees theme vowels as exponents/carriers of syntactic information.[12] However, any analysis that would involve a direct mapping between the theme vowel *-i-* and transitivity and the theme vowel *-ova-* and intransitivity would face clear counterexamples. We submit that a DM-based analysis relying on the 'flavors of *v*' framework (Folli & Harley 2005) offers a sufficiently articulated set of tools to capture the data at hand. The 'flavors of *v*' approach rests on the assumption that argument structure properties of verbs are determined syntactically based on the feature-content of the verbalizing head. The upshot is that different roots/bases can have different argument structure properties depending on the *v*-head that they merge with. This allows us to capture the argument structure differences within minimal pairs where the root/base is the same and the morphological difference comes down to the choice of the theme vowel.

[12] An anonymous reviewer suggests that the associations between verbal elements and clusters of argument structure properties are reminiscent of the relations described in the literature on 'phonesthemes' and 'affordances'. Phonesthemes are usually defined as frequently recurring sound-meaning pairings that are not clearly contrastive morphemes (Bergen 2004: 290, and references therein). An example is the English sequence *gl-*, which does not function as a morpheme but is found in different words related to 'vision' and 'light' (*glimmer*, *glisten*, *glitter*, *gleam*, *glow*, *glint*, etc.) (Bergen 2004). The notion of affordance is also related to the sound-meaning pairings beyond the morphemes. For example, according to Thomson & Do (2019: 1–2), an important 'implicit assumption underlying the term sound symbolism is that phonemes, or clusters of phonemes, map onto meaning below word or morpheme level thus acting as affordances which together allow the sound symbolic word to take on meaning'. The problem with analyzing theme vowels in terms of 'phonesthemes' and 'affordances' is that these notions are typically associated with content rather than functional words (see, e.g. Bergen 2004: 190 for phonesthemes), whereas all theme vowels presumably act as verbalizers, that is, they all share a common *grammatical* function.

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Moreover, different types of *v*-heads ('flavors of *v*') formalize the differences between the two categories of intransitive verbs, as we will show that in the exceptional cases where the theme vowel *-i-* derives intransitives, these intransitive verbs are different from those derived by means of the theme vowel *-ova-* (roughly, the unaccusative/unergative distinction). In what follows, we will present one possible implementation.

5.1. *i* is [BECOME], *ova* is [DO]

To recap, we have observed that the theme vowel *-i-* can be found in transitive and unaccusative environments, while *-ova-* correlates with unergatives. The derivations with ***-i-*** involve an internal argument undergoing a change of state, where the final state is defined by the property-denoting element in the base. The *-ova-* derivations show a looser semantic relationship with the base with an obligatory volitional component. Namely, control and volitionality are known to favor unergative behavior (Ramchand 2013: 290).

We implement these generalizations by assuming that (i) *-i-* is an exponent of either **v[BECOME]** or **v[BECOME]+v[CAUSE]**, and (ii) ***-ova-*** is an exponent of the unergative v → **v[DO]**. Thus, we propose the structures in Example (14) capturing the contrast between the transitive verb with the theme vowel *-i-* and the unergative version with *-ova-* given in Example (2) and repeated here as Example (13).

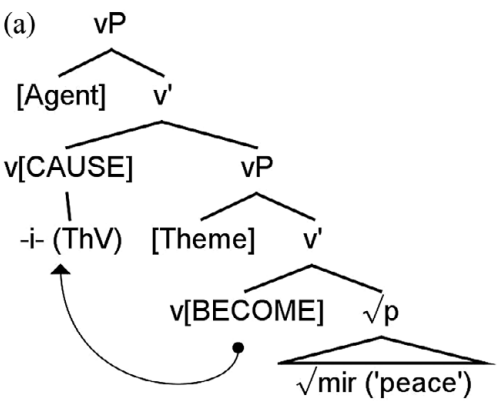
Example 13

(13) (a) Petar je mir-i-o *(braću)
Petar.NOM AUX peace-I-PST.M brothers.ACC
'Petar reconciled his brothers.'

(b) Petar je mir-ova-o (*braću)
Petar.nom AUX peace-OVA-PST.M brothers.ACC
'Petar rested.'

Example 14

(14) (a)



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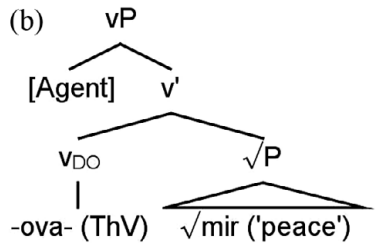
(b)

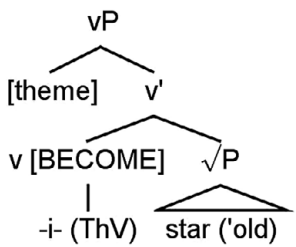


In Example (14a), representing transitive structures with the theme vowel *-i-*, the root/base merges with *v* [BECOME] introducing the theme argument. The causative *v* is then merged on top of this structure creating a transitive structure with an agent in its specifier position. *-ova-* verbs are represented in Example (14b), which is a typical unergative structure with an agentive v[DO] merging with the root/base and introducing the external argument.

The alternative unaccusative structure for the theme vowel *-i-* with the verb *stariti* (old-i-INF 'age') is presented in Example (15).

Example 15

(15)



The representation in Example (15) shows an unaccusative structure with *-i-*, which is also possible. This structure involves the same v[BECOME] responsible for the theme argument merged with the root/base. Of course, this is a smaller structure than the one in Example (14a) since it lacks the causative *v* and the external argument. We, thus, assume that the Vocabulary Item *-i-* contains the feature [BECOME], which makes it compatible with both morphemes that contain this feature (v[BECOME] and v[BECOME]+v[CAUSE]) as per the Subset Principle (Halle 1997).

The exact details of these implementations could vary. The projection introducing the Agent is often labeled VoiceP, but this chiefly terminological distinction is orthogonal to our analysis.[13] We also follow Embick (2004), among others, in assuming the existence of the [BECOME] version of *v*, which he labels [fient].

5.2. Loose ends

In this subsection, we focus on some of the issues raised by our analysis and offer tentative solutions. In Section 5.2.1, we address the issue of the category of the base. In Section 5.2.2,

[13] We do note, however, that some authors, perhaps most notably Harley (2013), argue for a principled distinction between VoiceP and *v*P.

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we briefly compare our analysis of the theme *-i-* in SC with the approach of Arsenijević & Milosavljević (2021). In Section 5.2.3, we discuss some pairs that do not display any differences with respect to the investigated properties (taking accusative objects, forming passive forms). Finally, subsection 5.2.4. addresses the limitations of the present study and proposes directions for further research.

5.2.1. Category of the base

Our discussion so far has glossed over the issue of the categorial status of the base with which the theme vowel gets merged. All the bases in our data set also show up as independent words, belonging to three different categories. The distribution is shown in Table 8.

In DM, when two words share the phonological exponent of the same root, two analyses are in principle possible: they either just share a root or they share a larger structure which involves further categorizers which lack phonological exponents. Taking *gostovati* ('be a guest') and *gostiti* ('to host') derived from the noun *gost* ('guest') as examples, it is possible that both of these verbs just consist of the root $\sqrt{gost}$ and a verbalizer. However, it is also possible that either or both of these verbs are denominal and contain the nP *gost*, consisting of the root $\sqrt{\text{GOST}}$ and a phonologically empty categorizer (*n*). In sum, any of our verbs could, in principle, be either deradical or decategorial (denominal or deadjectival).

One possible way of distinguishing between the deradical and decategorial words is by identifying cases of overt categorial heads embedded under theme vowels. The presence of such categorial heads is not amply attested in our dataset. The only convincing candidate is the base *tamn-,* which can be plausibly analyzed as the adjective *taman* 'dark', derived from the noun *tam-a* 'darkness' using an independently attested adjectivizer *-(a)n.* All the other bases can be equally (or more) plausibly analyzed as underived and, therefore, analyzable as roots.

In sum, the bases in our dataset, on the one hand, tend to be monomorphemic but, on the other hand, tend to show up as independent words. Since these are bases which show up both with *-i-* and with *-ova-*, this distribution can be taken as a strong indication that one of the verbalizers merges with roots (and therefore, we see very few derived bases), while the other tends to merge with categories (which is why all bases show up as independent words). Below, we will show some arguments that *-i-* might be root-selecting, whereas *-ova-* is category-selecting.

Table 8. The category of the related non-verb

Category of the related non-verb	Proportion in the database (N = 66)	Example verbs	Example related non-verb
Noun	0.83	gostiti 'host' gostovati 'be a guest'	gost 'guest'
Adjective	0.16	luditi 'make/become crazy' ludovati 'do crazy things'	lud 'crazy'
Adverb	0.03	napr(ij)editi 'advance' napredovati 'advance'	napr(ij)ed 'forward'

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Specifically, there are some arguments for *-ova-* as decategorial (and denominal more often than not), which do not easily apply to *-i-*. First, as we pointed out in the Introduction, in Eastern SC, *-ova-* is productive in loan verb integration (e.g. *lajkovati* 'to like on Facebook'), whereas *-i-* is not attested as the default integrator (**lajk-i-ti*). If we assume, following Moravcsik (1975), that only denominal patterns participate in verb integration, this could be seen as evidence that *-ova-* is denominal. New borrowings only make this evidence more prominent, as virtually every new verbal borrowing from English corresponds to a noun, even in cases where no such noun is attested in English. One example is the pair *ignor-ova-ti* 'press the ignore button' and *ignor* 'the act of ignoring (typically online)'.

One further piece of evidence in favor of a decategorial analysis of *-ova-* verbs comes from their makeup. The formant *-ov-* is amply attested in the nominal and the verbal domain. Some authors, for example, Zec (2019), analyze *-ov-* as one of the spell outs of the nominal theme, attested in, for example, what is usually termed the plural augment (e.g. *mir-ov-i* 'peaces') or has an unclear status (*mir-ov-n-i* 'related to peace'). Furthermore, Milosavljević, Simonović, Arsenijević, Mišmaš, Marušič & Žaucer (2021) observe that alternating mid vowels show up in various contexts in the nominal and adjectival declensions but are absent from verbal conjugation except in the morpheme *-ova-*. Based on this, these authors argue that the alternating mid vowels are the spell out of the nominal/adjectival theme.[14]

A final piece of evidence for *-i-* verbs being deradical and *-ova-* verbs being decategorial comes from prosody. Our preliminary analysis shows that *-ova-* is unique in the verbal domain in preserving nominal prosody, where *-i-* allows only two prosodic patterns allowed in all verbs. Focusing on the position of the High tone, we can say that strictly verbal prosody means High tone either on the theme vowel or on the base-final syllable. All other patterns constitute preservation of the prosodic patterns of other categories. As shown in Example (16), *ova*-verbs allow such 'earlier' H copied from related nouns. On the other hand, there are no attested verbs with the prosodic pattern like * *ˈínteresiti* or * *ˈprofésoriti.*

Example 16

(16) *Exceptional preservation of nominal stress in ova-verbs*

Noun	Verb	Gloss
ˈínteres	ˈínteresovati	'to interest'
ˈprofésor	ˈprofésorovati	'to be a professor'

5.2.2. Scales, telicity and [BECOME]

In this subsection, we briefly compare our approach to theme vowels with the approach of Arsenijević & Milosavljević (2021), given that in both cases, the theme vowel *-i-* in SC is explored in opposition to another theme vowel (*-ova-* and *-a-*, respectively).

Based on the direct comparison of the two major classes of theme vowels in SC, *-i-* and *-a-*, Arsenijević & Milosavljević (2021) propose that *-i-*, in addition to the [EVENT] feature shared

[14] The other common exponent of the nominal/adjectival categorizer is null, meaning that these forms lack an overt theme vowel (e.g. the singular *mir* 'peace' in the adjective *mir-an* 'peaceful'). This other exponent combines with the verbal theme vowel *-a-*, which results in the competition between *-a-* and *-ov-a-* denominal patterns discussed in the Introduction.

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with *-a-*, carries the feature [SCALE], essential in deriving telicity within the scalar approaches to telicity (e.g. Hay et al. 1999; Kennedy & Levin 2008). In this way, Arsenijević & Milosavljević (2021) account for the fact that *-i-* tends to correlate with perfective, telic, singular, and/or incremental (change-of-state) interpretations, while *-a-* is not restricted in this way and always appears in imperfective, atelic, plural, and/or non-incremental versions when *-i-* and *-a-* constitute a minimal pair (as in *bac-i-ti* 'throw.PFV' vs. *bac-a-ti* 'throw.IPFV'). The question that naturally emerges is whether this 'scalar' approach to *-i-* can be reconciled with the 'argument-structure' approach undertaken in the present paper. The answer is that the two approaches are fully compatible with each other. Namely, both unaccusatives and their causative counterparts are plausibly analyzed as carrying the feature [SCALE], as they are change-of-state predicates (cf. the BECOME component). Actually, the connection of *both* unaccusatives and their causative 'counterparts' with a scalar property and/or BECOME component related to *-i-* is supported independently by the fact that, generally, scalar properties responsible for telicity are orthogonal to the causative/inchoative alternation (Hay et al. 1999: 132, Kennedy & Levin 2008: 157), that is, they always apply to both pairs of the alternation. This is strikingly similar to what we find with *-i-*. This theme is an exponent of *either* v[BECOME] or v[BECOME]+v[CAUSE], which suggests that *-i-* is primarily connected to the 'unaccusative portion' of the structure. This further strengthens the link between 'scalar' and 'argument-structure' approaches to *-i-*. Specifically, it is known that when a verb can be used either as an unaccusative or an unergative depending on the telicity of the structure it is embedded in, unaccusativity tends to correlate with telicity, while unergativity tends to correlate with atelicity (Ramchand 2013: 290). It has further been argued that 'verbs which have an argument that undergoes a gradual change (without attainment of a definite result) often display unaccusative behavior in the languages where the diagnostics are clear' (Ramchand 2013: 294; cf. also Levin & Rappaport Hovav 1995; Levin & Krejci 2019). From this perspective, it may well turn out that neither of the two approaches (scalar/aspectual or argument-structural) needs to be seen as primary. Rather, they can both be on the right track, and theme vowels might actually prove to be a fruitful field for testing the relationship between the event structure and argument structure, in particular, contributing to the debate whether arguments contribute to the event structure (cf. Verkuyl 1972; Tenny 1994; MacDonald 2008), or, quite the opposite, the argument structure is licensed by functional structure interpreted as event structure (e.g. Borer 2005; cf. also Levin & Krejci 2019).

5.2.3. Deviant examples

In this subsection, we briefly comment on some examples which (at least at first sight) do not display differences w.r.t. the explored properties (taking accusative objects, forming passive forms). One kind of such 'deviant' example consists of pairs where both *-i-* and *-ova-* verbs take accusative objects and derive both types of passive forms, as in Example (17).

Example 17

(17) (a) kamen-i-ti (nešto)
stone-**I**-INF
'to turn something into stone'

(b) kamen-ova-ti (nekog)
stone-**OVA**-INF
'to stone (somebody)'

In examples of this kind, the distinction between the two verbs still goes in the direction predicted by our analysis: the *-i-* variant is causative (meaning, roughly, 'to make something

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become base-like'), while the *-ova-* verb shows a loose relationship to the base meaning (e.g. related to the instrument, as in Example (17b)) but comes with the component of volition, as all (other) unergatives in our sample.

Examples in which neither of the two verbs require the accusative complement constitute the second kind of 'deviant' examples, see Example (18) for one such case. Once again, the *-ova-* verb is accompanied by the volitional component, denotes an activity loosely related to the base meaning, and, like (other) unergatives, it derives impersonal passives. The *-i-* verb, on the other hand, describes a (individual-level) state. Although it is not a (typical) unaccusative, it could be seen as an instance of the category of unaccusative states (cf. Baker & Stewart 1997, inspired by the work of Cinque 1990; see also Taraldsen Medová & Wiland 2019: 1497 for examples from Polish and Czech where the theme vowels make the difference between *stative* unaccusatives and unergatives when combined with the same root).

Example 18

(18)	(a)	lič-i-ti	(b)	lik-ova-ti
		face-**I**-INF		face-**OVA**-INF
		'to resemble'		'to exult'

In fact, when it comes to meaning, *ova*-verbs generally exhibit a loose relationship to the meaning of the base across all *ova*-verbs in comparison to the systematic and more compositional meanings of the *i*-counterparts. Under the hypothesis that *i*-verbs combine with roots and *ova*-verbs are denominal, one possible explanation lies in the nature of (the types of) meanings of roots and *n*Ps. According to some approaches (cf., e.g. Arsenijević 2022), roots have only intensional meanings, while nouns are equipped with the extension. For instance, within the DM framework, Bazalgette (2015: 316–323) proposes that the reference index responsible for extension (reference to kinds) sits within the NP, merged with a nominalized root, and that it is in charge of encyclopedic meanings, that is, the relationship of the nominalized structure with different 'kinds of concepts' associated with a given noun. In this way, the DO-component with *-ova-* verbs may be related to different kinds of concepts related to the base (nominalized) meaning. This is exactly what we find with *ova*-verbs, in sharp contrast with *i*-verbs.

In light of these exceptional cases, a final point of qualification (and clarification) is in order. It is not our claim that every *v* that carries certain features will always be spelled out by the same theme vowel. However, it *is* our claim that there are default spell outs of each flavor of *v,* corresponding to the most general Vocabulary Item that makes reference to the features in question. Specifically, we can say that a causative transitive *v* gets spelled out as *-i-* in all cases where there is no more specific VI that can apply, making *-i-* the Elsewhere allomorph for the causative transitive *v* in SC. The same goes for *-ova-* and the unergative *v.* The status of these theme vowels as defaults for their respective flavors of *v* is confirmed by their quantitative distribution in our database. This defaultness becomes all the more apparent in 'minimal pairs' where the syntactic/semantic distinction between the two options can be signalized only by means of the theme vowel.

5.2.4. Limitations of the study and further research

Addressing the limitations of the present study, we must mention the issue of sample size. Our main corpus-based finding rests on a sample consisting of 23 'minimal pairs' of verbs

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with 2,300 corpus tokens. While this is a rather small sample, practical considerations prevented us from obtaining a larger dataset. We restricted ourselves to verbs that had at least 50 tokens (in srWaC and hrWaC combined) and annotated 50 tokens for each verb. Even though certain verbs had (many) more tokens, we refrained from including more examples in those cases to avoid inducing imbalance into our dataset.

A further limitation lies in the fact that our results only identify a correlation between argument structure properties and theme vowels (albeit a rather strong one), but our analysis is framed in terms of DM, a formal approach which typically operates with categorical rules. While this could be interpreted as a significant analytical limitation, we should point out that DM does predict the occurrence of rules which allow for exceptions. Marantz (2001) argues that unpredictable (lexicalized or idiomatic) semantic and phonological effects can occur in smaller derivations that involve a root (or a series of roots) and a 'phasal' (in the sense of Chomsky 2001) head (*v, n, a*). The structures that we investigated in this study are arguably of this sort (consisting of a root and *v*), which means that the regularities discovered with these structures are expected to allow for some exceptions. Alternatively, if *-ova-* verbs are, in fact, denominal, the occurrence of lexicalized derivations in this class of verbs can be accounted for based on the fact that *n* has the tendency to induce idiomatic interpretations, as argued in Bazalgette (2015) (see Section 5.2.3). In that sense, we might suggest that a discussion of rules of this sort should be framed in such a way as to quantify the strength of such rules *vis a vis* the share of attested exceptions.

Another limitation we should address is of methodological nature, and it concerns the issue of the applicability of corpus-based research in investigations of grammatical regularities of this sort. As pointed out by a *Journal of Linguistics* reviewer, our data provide evidence of a correlation between theme vowels and argument structure, but this correlation, of course, does not imply causation, which, in this context, means that we do not have evidence for the synchronic psychological reality of this link. We agree with the reviewer while also pointing out that this limitation is, at least to some extent, an artifact of the corpus-based methodology we chose to employ. Recall that we restricted our sample to the pairs of verbs in which both members had at least 50 attestations in the corpus (i.e. the most frequent lemmas that fit the designated criteria). In this way, we limited our investigation to the most frequent representatives of the relevant class, but to prove the synchronic psychological reality of the effect, we would ideally focus on pseudowords (e.g. some version of the famous 'wug' experiment), which would demonstrate the link we are arguing for is part of native speaker's linguistic competence. However, this would necessitate an experimental rather than corpus-based approach. Work of this kind has been done recently on French conjugation class markers (often analyzed as theme vowels), with results supporting the conclusion that the link between theme vowels and argument structure properties is a feature of a native speaker's mental grammars (Kastner & Martin 2021). We, nonetheless, maintain the significance of corpus-based studies as a way of capturing and quantifying correlations, which, despite not being definitive proofs, still provide valuable indications about grammatical phenomena. Such indications can, subsequently, be corroborated by experimental findings, and obtaining experimental validation of the suggestions we made in this paper is one of the goals we leave for further research.

6. Conclusion

The goal of this paper was to test the hypothesis that SC theme vowels are associated with argument structure properties. This hypothesis is derived from the broader theoretical

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approach within which theme vowels are treated as exponents of particular layers of syntactic (extended verb phrase) structure against the backdrop of a competing view, which treats theme vowels as strictly 'ornamental' elements relevant for (morpho)phonology as conjugation class markers and predicts no systematic link between theme vowels and argument structure. Correlations between theme vowels (and/or conjugation class markers) and argument structure have been reported to obtain between different pairs of theme vowels within the same language (*ova* vs. *i*, *a* vs. *i*, *e* vs. *i* in Serbo-Croatian), across different Slavic languages (at least Czech, Polish, Russian, Serbo-Croatian, Slovenian), and beyond Slavic languages (e.g. French), including non-Indo-European languages such as Kipsigis (see Section 2.2). These correlations have been confirmed on quantitative corpus data (as in our study), as well as on the experimental data (as in Kastner & Martin 2021 for French). Taken together, this strongly indicates that theme vowels are not just (purely ornamental) morphological markers of conjugation class membership but rather have a syntactic and semantic reality.

In order to test for the association between theme vowels and argument structure features, we compiled a set of 'minimal pairs' of verbs in SC, which differ only in terms of theme vowels (*-i-* vs. *-ova-*). All the verbs in the data set were simple derivations consisting only of the root/base and one of the two theme vowels under investigation, which allowed us to strip off all the other potential confounds known to affect argument structure (e.g. prefixes). A corpus-based study was conducted to compare the proportions of transitive uses with *-i-* and *-ova-* verbs. All the verbs under investigation were also coded for the availability of verbal passives and passive participle forms in general.

We observed rather clear and statistically significant differences between the two theme-vowel classes across their argument structure-related properties. Namely, our corpus study showed that *-i-* verbs are far more likely to be used transitively. Most of these verbs were able to derive verbal passives, which was not the case with *-ova-* verbs. Finally, when it comes to the ability to form passive participles, virtually all *-ova-* verbs tested positive, while a significant share (although still a minority) of *-i-* verbs failed this test. Once again, all these differences were statistically significant.

These results unambiguously confirmed the hypothesis that theme vowel differences correlate with argument structure differences. Our analysis of these findings was framed within the 'flavors of *v*' approach, and we assumed that the theme vowel *-ova-* derives unergative structures (i.e. it instantiates the unergative *v* [DO]), explaining why verbs that contain this theme vowel do not take accusative-case-marked objects and fail to produce passives, while still deriving passive participles (Aljović 2000). On the other hand, we treat the theme vowel *-i-* as an exponent of the unaccusative *v*[BECOME] or a complex head *v*[BECOME] + *v*[CAUSE] responsible for causative transitive structures. The analysis captures the overwhelming majority of cases, with a highly restricted number of exceptions that we have discussed. Thus, we showed that there is a strong empirical backing for the view that theme vowels are associated with argument structure properties, which can be implemented by means of the 'flavors of *v*' approach, and any account that treats theme vowels as purely ornamental faces a great difficulty when it comes to capturing these strong tendencies.

The area in which the present study remained inconclusive, despite some significant observations, is related to the status of the base that these theme vowels attach to. The options are that these theme vowels attach to roots or categories. We presented evidence that speaks in favor of a deradical analysis of *-i-* as well as some reasons to treat *-ova-* as a complex sequence consisting of a nominal theme *-ov-* and the independently attested verbal theme

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vowel *-a-*. However, we refrain from passing a final verdict on the matter and leave it for further research.

The reductionist approach that we applied in this study can, in principle, be applied more broadly to reveal associations between theme vowels and argument structure properties that may remain obscured by interfering factors. Namely, we have shown that very loose or even unobservable links in this domain become highly pronounced once we zoom in on pairs of verbs that differ only in their theme vowels. In that sense, similar comparisons can be made between other theme vowels in SC as well as in other languages where such 'minimal pairs' can be found.

While we offered an implementation in terms of different flavors of *v* as a possible fit for the observations obtained in the present study, other implementations remain possible. For instance, in Nanosyntactic works (e.g. Taraldsen Medová & Wiland 2019; Caha et al. 2023), it is usually assumed that theme vowels contribute argument structure properties together with the roots they combine with (by enlarging the root). Kastner & Martin (2021) ascribe differences between two (traditional) conjugational classes in French to the interaction of a special *v*-cause morpheme with the type of the base it combines with. Milosavljević & Arsenijević (2022) account for significant tendencies displayed by different theme vowels by proposing that all theme vowels are syntactically verbalizers, and their different morphological realization is based on multiple markedness scales in a procedure that takes place at the interface with phonology after the lexical material is introduced. Even more radically, Simonović & Mišmaš (2022) conclude that some traditional theme vowels in Slovenian that participate in argument structure alternations are not genuine theme vowels but rather roots that combine with other (lexical) roots. It is clear that there are numerous avenues for formalizing these phenomena, not all of which could be explored here. Our hope is that future research will bring important data and analytical insights that would tease these options apart.

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