

EXPRESSION OF INFORMATION STRUCTURE IN WEST SLAVIC: MODELING THE IMPACT OF PROSODIC AND WORD ORDER FACTORS

RADEK ŠIMÍK
Humboldt-Universität zu Berlin

MARTA WIERZBA
University of Potsdam

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The received wisdom is that word order alternations in Slavic languages arise as a direct consequence of word order-related information structure constraints such as ‘place given expressions before new ones’. In this paper, we compare the word order hypothesis with a competing one, according to which word order alternations arise as a consequence of a prosodic constraint – ‘avoid stress on given expressions’. Based on novel experimental and modeling data, we conclude that the prosodic hypothesis is more adequate than the word order hypothesis. Yet, we also show that combining the strengths of both hypotheses provides the best fit for the data. Methodologically, our paper is based on gradient acceptability judgments and multiple regression, which allows us to evaluate whether violations of generalizations like ‘given precedes new’ or ‘given lacks stress’ lead to a consistent decrease in acceptability and to quantify the size of their respective effects. Focusing on the empirical adequacy of such generalizations rather than specific theoretical implementations also makes it possible to bridge the gap between different linguistic traditions, and to directly compare predictions emerging from formal and functional approaches.¹

1. INTRODUCTION. This paper contributes to the long-standing discussion of how information structure is formally expressed. Our main research question is: To what extent do information structure-related word order alternations reflect an inherent connection between information structure and word order (the WORD ORDER HYPOTHESIS) and to what extent do they merely help to fulfill independent prosodic requirements (the PROSODIC HYPOTHESIS)? The word order hypothesis is incarnated in generalizations like ‘foci are sentence-final’, ‘topics are sentence-initial’, or ‘discourse given expressions precede new ones’. The prosodic hypothesis relies on generalizations like ‘focus realizes nuclear stress’, ‘topic realizes prenuclear stress’, or ‘discourse given expressions lack stress’ and takes word order alternations to be ways of

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satisfying prosodic requirements such as the nuclear stress rule. The Czech example in 1 illustrates the issue. Even though Czech is an SVO language, (1B) exhibits an OV order, as a result of being uttered in the context of 1A. According to the word order hypothesis, the OV order is used in order to comply with the requirement that given expressions precede new ones. According to the prosodic hypothesis, the OV order is a solution to two prosodic requirements: that given expressions lack sentence stress and that sentence stress is placed clause-finally.

- (1) A: Dnes večer dávají vaudeville.
 today evening give.3PL vaudeville.ACC
 ‘There’s a vaudeville show tonight.’
 B: Vaudeville mám rád. (cf. the canonical #Mám rád vaudeville.)
 vaudeville.ACC have.1SG glad
 ‘I like vaudeville.’

In this paper, we investigate the formal expression of the information-structural category of givenness in Czech, Slovak, and Polish. These languages are particularly suitable for tackling the research question because they exhibit a high degree of flexibility in both word order and prosody. At the same time, they are traditionally considered ‘discourse configurational’ and as such are believed to supply strong evidence for the word order hypothesis. The conclusion we reach in this paper is different. We argue that a careful investigation of these West Slavic languages lends unequivocal support to the prosodic hypothesis (as compared to the word order hypothesis). More particularly, our results indicate a strong and consistent connection between givenness and prosody to the effect that given expressions do not realize sentence stress. The relation between givenness and word order – to the effect that given expressions precede new ones – is shown to be much weaker and less consistent. Yet, our results also suggest that the most successful account might in fact be one that combines the strengths of both hypotheses.

The present contribution is unique in that the prosodic and the word order hypotheses are directly compared for a set of languages with relatively free word order. There is evidence from previous experiments that givenness is expressed prosodically in languages with restricted word order possibilities like English, but the issue remains largely open for languages which are in principle syntactically flexible enough to express givenness by reordering. Such languages, like the Slavic ones, are an ideal test case for our research question, as none of the hypotheses is implausible a priori. Furthermore, testing three related languages has the potential to detect commonalities as well as micro-variation: our results reveal that all investigated languages tend to avoid sentence stress on given expressions, but speakers of Czech and Slovak prefer to deviate from canonical word order to achieve this goal, whereas in Polish, it is easier to deviate from default prosody. More generally, our results indicate that the issue of prosodic vs. word order PLASTICITY (Vallduví & Engdahl 1996) is a matter of degree. Besides the selection of languages, a direct comparison of the prosodic and the word order hypothesis is also facilitated by the methodology that we employ. It is based on gradient acceptability judgments and multiple regression, which allows us to evaluate whether generalizations like ‘discourse given expressions precede new ones’ or ‘discourse given expressions lack stress’ are empirically adequate in the languages under investigation – that is, whether violations lead to a consistent decrease in acceptability – and to quantify the size of their respective effects. Focusing on the empirical adequacy of such generalizations rather than specific theoretical implementations also makes it possible to bridge the gap between different linguistic traditions, and to directly compare

predictions emerging from formal and functional approaches. We will thus refrain from discussing specific syntactic proposals concerning word order variation and specific prosodic proposals concerning prosody in Slavic.

The paper is organized as follows. In section 2, we provide some necessary background on the information-structural notion of givenness (and related notions), its formal realization, and the theoretical and experimental approaches to it. Section 3 and 4 form the core empirical contribution of the paper: three acceptability rating experiments on Czech, Slovak, and Polish. We first describe the experiments and their results in section 3. Then, in section 4, we present our modeling study, in which we evaluate the empirical adequacy of the word order hypothesis, the prosodic hypothesis, and a hypothesis combining both approaches. Section 5 summarizes and concludes the paper.

2. BACKGROUND ON GIVENNESS. In this section we provide the background necessary for a proper understanding and evaluation of our experiments. In section 2.1 we introduce a general definition of givenness, discuss its relation to anaphoricity, and clarify what exactly we mean when we call an expression ‘given’ in our experiments. In section 2.2 we briefly discuss two major strategies of expressing the discourse category of givenness at the sentential level: expression by prosody (lack of stress) and expression by word order (given-before-new ordering). Section 2.3 introduces two major theoretical approaches to modeling the word order-based expression of givenness: what we call the word order hypothesis and the prosodic hypothesis. We include a comparison of the basic predictions of these hypotheses and suggest how these predictions are tested in our experiments. Section 2.4 concentrates on the relation of givenness to related categories, particularly topic, focus, and definiteness. Section 2.5 is a brief overview of previous experimental approaches to the formal realization of givenness.

2.1. DEFINING GIVENNESS. Givenness, just like all other information-structural (IS) notions, has had a very complex history – both in terms of terminology and contents. On the terminological side, being GIVEN has also been referred to as being OLD, ACTIVATED, SALIENT, ACCESSIBLE, or THEMATIC. On the content-related side, givenness has been defined with respect to the properties of the discourse, interlocutors’ (or hearer’s) knowledge or expectations, or mental activation. We refrain from providing a comprehensive overview of the various approaches to givenness and refer the reader to existing ones, such as Prince 1981 or Molnár 1993.

The aspect of givenness that has been acknowledged across a wide range of approaches is the relation to previous discourse: broadly speaking, an expression is considered given if it is inferrable from previous discourse (early proponents include Halliday (1967) or Chafe (1976)).² We follow the tradition according to which the relation to previous discourse is materialized as a relation to a linguistic antecedent and is semantically defined in terms of a generalized version of entailment (Rochemont 1986, Schwarzschild 1999, Kučerová 2007, Wagner 2012, among others). For concreteness, we adopt the definition offered by Kratzer and Selkirk (2009). (For terminological simplicity we use ‘expression’ instead of ‘utterance of a constituent’ and ‘counts

² This characterization of givenness lends itself to a scalar approach, under which expressions can be given to a lesser or greater degree (see e.g. Chafe 1976, Ariel 1990, or more recently Slioussar 2007). For the purpose of operationalization as an experimental factor, we stick to a binary notion, which could, however, be viewed as a special case of the scalar notion (where given and new represent the two extremes at the givenness scale).

as given’ instead of ‘represents given information’.)³

(2) GIVENNESS

The expression E in a context c counts as given iff the discourse preceding c contains an antecedent A such that $[[A]]^c$ generalized-entails $[[E]]^c$.

(3) GENERALIZED ENTAILMENT

For any x, y of any type, generalized entailment (\Rightarrow) is the smallest relation satisfying the following conditions:

- i. If $x = y$, then $x \Rightarrow y$.
- ii. If $x, y \in D_t$, then $x \Rightarrow y$ if $x = 0$ or $y = 1$.
- iii. If $x, y \in D_{\langle \tau, t \rangle}$ for some type τ , then $x \Rightarrow y$ if for all $z, z \in D_\tau$, $x(z) \Rightarrow y(z)$.

Condition 3i implies that if the denotation of expression E is identical to the denotation of an antecedent A , then E counts as given. This condition is the only one applicable to referential expressions, that is, expressions of type e . For instance, the expression *the semanticist from Mindelheim* counts as given if the proper name *Angelika Kratzer* has been mentioned; it holds that $[[\text{the semanticist from Mindelheim}]] = [[\text{Angelika Kratzer}]]$ and therefore $[[\text{the semanticist from Mindelheim}]] \Rightarrow [[\text{Angelika Kratzer}]]$. Condition 3ii says that a truth-value-denoting expression E counts as given if there is a truth-value-denoting antecedent A such that the conditional of the form *if A then E* is true. For instance, the sentence *Jason is an animal* (interpreted relative to some world w) counts as given if it has an antecedent of the form *Jason is a cat* (interpreted relative to w). Condition 3iii applies to all functional expressions whose type ‘ends in’ t . It says that a function-denoting expression E counts as given if there is an antecedent A of the same type, such that the extension of A is a subset of the extension of E . For instance, the predicate *vegetable* counts as given if *vegetable* has been mentioned (also covered by condition 3i) but also if *carrot* has been mentioned (because every carrot is a vegetable).⁴

In our experiments, we deal with the core and arguably least controversial cases of givenness. In particular, if we call an expression ‘given’ in our experimental materials, it satisfies not only 3, but also the following conditions: (i) it is a ‘major’ sentential constituent (subject, object, verb, or a VP-modifying prepositional phrase); (ii) it has an overt linguistic antecedent in the preceding utterance of the interlocutor; (iii) it is identical in lexical form and semantic denotation to the antecedent; (iv) whenever possible, it is definite/referential and thereby referentially identical to the antecedent (this is possible for arguments – subjects, objects – but not for inherently functional expressions like verbs); (v) it is not focused. See section 2.4 on the relation between givenness and definiteness and givenness and focus.

Our decision to limit our attention to these core cases of givenness is motivated by two factors. Firstly, we conjecture that the formal expression of givenness will be most pronounced

³ To our knowledge, Kratzer & Selkirk (2009) offer the first (and thus far the only) entailment-based definition of givenness that is generalized (applicable to expressions of type e , t , and any type that ‘ends in’ t) and which, at the same time, aims at defining givenness independently of focus. Generalized definitions which tie givenness to focus can be found in Schwarzschild 1999 or Wagner 2012. A focus-independent definition which is, however, not formally generalized, can be found in Rochemont 1986 (who calls givenness ‘c-construability’).

⁴ Condition 3iii straightforwardly applies to one-place predicates of any order (ordinary predicates, generalized quantifiers), but requires de-Schönfinkelization (see Heim & Kratzer 1998) for predicates with higher arities, such as transitive predicates: type $\langle e, \langle e, t \rangle \rangle$ is not covered by 3iii, but type $\langle [e, e], t \rangle$ is ($[e, e]$ is an ad hoc notation for the ordered pair of two entities).

in these core cases. Secondly, our given expressions are likely to count as given in a larger variety of approaches to givenness. Kučerová's (2007, 2012) approach is a case in point. While she adopts the entailment-based approach to givenness (in particular she adopts and modifies Schwarzschild's (1999) definition), she adds the condition that only expressions carrying an existence presupposition count as given in Czech (or Slavic more generally). This condition is satisfied by the given expressions in our experiments.

2.2. FORMAL EXPRESSION OF GIVENNESS. Despite being a discourse-based category, givenness can be formally manifested at the sentential level. Below we discuss the two most prominent ways of expressing givenness: prosodic expression of givenness (lack of stress) and word order-based expression of givenness (given-before-new ordering).

PROSODIC EXPRESSION OF GIVENNESS. It is uncontroversial that givenness in English is sometimes expressed by the means of phrasal or sentential prosody. The generalization is that given expressions cannot realize the most prominent stress in a certain domain (sometimes called NUCLEAR STRESS).^{5,6,7} Since we are always concerned with the domain of the whole sentence, we invariably call the most prominent stress SENTENCE STRESS. Consider the little discourse in 4. In B's utterance sentence stress (= boldface) is realized on *vaudeville*. This stress placement is predictable from general accentuation properties of English, particularly from the so called NUCLEAR STRESS RULE (NSR; Chomsky & Halle 1968). In 5B the expression *vaudeville* is given (= underlined) by virtue of having been mentioned in A's utterance and consequently, sentence stress is realized on *like*. This deviation from default stress is sometimes referred to as STRESS SHIFT.

- (4) A: Are you interested in theatre?
B: I like **vaudeville**.
- (5) A: There's a vaudeville show tonight.
B: I **like** vaudeville. (cf. #I like **vaudeville**.)

Stress shift for reasons of givenness only takes place if the given expression is in a position where it would normally (by virtue of the NSR) receive sentence stress. In the conversation 6, the sentence-initial *vaudeville* in 6B is given, just as it is in 5B, but this has no impact on the stress pattern of the utterance, which remains default (governed by the NSR). Consequently, givenness is not expressed formally in this case. One could therefore say that the prosodic expression of givenness is obligatory, provided certain conditions are fulfilled.

- (6) A: What is vaudeville?
B: Vaudeville is a theatrical **genre**.

⁵ The literature on this topic is rich. Here is a small selection of relevant references: Halliday 1967, Schmerling 1976, Ladd 1980, Reinhart 1997, Schwarzschild 1999, Féry & Samek-Lodovici 2006, Wagner 2012.

⁶ There is research suggesting that expressions may be phonologically reduced (destressed) to various degrees, potentially reflecting the degree to which an expression is given (see footnote 1). See e.g. Bard et al. 2000 and Jurafsky et al. 2001. In this paper, we take sentence stress to be a categorical notion.

⁷ From now on, when we say 'given', we mean 'given but not focused', unless indicated otherwise.

Since the present paper focuses on empirical generalizations, we leave aside a detailed discussion of the theoretical approaches to the givenness–prosody correlation.

WORD ORDER-BASED EXPRESSION OF GIVENNESS. Languages that exhibit free word order tend to use this freedom for expressing givenness. The basic observation is that given expressions are placed towards the beginning of sentences, whereas new expressions are placed towards the end of sentences. Observations of this kind gave rise to what one could call the given-before-new generalization: given expressions linearly precede new expressions.⁸ Consider the Czech discourse in 7. B's utterance is all new and the word order is canonical, that is VO. In the utterance 8B, on the other hand, *vaudeville* is given, which in turn leads to a word order alternation – yielding the non-canonical OV order.

- (7) A: Zajímá tě divadlo?
 interest.3SG you.ACC theatre.NOM
 'Are you interested in theatre?'
 B: Mám rád **vaudeville**.
 have.1SG glad vaudeville.ACC
 'I like vaudeville.'
- (8) A: Dnes večer dávají vaudeville.
 today evening give.3PL vaudeville.ACC
 'There's a vaudeville show tonight.'
 B: Vaudeville mám **rád**. (cf. #Mám rád vaudeville.)
 vaudeville.ACC have.1SG glad
 'I like vaudeville.'

Givenness-induced word order alternations do not take place if the given expression normally (in a canonical word order, unaffected by IS) appears in the clause-initial position. In the conversation 9, the sentence-initial *vaudeville* in 9B is given, just as it is in 8B, but this has no impact on the word order of the utterance, which remains canonical (subject < predicate in this case). In this case givenness remains unexpressed.

- (9) A: Co je to vaudeville?
 what.NOM is it vaudeville.NOM
 'What is vaudeville?'
 B: Vaudeville je divadelní **žánr**.
 vaudeville.NOM is theatrical genre.NOM
 'Vaudeville is a theatrical genre.'

2.3. THEORETICAL APPROACHES TO GIVENNESS-INDUCED WORD ORDER ALTERNATIONS. There are two major hypotheses as to how givenness-induced word order alternations come about. One assumes a direct relationship between givenness and word order, while the other postulates that this relation is mediated by prosody. The two hypotheses partly overlap in

⁸ The given-before-new generalization is much older than modern linguistics and survives until today. Relevant references include Weil 1844, Mathesius 1939, Siewierska 1993, Choi 1999, Slioussar 2007, Kučerová 2007, and Skopeteas and Fanselow 2010.

predictions. Nevertheless, they can be empirically distinguished, which makes the present experimental study possible. At the end of this section, we sketch two core differences in predictions, which in turn form the basis for our experiments.

THE WORD ORDER HYPOTHESIS (THE DIRECT APPROACH). The word order hypothesis takes the word order-based expression of givenness at face value and holds that there is a direct relation between givenness and word order. Abstracting away from particular implementations, it is assumed that there is a rule or constraint in the grammatical system (of at least some languages) that requires given expressions to precede new ones. Recent proposals which integrate the word order hypothesis in one way or another include Choi 1999 (Korean, German), Müller 1999 (German), Haider and Rosengren 2003 (German), Slioussar 2007 (Russian), or Titov 2012 (Russian). Here, we briefly discuss Kučerová's (2012) proposal, which is relevant for our purposes because it builds on Slavic evidence.

Kučerová (2012) argues for Czech, Russian, and Serbo-Croatian that, within a propositional domain, given expressions must precede new ones.⁹ For Kučerová this requirement is a categorical one, whose violation causes a semantic deviance (qualitatively similar to using an indefinite NP where a definite NP is required in English). It follows from what she considers a grammatical system of givenness marking: there is a specialized G-operator that marks expressions as given, similarly as the definite article marks DPs as definite. Even though the G-operator is covert, its position can be partly recovered by word order. Consider the example in 10. The scrambled order 10a satisfies the given-before-new requirement because the only given expression *lízátko* precedes all the new ones. This contrasts with the canonical order 10b, where the given-before-new requirement is violated. In Kučerová's intuition, 10b either entails that *chlapeček* and *našel* are also given (which is not supported by the context and amounts to a presupposition failure) or that *lízátko* is new (which is possible but fails to establish the anaphoric relation to the previously mentioned lollipop and hence is unacceptable under the intended interpretation).

- (10) *Scenario:* A little girl on her way to school lost a lollipop. And then...
- a. lízátko_{Given} našel_{New} chlapeček_{New}.
lollipop.ACC found boy.NOM
 - b. # chlapeček_{New} našel_{New} lízátko_{Given}.
boy.NOM found lollipop.ACC
'A boy found the lollipop.' (intended) (Cz, Kučerová 2012: 3, 6)

THE PROSODIC HYPOTHESIS (THE INDIRECT APPROACH). The prosodic hypothesis takes the word order-based expression of givenness to be a mere side-effect of two independent prosodic generalizations (both discussed in section 2.3): 11a, which relates prosody and word order, and 11b, which relates prosody and givenness. If we take 11a and 11b to be the premises, the givenness–word order correlation in 11c follows as the conclusion.

⁹ Kučerová's notion of givenness is narrower than ours. For her, an expression (an NP) is given if it is given in our sense and, in addition, if it is 'presuppositional' (where 'presuppositional' roughly corresponds to Enç's 1991 'specific').

- (11) a. Sentence stress is sentence-final.
 b. Given expressions cannot bear sentence stress.

 c. Given expressions cannot be sentence-final.

Abstracting away from particular implementations, this indirect approach implies that there is no rule or constraint in the grammar that is dedicated to deriving the given-before-new word order. All that is needed are the prosodic constraints discussed above, combined with a certain freedom in word order. The indirect approach has typically been applied to focus-related word order phenomena, where a focused expression changes its position in the sentence in order to satisfy the requirement that it be stressed; examples include Zubizarreta 1998 (Spanish), Buring 2001 (German), Szendrői 2003 (Hungarian), Arnaudova 2003 (Bulgarian), Samek-Lodovici 2005 (Italian), and Hamlaoui 2009 (French). Examples of the indirect approach being applied to givenness-related word order alternations include Szwedek 1974a,b, 1976/2011 (Polish), Neeleman & Reinhart 1998 (Dutch), and Šimík & Wierzba 2015 (Czech). To the best of our knowledge, Szwedek's work from the 1970s represents the very first indirect approach to information structure-induced word order alternations.

Consider Szwedek's (1976/2011) example 12c, intended as a continuation of 12a. According to Szwedek, the non-canonical OVS order is used in order to satisfy the ban on stressing given expressions, rather than a given-before-new requirement.

- (12) a. Widziałem na ulicy kobietę.
 saw.1SG on street woman.ACC
 'I saw a woman in the street.'
 b. #Mężczyzna bił **kobietę**.
 man.NOM beat woman.ACC
 Intended: 'A man was beating the woman.'
 c. Kobietę bił **mężczyzna**.
 woman.ACC beat man.NOM
 'A man was beating the woman.'

(Po, Szwedek 2011:72–73)

A COMPARISON OF THE HYPOTHESES. We have just demonstrated that both hypotheses under discussion equally predict a word order alternation of an SVO sentence in a context where the object is given, while the subject and the verb are new. The alternation turns the canonical SVO order to the non-canonical OVS order in both accounts, though for different reasons. According to the word order hypothesis, the non-canonical OVS order is motivated by the given-before-new requirement; according to the prosodic hypothesis, it is motivated (i) by placing the stress sentence-finally and (ii) by not stressing a given expression.

Yet, the predictions of the two hypotheses overlap only partly. In general, it holds that the word order hypothesis is more restrictive than the prosodic hypothesis. In sentences with rightmost stress, the word order-based account generates a proper subset of the structures that the prosodic account generates. Consider the schematic example 13, where A and B are new (unmarked), C is given (underlining), and sentence stress (boldface) is always final. Out of the three logically possible word orders (with the order of A and B kept constant), the prosodic hypothesis is consistent with two (those where the given C is not final), while the word order hypothesis is consistent only with one order (the one where the given C precedes both A and B).

For completeness, we add the predictions of what we call a combined hypothesis – a logically possible hypothesis according to which givenness is expressed by both prosody and word order. Our *given object* experiment (section 3.4) tests an empirical situation that corresponds to 13.

(13)		<i>Prosodic</i>	<i>Word order</i>	<i>Combined</i>
a.	A B <u>C</u>	*	*	*
b.	A <u>C</u> B		*	*
c.	<u>C</u> A B			

The situation becomes more complex when the factor of sentence stress placement is manipulated. Consider the schematic 14, where A is new and B is given. Out of the four logically possible combinations of word order and sentence stress placement, the prosodic hypothesis is consistent with those where sentence stress is not realized on B, while the word order hypothesis is consistent with those where B precedes A. Our *stress shift* experiment (section 3.3) tests a comparable empirical situation.

(14)		<i>Prosodic</i>	<i>Word order</i>	<i>Combined</i>
a.	A <u>B</u>	*	*	*
b.	<u>A</u> B		*	*
c.	<u>B</u> A			
d.	<u>B</u> A	*		*

These and other differences in predictions give us a chance of testing the three hypotheses. It should be clear, however, that the results are unlikely to come out as categorically as represented in the schematic examples above. There are several reasons for this. Firstly, it is possible that the ways of expressing givenness are not categorical; in particular, they can only be tendencies, which would reduce the expected effects. Secondly, it is likely that other factors interfere with the overall acceptability of the tested structures. For instance, stress shift might be independently penalized, rendering 14b less acceptable than 14c (within the prosodic hypothesis) or 14d less acceptable than 14c (within the word order hypothesis). Similarly, non-canonical word order might be independently penalized. If we assume that A B is the canonical word order, for instance, 14b would come out as more acceptable than 14c (within the prosodic hypothesis) and it would compromise the acceptability of 14c/d (within the word order hypothesis). In our experiments and our modeling study we can factor out the major interfering factors (non-canonical word order, stress shift) by including them as factors in our statistical models.

2.4. GIVENNESS IN RELATION TO OTHER (IS) CATEGORIES. Although the present paper focuses on the formal expression of givenness, it is important to clarify the relation between givenness and other IS notions, particularly topic and focus. Our aim in this section is not to give a representative overview of the various IS notions and their definitions (see e.g. Molnár 1993 and Krifka 2007/2008), rather, we intend to clarify the ways in which the present empirical work bears consequences for these IS notions. In addition, we briefly discuss the relation between givenness and definiteness, which continues to be a source of confusion.

GIVENNESS AND TOPIC. Since Reinhart (1981), TOPIC (or more precisely SENTENCE TOPIC) has been widely understood as the expression that a sentence is ‘about’. The non-topical part of

the sentence, that is, what is being said about the topic, is referred to as COMMENT.¹⁰ See the illustration in 15.

- (15) A: What about Mary?
 B: Mary_{topic} [will come **later**]_{comment}.

There are reasons to believe that topicality and givenness are systematically related. Some have argued, for instance, that topics are always given (e.g., Chafe 1976). Others assume that the topic is the most accessible expression in the sentence (and hence, in some sense, ‘most given’, assuming scalar approaches to givenness; see footnote 1); see, for instance, Slioussar 2007.¹¹ In terms of formal expression, both word order and prosodic correlates of topicality have been identified. Concerning the former, topics are typically placed clause-initially.¹² Concerning the latter, topics are often stressed (and marked by a rising tone; e.g. Jacobs 1984, Alter & Junghanns 2002), though the stress is always a prenuclear one – being followed by the nuclear stress (sentence stress) associated with focus. It is not unlikely that these strategies correlate with the means of expressing givenness: Sentence-initiality might correspond to the given-before-new placement and the association with non-nuclear stress might correspond to the ban on (nuclear-)stressed given expressions.

Despite these correlations, we remain cautious about interpreting the present work on givenness in the light of topicality. In fact, we tried to avoid the bias towards a topical interpretation in our experimental materials by never placing given expressions sentence-initially and never pronouncing them with a dedicated topic-related intonational contour.

GIVENNESS AND FOCUS. Since Rooth 1985, FOCUS has been widely understood as the expression that ‘indicates the presence of alternatives that are relevant for the interpretation of linguistic expressions’ (Krifka 2007:18). The non-focused part of the sentence is referred to as BACKGROUND. Rooth (1992) identifies a number of pragmatic ‘uses’ of focus and the alternatives it indicates. The prototypical use of focus is to indicate the propositional alternatives that constitute the possible answers to a prior wh-question.¹³ In 16, for instance, the focus on *Mary* indicates the presence of propositional alternatives of the form {x will come later : x is a human}. These propositional alternatives are relevant for the interpretation of 16B in that they indicate the set of possible answers to 16A, to which 16B belongs.

- (16) A: Who will come later?
 B: **Mary**_{focus} [will come later]_{background}.

Concerning the formal expression of focus, both prosodic and word order-based correlates have been identified. The prosodic generalization is that focus must contain sentence stress (Chomsky 1971, among many others). The main word order-related generalization is that

¹⁰ The ‘aboutness’ approach to topic goes back to the works von der Gabelentz 1869, Ammann 1925–28, and Mathesius 1929.

¹¹ Yet, many researchers, including Reinhart (1981), assume that topicality and givenness are entirely orthogonal, pointing out examples where topics are bluntly new.

¹² For some (e.g. Halliday 1967), clause-initiality is even a defining criterion of topicality. This, of course, precludes a purely pragmatic definition of topicality.

¹³ Beaver & Clark (2008) propose that focus is even defined by its relation to (wh-)questions, so called questions under discussion (which can be explicit or implicit).

focus is realized in the clause-final position, which is often taken to reflect the desire to satisfy both the stress-focus correspondence with default stress placement within the sentence (the indirect view to focus ordering).¹⁴

Many authors have noted that there is an intimate relation between givenness and focus. For instance, it is often assumed that the background to focus must be given (e.g. Halliday 1967 or Jacobs 1988), as it is in 16B. This matches the generalization that sentence stress is realized in the focus and therefore not in the (given) background. Schwarzschild (1999), Büring (2006), and Wagner (2006, 2012) propose to account for IS-conditioned prosodic patterns by devising a hybrid system which integrates givenness and focus. For instance, Wagner 2012 (which also contains a detailed discussion of previous approaches) contains a proposal that whenever stress ‘shifts’ from X to Y, then X is interpreted as given and Y is interpreted as focused.

Despite the strong connection between givenness and focus, we subscribe to the position that they are mutually independent (thereby following Féry & Samek-Lodovici 2006, Katz & Selkirk 2011, or Stevens 2013). This view straightforwardly accounts not only for given expressions that are focused and backgrounds that are (in part) new (see e.g. Molnár 1993), but also for cases of broad focus within which there is a given–new division. A representative example is 17B – a broad focus answer to the question *What happened next?*, where the direct object is given and the sentence stress is therefore shifted to the verb (without there being focus on the verb). This is considered the optimal solution to the conflicting requirements of realizing sentence stress rightmost while not realizing it on a given expression. Examples of this kind have been known since Schmerling 1976 and have always figured prominently among the arguments for keeping focus and givenness apart.¹⁵

- (17) A: Smith walked into a store. What happened next?
 B: [A detective **arrested Smith**]_{focus}. (Wagner 2012)

In two of our experiments, the materials are constructed in a similar fashion: the target items are broad focus utterances containing a given object, whereby both focus and givenness are controlled for contextually.

GIVENNESS AND DEFINITENESS. There has been a long-standing confusion of how givenness and definiteness are related: it has sometimes been assumed that (i) given expressions are automatically definite or that (ii) definite expressions are automatically given. For us, it is vital to clarify the relation because in two of our experiments (*given O* and *stress shift*), we manipulate givenness as a factor (given vs. new/focused), but keep definiteness constant (definite). If the assumption (ii) were correct, our givenness manipulation might be compromised: expressions that we consider to be new would in fact be given.¹⁶ Nevertheless, there is convincing evidence showing that definiteness and givenness are independent of one another, suggesting that neither (i) nor (ii) are justified. Below we illustrate the issue on the example of English, for which we take it to be uncontroversial that (in)definiteness is expressed by articles

¹⁴ Many researchers assume that at least some kinds of focus require fronting to the left periphery (e.g. Rizzi 1997).

¹⁵ In order to account for this phenomenon in his hybrid givenness–focus account, where the expression to which stress is shifted (in order to satisfy the lack of stress on a given expression) is automatically focused, Wagner (2012) postulates covert movement of the direct object *Smith* to a position where it c-commands the rest of the sentence. This covert movement is loosely related to Kučerová’s (2007, 2012) overt G-movement in Slavic.

¹⁶ A similar discussion to the present one can be found in Umbach 2001 and Wagner 2012.

and givenness can be expressed by destressing (see section 2.2). The examples in 18 clearly show all four logically possible combinations of definiteness / givenness values of the sentence-final NP are attested.

- (18)
- | | |
|--|-------------------|
| a. Mr. Smith _i was present. I had a chance to speak to <u>the senator</u> _i . | DEFINITE, GIVEN |
| b. I visited the townhall. I had a chance to speak to the mayor . | DEFINITE, NEW |
| c. Senators frequently come to this restaurant. Actually, I once had
a chance to speak to a <u>senator</u> . | INDEFINITE, GIVEN |
| d. We visited the congress. I had a chance to speak to a senator . | INDEFINITE, NEW |

In order to leave no doubts in the readers, we would like to discuss a potential caveat. It is a well-known fact that definite NPs come in two major kinds: *anaphoric definites* and *situational definites* (see Schwarz 2009 for a recent perspective). An example of the former is *the senator* in 18a. It is an anaphoric definite NP because its reference is determined by its relation to the antecedent *Mr. Smith*. An example of the latter is *the mayor* in 18b. It is a situational definite NP because its reference depends on what Schwarz (2009) calls a *resource situation*, which in 18b corresponds to the relevant aspects of the town whose townhall the speaker visited. The potential caveat is the following: even if definites in general are not always given, it could well be that *anaphoric* definites are. Certainly, the pattern in 18 supports that impression. We believe that this assumption is unjustified, however. As it appears, the conditions for a definite NP to be given are stricter than for it to be anaphoric. Consider example 19, where *the book* in B's utterance arguably counts as anaphoric but not as given, as witnessed by the impossibility of shifting the stress. If, on the other hand, the conversation looks as in 20 (assuming the same context), where A explicitly mentions *the book*, the definite NP counts as given in the subsequent utterance of B.

- (19) Context: Over the past month, A repeatedly asked B to read a particular book that she found worthwhile. Now, A and B meet again after a couple of days and start a conversation:
- A: Hi, how is it going?
B: Fine, thanks. By the way, I finally read the **book**! (cf. #**read** the book)
- (20)
- A: Hi, how is it going?
B: Fine, thanks.
A: How about the book I told you about?
B: I finally **read** the book!

2.5. PREVIOUS EXPERIMENTAL WORK. The experiments of Most and Saltz (1979) are, to our knowledge, the first ones to directly compare the two hypotheses under discussion. Their prosodic hypothesis was that focus correlates with sentence stress in English (based on Halliday 1967) and their word order hypothesis was that focus correlates with clause-finality (based on Mathesius 1975). In their materials focus-background perfectly overlapped with new-given, which makes the experiments relevant here. Most and Saltz's (1979) core result was that prosody (sentence stress) is a better predictor for focused/new information than word order (final position). Nooteboom and Kruyt (1987) designed auditive acceptability rating experiments to study the interaction between stress and givenness in Dutch. Their main hypothesis – namely that

stressed constituents correspond to new information and unstressed constituents correspond to given information – was supported by their results. Skopeteas and Fanselow (2010) ran a cross-linguistic production study (picture description) to investigate the interaction between givenness and word order. Their hypothesis was that the givenness of an argument (agent or patient) will lead to its clause-initial placement – in accordance with the present word order hypothesis. The results provided tentative support to the hypothesis – patient-givenness led to a higher probability of producing patient-initial orders in all the languages investigated, except for Greek (which exhibited agent-initial orders across the board). Still, however, the agent-initial order was the most common one in most of the languages (including English, French, and Dutch), even in patient-given conditions. Only three of the 12 languages, namely Georgian, Czech, and Hungarian, preferred patient-initial orders over agent-initial ones (in the patient-given condition). The experiments of Šimík, Wierzbica, and Kamali (2014) and Šimík and Wierzbica (2015) on Czech (which inspired the present cross-linguistic experiments) manipulated word order and prosody with the goal to test the word order and prosodic hypothesis. The results supported the prosodic hypothesis and furthermore suggested that what word order interacts with in Czech is not givenness but rather definiteness (or, more generally, presupposition).

In summary, the experimental literature generally supports the link between givenness (or more generally information structure) and prosody (in English, Dutch, and Czech). Skopeteas and Fanselow (2010) provided some cross-linguistic tendential support for the link between givenness and word order, though in their study, prosody was not controlled for and the authors themselves admit that it could in principle account for the word order effects.

3. EXPERIMENTS¹⁷

3.1. OUTLINE. The main goal of our experimental study is to test the adequacy of three models that correspond to the three hypotheses outlined in the previous sections (the prosodic hypothesis, the word order hypothesis, and the combination of both) against a cross-linguistic data set of acceptability judgments.

In order to make the three kinds of approaches directly comparable and to derive precise empirical predictions from them, we conceptualize them as sets of generalizations, abstracting away from specific theoretical implementations. For example, we take Kučerová's (2012) proposal to be an instance of a word order model, because of Kučerová's view that the generalization 'All given elements must precede all new elements' is a crucial part of an adequate description of word order variation in Czech. On the other hand, we would classify any theory entailing the view that the crucial generalization is 'A given constituent must not contain sentence stress' as an instance of what we call prosodic model. It is irrelevant for our purpose that Kučerová's (2012) theory accounts for the word order related generalization in terms of an operator that is active during the syntactic/semantic derivation, whereas the implementation of most prosodic models involves post-derivational constraints; they can nevertheless be compared with respect to the empirical adequacy of the generalization that they aim to capture.

The core assumption that we make is the following: if a statement like 'All given elements must precede all new elements' or 'A given constituent must not contain sentence stress' correctly describes a generalization about a given language, utterances in which the statement is

¹⁷ The complete set of materials, a translation of the instructions, our annotation of constraint profiles, and the raw data can be accessed under <https://...> [URL to be assigned by the editors; for the time being, feel free to contact the authors, who will be glad to share the materials].

violated will show a consistent decrease in acceptability. We assume that violating a generalization does not necessarily lead to categorical unacceptability of a sentence – violation of some generalization A might lead to only a slight acceptability decrease, whereas violation of a different generalization B might cause severe degradedness. However, crucially, we assume that if a generalization really holds, it should have a consistent effect on acceptability that *always* occurs when it is violated (even if the sentence is already degraded due to other factors – that is, we assume that in the case of several violations, the effects add up in a cumulative way).¹⁸ This assumption allows us to establish a direct link between the three tested models and the results of our empirical study: if the data show that sentences which do not adhere to a certain generalization are **CONSISTENTLY** perceived as degraded to a similar degree, this can be interpreted as evidence that the corresponding generalization is descriptively adequate. Crucially, our materials include conditions which only the prosodic model but not the word order model predicts to be acceptable, as well as the reversed case. We assume that the model that provides the best fit across all data is empirically superior.

The novel data used for testing the models stem from three experiments (inspired by Šimík, Wierzba, & Kamali 2014 and Šimík & Wierzba 2015; see section 2.5), all of which we conducted in Czech, Slovak, and Polish. These languages exhibit a fair amount of information structure-related flexibility of both word order and prosody, which makes them a perfect fit for tackling the kind of research question that we are interested in. The particular cross-linguistic perspective we take comes with a number of benefits. First, it is expected to provide support to our assumption that the decrease in acceptability caused by a violation of a generalization is gradient. More specifically, even if a violation of a generalization causes an acceptability decrease in all the languages investigated, the degree to which the acceptability decreases can differ from language to language. This also illustrates the relative power of our approach: not only does it allow us to draw inferences like ‘generalization X characterizes language Y’, we can also infer the **DEGREE** to which this holds and compare these degrees cross-linguistically. Second, comparing such closely related languages as Czech, Slovak, and Polish (all belonging to the West branch of the Slavic family) gives us confidence that the results are directly comparable to each other and that they are not affected by unforeseen confounds. Third, Czech and Slovak are more closely related to each other than either of them is to Polish. If our cross-linguistic comparison works in the intended way, we expect there to be a larger difference between Polish and Czech or Slovak than between Czech and Slovak.

3.2. SPECIFYING THE APPROACHES: CONSTRAINTS AND MODELS. The three approaches crucially differ in which generalizations are assumed to describe givenness-related word order variation adequately. For the purpose of testing the approaches empirically, we will formulate these generalizations as binary constraints, so that it can be decided for any sentence in our materials whether the constraint is violated or not. The complete list of constraints that are needed to represent the different approaches are given in 21–24.

¹⁸ In the assumptions that violations of linguistic restrictions lead to a systematic decrease in acceptability, and that violations add up in a cumulative way, our approach is similar to (and was inspired by) Keller’s (2000) Linear Optimality Theory.

- (21) CWO (CANONICAL WORD ORDER): The linear order of S, V, and O is SVO.
- (22) NSR (NUCLEAR STRESS RULE): Sentence stress falls on the rightmost constituent.
- (23) *SG (*STRESS GIVEN): A given expression does not realize sentence stress.
- (24) G<N (GIVEN BEFORE NEW): Within a clause, given expressions precede new ones.

We take these constraints to be binary. This means that we do not assume that they can be violated to a certain degree or a certain number of times, depending, for instance, on how far away sentence stress is from the default stress position in the case of NSR, or on how many given elements precede a new element in the case of G<N. We count NSR as violated if stress is not rightmost, and G<N as violated if at least one new element precedes a given one. However, as outlined above, the binary conceptualization of the constraints does not entail that a violation leads to categorical unacceptability – the EFFECT of a violation can be gradient.

We can now describe the three models in terms of which of these generalizations they assume to be descriptively adequate, or, in other words, which constraints they assume to be active:

- (25) Prosodic model: CWO, NSR, *SG are active.
- (26) Word order model: CWO, NSR, G<N are active.
- (27) Combined model: CWO, NSR, *SG, G<N are active.

Note that we assume that every model involves constraints concerning default sentence form, both with respect to word order (CWO) and prosody (NSR). For evidence that the default word order is SVO in the West Slavic languages under consideration see, for instance, Sgall, Hajičová, and Buráňová 1980, and for evidence that the default prosody involves rightmost stress in these languages see, for instance, Daneš 1957 (for Czech) and Szwedek 1976/2011 (for Polish). We take CWO and NSR to be the common ground of any model describing the form of Slavic sentences.

According to the prosodic model, it is sufficient to add the constraint *SG in order to account for givenness-related word order variation: as described in section 2.3, in a situation where a given constituent would receive sentence stress under default word order and default prosody (because it appears in the rightmost position canonically), a violation of *SG can be avoided by reordering. In contrast, according to the word order model, the constraint G<N is active instead, which enforces all given elements to precede new ones. The combined model represents the logically possible option that both constraints are active, that is, that both generalizations are needed for an empirically adequate description of the facts.

All constraints are formulated in a maximally theory-neutral way. For example, the CWO is akin to the constraint STAY, as proposed in Grimshaw 1997, in that both express a tendency towards default word order. However, in contrast to STAY, the CWO remains agnostic as to whether deviations from the default are the result of syntactic movement or non-canonical base-generation. Similarly, the NSR merely describes a generalization concerning default prosodic form. A deviation from the prosodic default is usually referred to as STRESS SHIFT and we adopt

this term, but we remain agnostic as to whether deviations are the result of an operation that literally shifts the default stress to a different position or of an assignment of non-default stress. The same considerations apply to our formulation of *SG and G<N.

As already indicated, we assume that if a constraint is indeed active in a given language, violating it should have a consistent effect on the acceptability of a sentence, but the size of the effect can differ between the constraints and between languages. In other words, we assume that each constraint is associated with a certain language-specific WEIGHT representing the severity of its violation. Under this assumption, we can use the statistical method of multiple regression to test whether violations of the respective constraints lead to a consistent decrease in acceptability, and to estimate the constraint weights for each language. Measures of model quality can then be used to determine how well a certain set of constraints (i.e. a certain model type) fits the data. If a constraint decreases acceptability consistently, all data will suggest a similar weight for that constraint. In contrast, if some part of the data requires the weight to be small or zero and another part of the data requires it to be large, this will result in an intermediate estimate that does not fit the data well in any of the conditions. Such a situation will be reflected in decreased model quality, and it can be visualized in form of a mismatch between the actual data and the best fit that the model can provide. We will interpret these two cues as indications that the generalization which the constraint represents is not fully adequate. Further details about the modeling methodology will be provided in section 4.1.

3.3. PARTICIPANTS AND PROCEDURE. We ran a cross-linguistic set of experiments in Czech, Slovak, and Polish. 40 native speakers of Czech (students in Prague), 40 native speakers of Slovak (students in Bratislava), and 40 native speakers of Polish (students in Poznań) took part. The stimuli were presented auditorily via headphones. Each stimulus was a short pre-recorded dialog. At the beginning of the experimental trial, the participants read the instructions on the computer screen telling them to rate the acceptability of the response part of the dialog in the short context preceding it. The task was illustrated by two examples. After that, the experimental stimuli were presented in pseudo-randomized order. In total, there were 136 stimuli (32 from the *all new* experiment, 32 from the *given object* experiment, 48 from the *stress shift* experiment, and 24 fillers). After an auditory stimulus had been presented, a scale from 1 to 9 appeared on the screen and participants chose the rating that they found most adequate by pressing the corresponding digit on the computer keyboard (1 meaning completely unacceptable and 9 completely acceptable), using the standard (non-numeric) keyboard. There was no time limit imposed on providing the rating and the participants could determine when they were ready to listen to the next dialog by pressing the Space bar. The experiment took the participants 20 to 40 minutes, depending on their individual pace. Reaction times were measured, but will not be discussed in this paper.

3.4. MATERIALS. The materials contained three experimental sub-designs and a set of filler items. They were first constructed for Czech and then translated to Slovak and Polish. The translated materials were inspected by the authors, who have competence in the languages, to ensure that the relevant factors were not affected by the translation procedure. Each stimulus was a short pre-recorded dialog between two interlocutors – native speakers of the respective languages. The two parts of each dialog – the context and the target utterance – were recorded separately, so that the speakers could not see the context in which their utterance is to be evaluated. The recording sessions were supervised by the authors, who made sure that the utterances had the intended form, esp. prosody. No artificial post-hoc pitch manipulations were

applied.

The context (mostly a question, sometimes a declarative) was designed to determine the information structure of the target utterance. More particularly, it determined which expressions in the target utterance are given (vs. new) and which part of the utterance is focused (vs. backgrounded). Givenness was controlled by mentioning the relevant expression in the context (see section 2.1). Focus was controlled in a number of ways, in part depending on whether it was narrow or broad. Narrow focus was induced by mentioning a contrasting expression in the context (a method used for verb focusing in a part of the *stress shift (given O)* experiment) or by a wh-question where the wh-expression corresponded to the focused expression in the target (a method used in the *stress shift (focused O)* experiment). Broad focus was induced by a ‘What’s new?’ type of question (*all new* experiment), by a ‘why’-question (*given object* experiment), or by another kind of utterance (including declaratives or yes-no questions) to which the target was a natural all-focus continuation (*stress shift (given O)* experiment). The use of these different ways of determining focus was motivated mainly by the fact that each experimental sub-design imposed its own constraints on setting up a naturally sounding mini-conversation. The benefit of this variability is that the materials end up being more balanced, potentially averaging out effects that could be specific to individual ways of focus-determination, and also yielding a less tiring experience for participants.

Given expressions always took the form of full (= non-pronominalized) NPs in our experiments. This decision is motivated by the need to manipulate givenness (vs. newness) as a factor, without the interference of any confounding factors which pronominalization would entail. For instance, in Czech and Slovak, non-contrastive pronouns take the form of clitics that appear in the designated ‘Wackernagel position’ and always avoid stress. This restricted grammar renders almost all of the word order and prosodic manipulations of (non-contrastive) given expressions impossible for pronouns, making them unfit for the use in our experiments. Another reason to avoid pronouns is theoretical – there are good reasons to believe that pronouns are exempt (precisely due to their restricted grammar) from any information structure-related word order generalizations or rules (see e.g. Kučerová 2007 for some discussion). Having said this, we should also point out that using full NPs comes with problems of its own. In particular, it has been observed that repeating a full NP (rather than pronominalizing it) induces an additional processing cost and can influence acceptability judgments – an observation dubbed the REPEATED NAME EFFECT by Gordon and colleagues (1993). It is plausible that there is a repeated name effect in our conditions containing given material, lowering their acceptability. Crucially, however, it should affect all these conditions alike, irrespective of word order and prosodic realization. The hypotheses that we aim to test concern the interaction of givenness with prosody and word order. Therefore, it is still possible to evaluate them accurately, even if all stimuli containing given constituents are rated as less acceptable to some (constant) extent – this would not unevenly favor any of the hypotheses.

We now turn to a more detailed description of the design and goals of the three sub-experiments.

THE ALL NEW EXPERIMENT. The *all new* experiment represents a kind of baseline for the *given object* experiment. The context used to trigger the all new (and all focus) information structure was a question like ‘Was there anything interesting in the news?’ All target utterances started with a temporal/locative adverbial (e.g. ‘yesterday’ or ‘in Prague’) and an adverb meaning ‘allegedly’, followed by a subject (S), a verb (V), a direct object (O), and an (argument

or adjunct) prepositional phrase (PP). We tested four different positions of the object, as illustrated by the Czech example in 28. For practical reasons, it was impossible to test all possible word order permutations; we decided to focus on the position of the direct object – in parallel to the manipulation *given object* experiment. Varying the position of the object in the experiments is sufficient to create crucial test cases for the tested hypotheses.

(28) Context: ‘Was there anything interesting in the news?’

- | | | |
|----|--|--------|
| a. | Včera prý ministr dopravy obvinil z korupce
yesterday allegedly minister transportation.nom accused of corruption
premiéra.
prime.minister.acc | SVPPPO |
| b. | Včera prý ministr dopravy obvinil premiéra z korupce. | SVOPP |
| c. | Včera prý ministr dopravy premiéra obvinil z korupce. | SOVPP |
| d. | Včera prý premiéra ministr dopravy obvinil z korupce.
‘Yesterday allegedly the minister of transportation accused the prime minister of corruption.’ | OSVPP |

We included this design in our study in order to get a clear idea about the influence of word order, unaffected by information structure. All the elements in the target sentences were new, and thus, neither of the givenness-related constraints (*SG, G<N) plays any role. Sentence stress (marked by boldface) was kept constant: it always fell on the rightmost constituent. Thus, the conditions do not differ with respect to NSR either. The results should thus solely reflect the influence of the CWO constraint.

It is important to stress in this connection that the label *all new* is not to be conflated with *thetic*, used for utterances without a topic (Ulrich 1985, Sasse 1987). We do not rule out that there is a topic–comment structure in our target sentences; in fact, it is plausible that the adverbial is interpreted as a topic due to its initial position (as suggested by a reviewer). But crucially, even if this is the case, it does not introduce any information-structural partitions among the constituents that we analyze (S, V, O, PP) – they would all remain part of the comment made about the initial adverb. Thus, in our view it is unlikely that topicality affects our assumptions about S, V, O, PP being new.¹⁹

We constructed 32 items for this experiment. They were balanced for definiteness of the object and subject and varied in their animacy. The complete scheme according to which we composed the items can be found in the appendices.

THE *GIVEN OBJECT* EXPERIMENT. The main question of the *given object* experiment was in which way the word order options change in comparison to the *all new* experiment when one of the elements is given. The general form of the items was thus similar (four different positions of the object; sentence stress always on the rightmost constituent), but the object was always given. In addition, the givenness of the subject (S given / S new) was manipulated. A Czech example is given in 29.²⁰

¹⁹ An anonymous reviewer also pointed out that the items of this experiment resemble newspaper headlines, which are known to differ from natural speech in certain respects. We hope that the fact that the target sentence is part of an (auditorily presented) dialog and the presence of an adverb meaning ‘allegedly’ rules out this potential interference.

²⁰ We refrain from marking givenness by underlining, as in the preceding sections, because the givenness of

- (29) Context 1: ‘Do you have an idea why Marta made a phone call?’ S new
 Context 2: ‘Do you have an idea why Marta called the aunt?’ S given
- | | | |
|----|---|-------|
| a. | Protože prý teta poveze do nemocnice Martu . | SVPPO |
| | because allegedly aunt.nom take to hospital Marta.acc | |
| b. | Protože prý teta poveze Martu do nemocnice . | SVOPP |
| c. | Protože prý teta Martu poveze do nemocnice . | SOVPP |
| d. | Protože prý Martu teta poveze do nemocnice . | OSVPP |
- ‘Because allegedly the aunt will take Marta to hospital.’

If $G < N$ was active, we would expect a consistent penalty for all conditions in which a new element precedes a given one (SVPPO, SVOPP, and, if the subject is new, also SOVPP). Thus, the acceptability should depend both on the position of the object and the givenness of the subject. If *SG was active, we would expect a consistent penalty for the condition in which the given object is in the rightmost position carrying sentence stress (SVPPO). The givenness of the subject is expected to play no role because the subject never bears sentence stress.

We constructed 32 items for this experiment. They were balanced for type of the object (proper name/definite description), gender of the object, animacy of the object, and the order of the target subject and the target object in the context (to avoid syntactic priming effects). Definiteness was held constant (all subjects and objects were definite).

An inspection of the factors definiteness and animacy can be found in the appendix.

THE *STRESS SHIFT* EXPERIMENT. The goal of the *stress shift* experiment was to study the influence of non-default stress assignment. This means that we manipulated not only word order (SVO vs. SOV), but also the position of sentence stress (stress on O / stress on V). The general form of the target sentences differed from the first two experiments: they were always initiated by ‘I think that...’, followed by a subject (S), a verb (V), and a direct object (O).

Information structure was manipulated as an additional within-items factor. We tested each target sentence in two different contexts. In Context 1, the target sentence involved a given object and a new subject and verb. Context 2 was a wh-question, inducing a narrow focus interpretation on the object in the target sentence. The background to the focused object (i.e., the subject and the verb) was always given. For the presentation of the results, we will divide the data from this experiment into two parts, which we will refer to as *stress shift (given O)*, and *stress shift (focused O)*, depending on the type of context that was involved. A Czech example is given in 30.

- (30) Context 1: ‘We’d like to talk to the Italian ambassador.’ O given / V new
 Context 2: ‘Do you have an idea who Mr. Sládek contacted in the end?’ O foc. / V given
- | | | |
|----|--|-----|
| a. | Myslím, že pan Sládek kontaktoval toho velvyslance . | SVO |
| | think that Mr. Sládek.nom contacted the ambassador.acc | |
| b. | Myslím, že pan Sládek kontaktoval toho velvyslance. | SVO |
| c. | Myslím, že pan Sládek toho velvyslance kontaktoval . | SOV |
| d. | Myslím, že pan Sládek toho velvyslance kontaktoval. | SOV |
- ‘I think that Mr. Sládek contacted the ambassador.’

The experiment involved also a third context type, in which the object was given like in Context 1, but in addition, it involved an explicit contrastive alternative to the verb in the target sentence (e.g. ‘I don’t understand why we’re still not in touch with the Italian ambassador’). We wanted to test this additional context because we hypothesized that the acceptability of stress shift to the verb might be increased if there is an additional information-structural motivation for stressing the verb (as assumed e.g. in Kučerová 2007 or Wagner 2012). In addition, we varied whether the subject was given or new in this condition; a given subject supports a narrow contrast interpretation of the verb and might thus further motivate stress on the verb. However, we decided to exclude the conditions with verb contrast from the dataset for the purpose of the main analysis in this paper. The reason for this is that subject givenness is a relevant factor for the predictions of the word order model. In the *stress shift (given O)* experiment, this factor was not fully crossed with the factor verb contrast (when the verb was non-contrastive, the subject was always new; when the verb was contrastive, the subject was given in half of the items and new in the other half of the items). Thus, any potential effect of subject givenness would be conflated with the effect of verb contrast. This would be an unfair disadvantage for the word order model – if its predictions for the influence of subject givenness did not match the observed pattern, this could be due to the verb contrast confound. The results presented in the following sections are therefore based only on a part of the data from the stress shift experiment, namely on the conditions with Context 1 and Context 2. We provide a separate analysis of the items involving verb contrast in the appendix.

We constructed 48 items for this experiment. The items were balanced for type of object (O proper name / O definite description).

3.5. RESULTS OF THE EXPERIMENTS. Figures 1–3 illustrate the results of our experiments for Czech, Slovak, and Polish, respectively. Each of our experiments (*all new*, *given object*, *stress shift (given O)*, *stress shift (focused O)*) is plotted separately for each language. The plots show the mean acceptability ratings for each word order (transformed to z-scores) with 95% confidence intervals. The labels on the x-axis represent the tested word orders and sentence stress distribution (boldface). In the experiments *given object* and *stress shift (given O)*, filled points / solid lines correspond to the mean acceptability ratings for items with a new subject and empty points / dashed lines to the rating of items with a given subject. The analysis was conducted using R and the packages lme4 (Bates et al. 2014) and lmerTest (Kuznetsova et al. 2016).

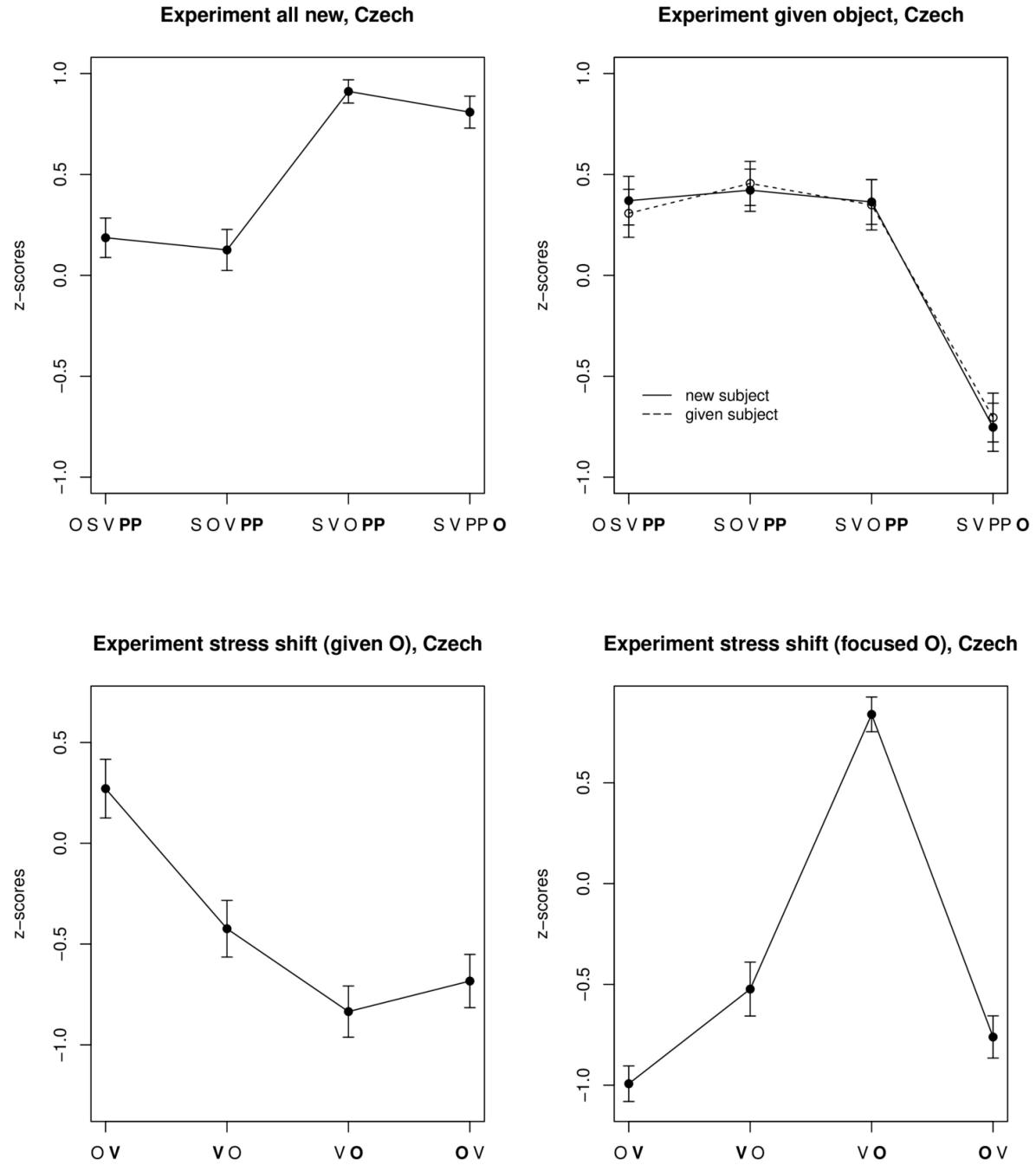


FIGURE 1. Results with 95% confidence intervals for Czech.

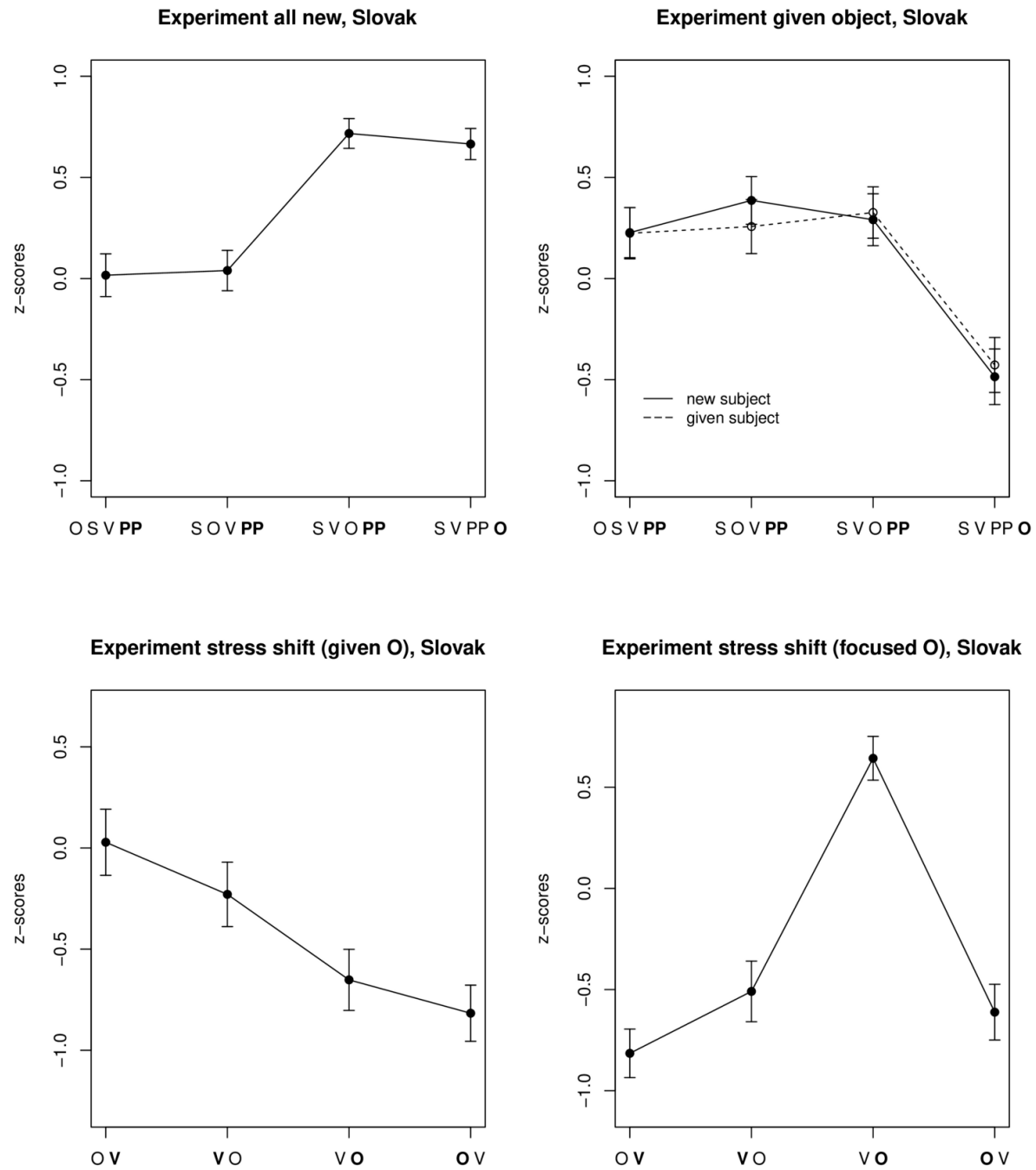


FIGURE 2. Results with 95% confidence intervals for Slovak.

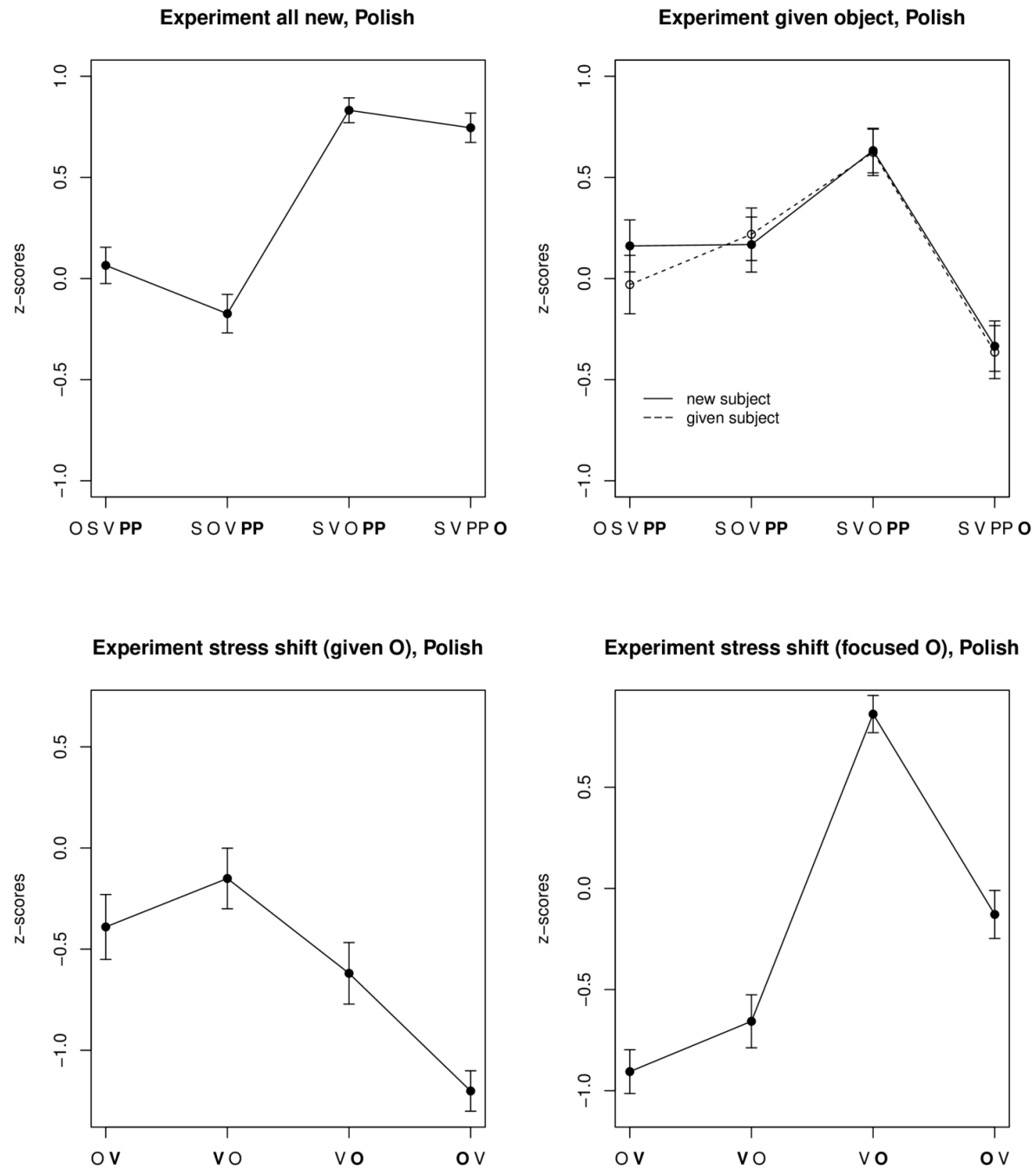


FIGURE 3. Results with 95% confidence intervals for Polish.

The results of the *all new* experiment show that in this context objects are more acceptable in postverbal than in preverbal position in all three languages.²¹

The most striking result in the *given object* experiment is that a given object is worse in the sentence-final position, where it carries sentence stress, than in the penultimate position. For Czech and Slovak, the three other object positions show a very similar degree of acceptability. In Polish, the immediately postverbal position is more acceptable than the preverbal positions. A further observation is that subject givenness has almost no effect.²²

The results of the *stress shift (given O)* experiment show that the two conditions in which the given object carries sentence stress (**VO** and **OV**) are the worst ones in all languages. The other two conditions behave differently across languages. In Czech and Slovak, non-canonical word order (**OV**) is preferred over non-canonical sentence stress (**VO**); in Polish, it is the other way round.²³

The main result of the *stress shift (focused O)* experiment, in which the object was new+focused and the subject and the verb were given, is that **VO** is the by far preferred realization in all three languages.²⁴ Visual inspection of the plots suggests that scrambling the focused object (while keeping the object stressed) is less problematic in Polish than in Czech and Slovak (this observation will be discussed in more detail in section 4).

4. EVALUATION OF THE APPROACHES: MODEL COMPARISON. In this section, we present a modeling study, which we use to compare the different approaches to word order variation with respect to their empirical adequacy – the prosodic approach, the word order approach, and the combined approach. In section 4.1 we introduce our modeling methodology, which is based on the general method of multiple regression. Section 4.2 presents the general results of our modeling study and section 4.3 contains the discussion. Section 4.4 zooms in onto the individual models and discusses their advantages and problems.

4.1. MODELING METHODOLOGY. We use multiple regression to evaluate whether the generalizations – represented by binary constraints – have a consistent effect on acceptability,

²¹ We compared adjacent (according to the displayed order) levels of the factor word order (with forward difference coding for the planned contrasts) using a linear mixed model with random intercepts for subjects and items. In all languages, there is a significant difference between the second and the third level (SOVPP vs. SVOPP; Czech: $t = 13.9$, $p < 0.001$; Slovak: $t = 11.8$, $p < 0.001$; Polish: $t = 19.0$; $p < 0.001$). In Polish, in addition there is a significant difference between OSVPP and SOVPP ($t = 4.5$; $p < 0.001$). Additional post-hoc comparisons (with Holm-Bonferroni correction for all pairwise tests) confirmed that both postverbal conditions differ significantly from the two preverbal conditions in all languages (all $ps < 0.001$).

²² As in the *all new* experiment, adjacent levels of the factor word order were compared. In all languages, there is a significant difference between SVOPP and SVPPO; (Czech: $t = 20.7$, $p < 0.001$; Slovak: $t = 12.7$, $p < 0.001$; Polish: $t = 16.8$; $p < 0.001$). In Polish, in addition, there is a significant difference between OSVPP and SOVPP ($t = 2.2$, $p = 0.03$) and between SOVPP and SVOPP ($t = 7.5$, $p < 0.001$). *Subject givenness* (effect-coded) has no main effect in any of the languages. In Czech and Slovak, it does not enter into any significant interaction, either. Only in Polish, it significantly influences the difference between OSVPP and SOVPP ($t = 2.1$, $p = 0.04$).

²³ Stress (effect-coded as sentence stress on the object vs. sentence stress on the verb) and word order (effect-coded) interact significantly in all languages (Czech: $t = 4.5$, $p < 0.001$; Slovak: $t = 3.1$, $p = 0.002$; Polish: $t = 2.9$; $p = 0.004$). Pairwise comparisons of individual conditions with Holm-Bonferroni correction confirm that **VO** and **OV** are worse than all other conditions (all $ps < 0.05$). In Czech and Slovak, **OV** is significantly better than **VO** ($t = -6.9$, $p < 0.001$ / $t = -2.3$, $p = 0.02$); in Polish, the opposite holds ($t = 2.2$, $p = 0.03$).

²⁴ Stress and word order interacted significantly in all three languages (Czech: $t = 11.13$, $p < 0.001$; Slovak: $t = 7.7$, $p < 0.001$; Polish: $t = 6.8$, $p < 0.001$). Pairwise comparisons confirm that **VO** is significantly better than all other conditions in all languages (all $ps < 0.001$).

and to estimate the constraint weights. In general, multiple regression is a method to estimate the relation between dependent and independent variables. Applied to the problem investigated here, we can formulate the dependency as in 31.

$$(31) \quad r_i = \text{highest_possible_acceptability} \\ + \text{constraint_weight}_1 \times \text{number_of_constraint_violations}_{i1} \\ + \text{constraint_weight}_2 \times \text{number_of_constraint_violations}_{i2} \\ + \varepsilon_i$$

The basic idea is that an acceptability rating r is a function of the weights of violated constraints. The value of the independent variables corresponds to the number of times the constraint is violated in this i^{th} data point; as already pointed out, we assume that a single constraint can only be violated once, so the only possible values are 1 for ‘violated’ and 0 for ‘not violated’. The coefficients are the constraint weights (which are assumed to be the same across all data points); since they represent the weight of constraint VIOLATIONS, they will have negative values. The intercept can be interpreted as the highest possible acceptability, from which the constraint penalties are then subtracted. We assume that if several constraints are violated in a sentence, their weights add up in a cumulative way. For example, if a sentence violates a constraint C1 with a weight of x and a constraint C2 with a weight of y , the acceptability of that sentence should be decreased by the sum of x and y in comparison to a sentence in which none of the constraints is violated. This assumption translates to a linear relationship between the independent variables (constraints) and the dependent one (acceptability), with no interaction between the independent variables.²⁵ Least Square Estimation is used to set the coefficients (constraint weights) such that the sum of all squared errors is minimized. More precisely, we specified linear mixed models including the constraints as predictors (CWO, NSR, *SG for the prosodic model, CWO, NSR, G<N for the word order model, CWO, NSR, *SG, G<N for the combined model), without interaction terms, with by-item random intercepts.²⁶ For each language, we fit separate models, based on the data from all sub-experiments (*all new, given object, stress shift*). Measures of model quality are then used to determine how well a certain set of constraints (i.e. a certain model type) fits the data.

4.2. RESULTS OF THE MODELING STUDY. Table 1 contains a summary of the prosodic model, the word order model, and the combined model, applied to the data from Czech, Slovak, and Polish. As measures of model quality, we report the (marginal) R^2 and BIC. The R^2 value can be interpreted as the proportion of variance in the data that is explained by the fixed factors; for instance, an R^2 value of 0.3 would mean that 30% of the variance in the data is explained by the model.²⁷ As for the BIC, a lower value indicates a better model fit, taking into account the

²⁵ Alternative hypotheses about the way the constraint weights combine could be tested by including interaction terms. For example, Hofmeister, Casanato, and Sag (2014) discuss the possibility that constraints combine in a super-additive way. In this paper, we stick to the assumption that constraints combine in a linear, non-interacting way.

²⁶ The maximal random effects specification justified by the design, following Barr et al. (2013), would include by-subject random slopes and intercepts, as we had a full within-subject design. However, the variance estimate for the subject variable was zero in the fitted models, so we removed it from the model.

²⁷ More precisely, it would mean that the variance of the regression model’s errors is smaller by 30% than the variance of the dependent variable. The marginal R^2 value (based only on the model’s fixed factors) was derived from our linear mixed effects models following Nakagawa & Schielzeth 2013 and using the R package MuMIn

number of predictors (Schwarz 1978). The respective model coefficients (which we interpret as estimates of the constraint weights) are also summarized in Table 1. For each model, each of the included factors had a significant effect ($p < 0.001$); and within each language, the combined model was significantly different from the two others models according to an ANOVA. The estimated constraint weights are also reported in Table 1. We transformed our acceptability ratings to z-scores (following Schütze and Sprouse’s 2014 recommendation for linguistic judgment data).

		model quality		estimated weights (standard error in parentheses)				
		R ²	BIC	intercept	*SG	G<N	NSR	CWO
Cz	prosodic	0.28	9117	0.55 (0.03)	−1.01 (0.03)		−0.46 (0.04)	−0.31 (0.03)
	word order	0.19	9616	0.54 (0.03)		−0.64 (0.03)	−0.50 (0.04)	−0.20 (0.03)
	combined	0.34	8968	0.71 (0.03)	−0.89 (0.03)	−0.40 (0.03)	−0.41 (0.04)	−0.33 (0.03)
Sl	prosodic	0.20	9638	0.47 (0.03)	−0.82 (0.03)		−0.39 (0.04)	−0.36 (0.03)
	word order	0.12	9985	0.43 (0.03)		−0.46 (0.03)	−0.43 (0.04)	−0.27 (0.03)
	combined	0.23	9582	0.58 (0.03)	−0.74 (0.03)	−0.26 (0.03)	−0.36 (0.04)	−0.37 (0.03)
Pl	prosodic	0.29	9076	0.63 (0.03)	−0.98 (0.03)		−0.32 (0.04)	−0.62 (0.03)
	word order	0.14	9766	0.50 (0.04)		−0.40 (0.03)	−0.37 (0.04)	−0.49 (0.03)
	combined	0.31	9057	0.70 (0.03)	−0.94 (0.03)	−0.16 (0.03)	−0.30 (0.04)	−0.63 (0.03)

TABLE 1. Comparison of the models

4.3. DISCUSSION. According to the modeling results, the combined model, involving both *SG and G<N, is the most successful one. However, for Polish, a comparison to the other models shows that the difference between the combined model (involving both *SG and G<N) and the prosodic model (involving *SG, but not G<N) is small: the combined model accounts for 31% of the variance, the prosodic model alone accounts for 29%. Furthermore, the estimated weight of G<N in the combined model is low (−0.16, i.e. it has a negative effect on acceptability of the size of 0.16 standard deviations), suggesting that establishing an IS-word order connection on top of the prosodic constraints does not provide much additional descriptive value for Polish. The estimated weight of the *SG constraint, on the other hand, is large in the combined model (−0.94), and there is a considerable difference between the combined model and the word order model (involving G<N, but not *SG): the word order model alone accounts for only 14% of the variance.

In Czech, the G<N estimate in the combined model is higher (−0.40), and the difference between the variance explained by the combined model (34%) and the prosodic model (28%) is more pronounced than in Polish. This suggests that G<N has a non-negligible effect in this language. As in Polish, the estimated weight of *SG in the combined model is large (−0.89), and there is a clear quality difference between the combined model (34%) and the word order model (19%). Also the prosodic model (28%) fares better than the word order model (19%).

Slovak can be placed in between Polish and Czech with respect to the influence of G<N.

The difference in variance explained by the combined model (23%) and by the prosodic model (20%) is similarly small as in Polish, but the estimated weight of $G < N$ is higher (-0.26). The estimated weight of $*SG$ in the combined model was smaller than in the other languages (-0.74), but still the largest among all constraints. The word order model (12%) fared worse than the prosodic model (20%) also in Slovak.

It can thus be considered a clear result of the modeling study that there is a strong connection between information structure and prosody in Czech, Slovak, and Polish in the form of a ban on assigning sentence stress to a given element: the poor results of the word order model support the view that $*SG$ is a necessary part of a descriptively adequate model of word order variation in West Slavic languages. This resonates with the previous experimental findings concerning English (Most & Saltz 1979), Dutch (Nooteboom & Kruijt 1987), and Czech (Šimík, Wierzba, & Kamali 2014, Šimík & Wierzba 2015). For all languages, adding a constraint that directly relates word order to givenness further improves the model; however, for Polish, the improvement is relatively small. The more pronounced improvement in Czech resonates with the results of Most and Saltz's (1979) experiments, which tentatively suggest the relevance of both prosodic and word order factors for the expression of information structure in English.

In the following section, we will provide a more detailed look at each of the models. Plots will help to identify the main benefits and problems of the respective models and the generalizations they rely on.

4.4. DETAILED LOOK AT THE INDIVIDUAL MODELS. The plots in this section show the predictions of the three different models in comparison to the actual results. A separate model was fit for each language: Figure 4 shows the predictions for Czech, Figure 5 for Slovak, and Figure 6 for Polish. For each language, the data from all three sub-experiments was used to fit the model. The predicted values²⁸ of the prosodic model are plotted in blue, those of the word order model in yellow, and those of the combined model in green. The actual results are repeated for comparison in black.

The columns in gray below the plot indicate the violation profile of the conditions. For example, the first column in the first plot in Figure 4 (OSVPP – $*SG: 0$, $G < N: 0$, $NSR: 0$, $CWO: 1$) indicates that in this condition, CWO is violated, because the object precedes the verb. $*SG$ and $G < N$ are trivially satisfied, because there are no given elements. NSR is satisfied because sentence stress falls on the rightmost constituent. The same holds for the second condition (SOVPP). In the third and fourth condition (SVOPP, SVPPO), none of the constraints is violated. Note that each model necessarily predicts the same mean for conditions with an identical violation profile of the relevant constraints: for example, for all models, the predicted means in the *all new* experiment are the same for the first condition as for the second one, and the predicted mean value for the third condition is the same as for the fourth one. Recall that according to our assumptions, a constraint violation is linked to a certain consistent decrease in acceptability. The predicted difference between the two pairs of conditions (first and second condition vs. third and fourth condition) corresponds to the best estimate for the weight of a CWO violation that the linear models determined in view of the overall data.

²⁸ In contrast to fitted values, predicted values are based only on the fixed effects of the model.

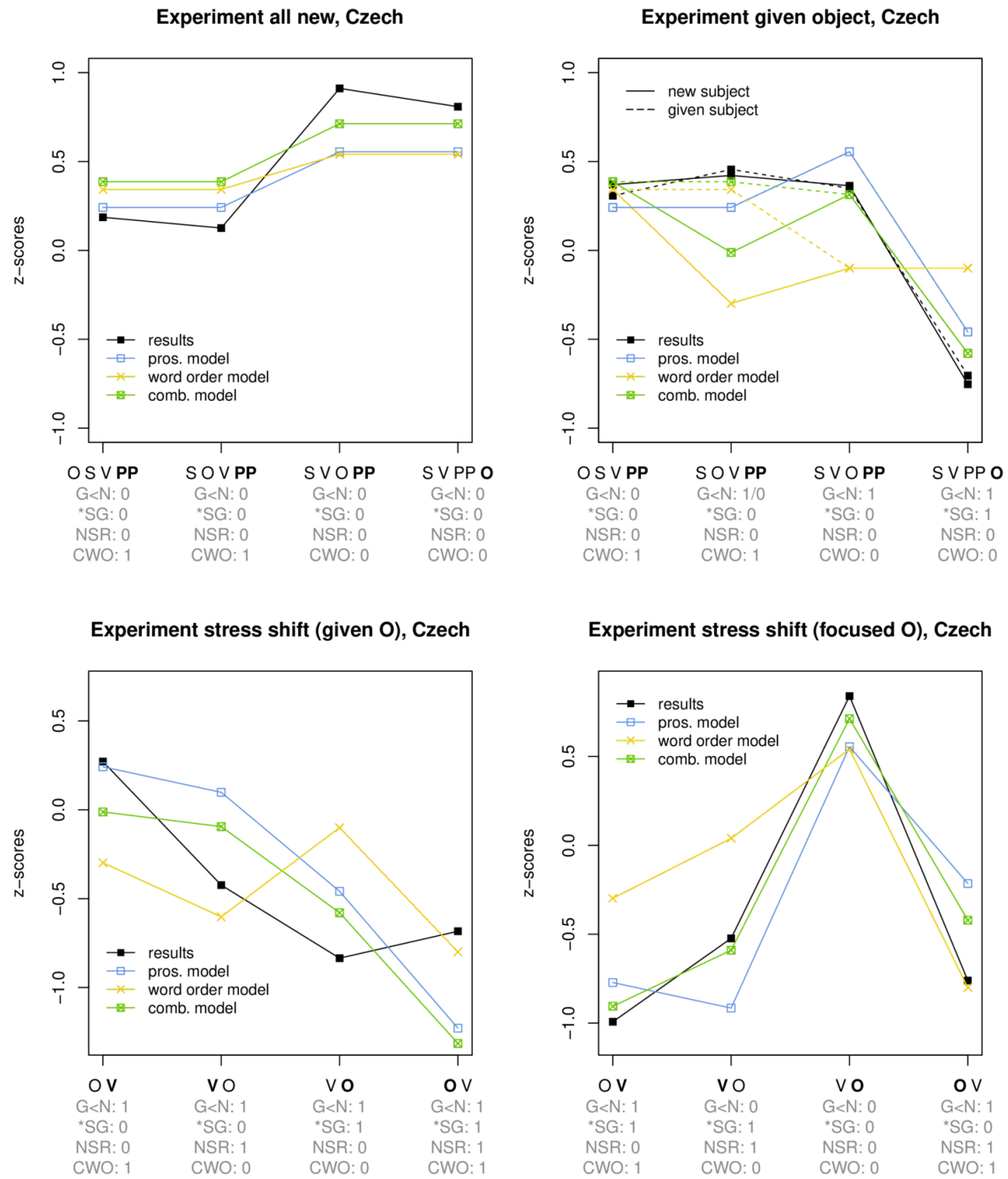


FIGURE 4. Results (black) in comparison to the predictions of the prosodic model (blue), of the word order model (yellow), and of the combined model (green) for Czech.

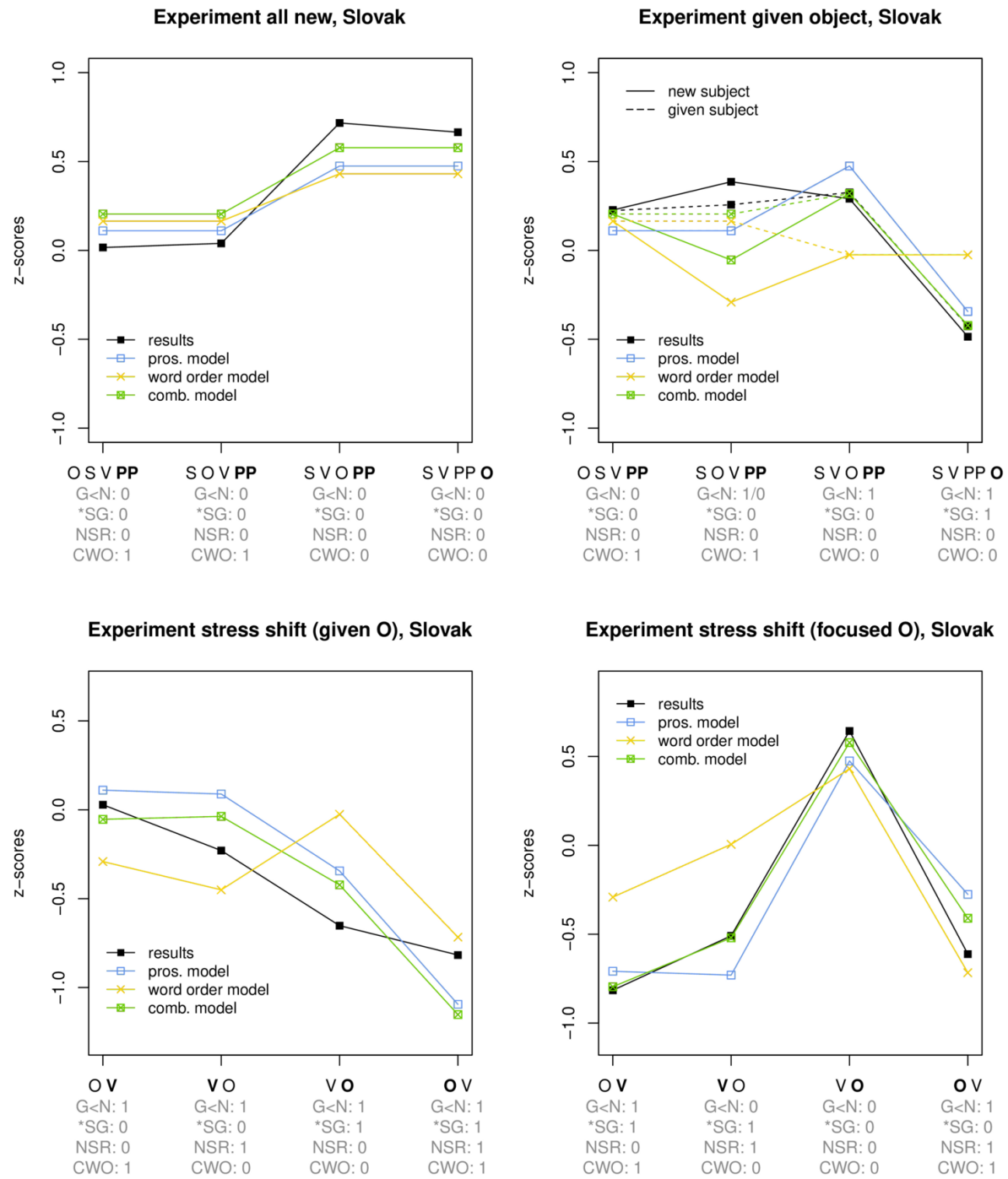


FIGURE 5. Results (black) in comparison to the predictions of the prosodic model (blue), of the word order model (yellow), and of the combined model (green) for Slovak.

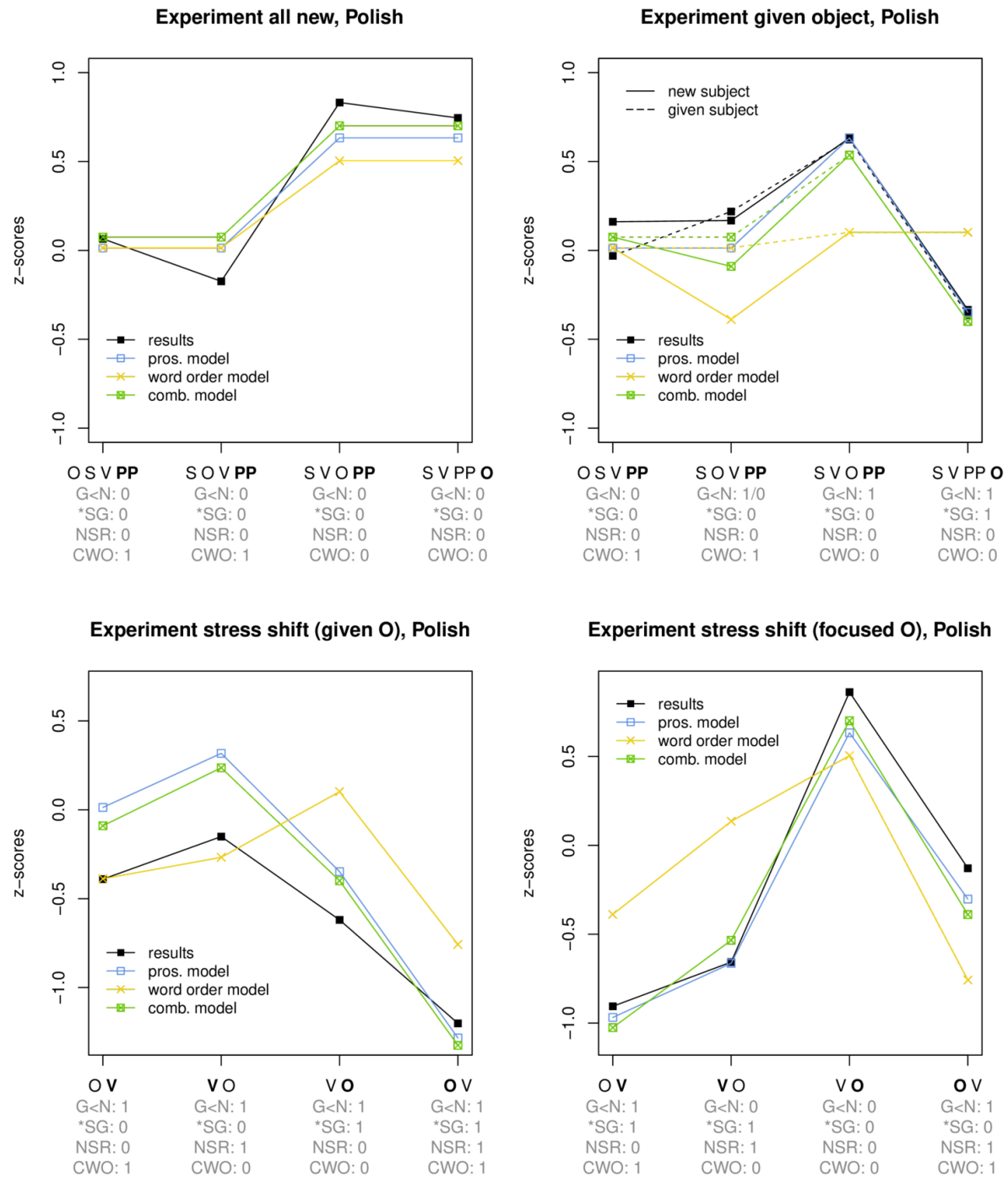


FIGURE 6. Results (black) in comparison to the predictions of the prosodic model (blue), of the word order model (yellow), and of the combined model (green) for Polish.

ALL NEW EXPERIMENT. A comparison of the predicted means in comparison to the actual results in the *all new* experiment shows that in principle, the CWO constraint is capable of capturing the preference for a postverbal object in this context. CWO is violated in structures with OV order and not violated in structures with VO order. Thus, all the models have to do in this case, so to speak, is to find the optimal estimate for the CWO weight. It is evident from the plots that the calculated estimates (of any of the models) do nevertheless not fit the data perfectly. The reason is that the constraint weights were estimated based on the data from all experiments, and not all of them support a strong CWO effect, as will be discussed below. A further observation is that the estimated weight of the CWO constraint is larger for Polish than for Czech and Slovak.

GIVEN OBJECT EXPERIMENT. The plots illustrate some of the core strengths and weaknesses of the individual models. Let us consider the PROSODIC MODEL first. The plots suggest that *SG is suitable to capture the core result, namely that a given object is much worse in sentence-final position than in any other position. *SG singles out the deviant condition: it is the only one in which a given element carries sentence stress. For CWO, we can see a trade-off situation when we compare the Czech and Slovak results from the first two experiments: in the *all new* experiment, there seems to be a clear penalty for preverbal objects, whereas this penalty seems to be completely absent when the object is given, so the model finds an estimate for the CWO weight that is too small to account for the difference in the first case and too large to model the three equally acceptable conditions in the given object experiment adequately. Polish behaves differently: there, we see the penalty for preverbal objects in both experiments, which allows to estimate the weight of the CWO constraint more consistently.

Let us turn to the WORD ORDER MODEL next. The first problem is that the one condition that clearly deviates from the rest (given object in final, stressed position) is not singled out in the violation profile: there is no constraint that is violated only in this condition. The second problem is that no consistent estimate can be found for $G < N$. In the items with a new subject, $O_G S_N V_N PP_N$ is the only condition in which the object is not preceded by any new element. In the items with a given subject, both $O_G S_G V_N PP_N$ and $S_G O_G V_N PP_N$ satisfy the constraint. The plotted predicted values show that no estimate for the weight of $G < N$ can be found that represents the data well: the model arrives at an intermediate value which minimizes the error across all conditions, but does not fit any of the concerned actual means particularly well. It also leads to a third problem: a considerable influence of subject givenness is predicted, which is not supported by the data.²⁹

When we look at the predictions of the COMBINED MODEL, we can see that the combined model provides an even more precise prediction for the unacceptable condition (S V PP O) than the prosodic model alone did. This suggests that the presence of the $G < N$ constraint helps to find a more consistent estimate for *SG, indicating an effective division of labor between the two constraints to some extent. However, this comes at the price of introducing one of the word order model's problems: if $G < N$ has any effect, then an influence of subject givenness is predicted, which is absent in the data.

²⁹ Only in Slovak we see a small effect of subject givenness, but the trend goes against the direction predicted by the word order model: S O V PP order is a little worse when the subject is given than when it is new, but $G < N$ is violated only in the latter case.

STRESS SHIFT (GIVEN O) EXPERIMENT. The PROSODIC MODEL can capture that the two conditions in which sentence stress falls on the given object (**VO** and **OV**) are the worst ones across languages: this pattern lends further support for a large weight for *SG. Another result is that in Czech and Slovak, using non-canonical word order is a better solution to satisfy *SG than using non-canonical sentence stress, whereas in Polish, it is the other way around. This results in a difference in the estimated weight for NSR and CWO: in Czech and Slovak, the estimated weight for NSR is larger than for CWO, in Polish the estimated weight for CWO is larger than for NSR. This can be interpreted as a cross-linguistic difference in the relative importance of the generalizations represented by the two constraints. The priority of the CWO constraint in Polish fits together with the finding that there is a consistent penalty for preverbal objects in Polish, but not in the other two languages. However, although the prosodic model is capable of capturing the relative acceptability of the structures quite well (**OV** < **VO** < **VO** / **OV** in Czech and Slovak, **VO** < **OV** < **VO** / **OV** in Polish),³⁰ there is still a considerable mismatch between the actual and predicted means. One problem is that the predicted mean for the stress shift condition **VO** is too high in all three languages, whereas the predicted mean for the **OV** condition is too low. In both conditions, NSR is violated. The inconsistent requirements could indicate that an important factor is being missed here. It is, for example, conceivable that the NSR constraint should be specified further; maybe, stress shift to a verb is worse than stress shift to an object.³¹ Another factor contributing to the overly low estimate for **OV** could be a floor effect, as the ratings for this condition approach the lower end of the provided scale. Incorporating the scale limits into the models would be a way to further improve the fit in future work. We hope that in this study, floor effects did not introduce too large a bias against one of the models---here, it presumably worsened the fit of the prosodic model, whereas in the same condition in the stress shift (focused O) experiment, it possibly affected the word order model. The final problem we would like to mention is that the predicted mean for the **VO** condition is too high.

For the WORD ORDER MODEL, the main problem is that it does not provide any means to capture the decreased acceptability of the conditions with a given but stressed object.

When we compare the predictions of the COMBINED MODEL to those of the prosodic model, the combined model offers the advantage that the G<N constraint allows to lower the predictions for the VO conditions in relation to the OV conditions, which helps to improve the fit (mainly in Czech and Slovak; in Polish, the difference between the combined and the prosodic model is smaller due to the small estimate for G<N).

STRESS SHIFT (FOCUSED O) EXPERIMENT. The main result, namely that **VO** is by far the most acceptable realization in all three languages when the object is focused, can be captured by the PROSODIC MODEL: in this condition, none of the constraints are violated, whereas all other conditions violate two of them. The cross-linguistic difference with respect to scrambling of a focused object (less problematic in Polish than in Czech and Slovak), however, is not captured by the prosodic model. Different weights for NSR and CWO do not help in this case: the relevant condition **OV** violates both of them, so this difference is unaccounted for by the prosodic model. A further problem is visible in Polish and Czech: the predicted means for the conditions

³⁰ The only exception is the (surprising) acceptability advantage of **OV** over **VO** in Czech, which was not found in previous experiments; in the experiment reported in Šimík and Wierzbą 2015, there was a trend in the opposite direction, which would be more in line with the Slovak and Polish findings here.

³¹ This hypothesis was tested in Groeben 2015 for the case of stress shift to a contrastive verb vs. to a contrastive object. The asymmetry was not confirmed by the results.

containing a scrambled object (OV and **OV**) are too high. Finally, the acceptability of the optimal candidate is underestimated for all three languages. We could take this as an indication that some of the candidates that were assumed to not violate any constraint in the other experiments in fact do. When we compare the respective optimal structures in the data involving a given object (*given object* and *stress shift (given O)*) to those involving a new object (*all new* and *stress shift (focused O)*), the former are clearly less acceptable than the latter. A possible explanation for this difference could lie in the repeated name effect, which was discussed in section 3.4.

The WORD ORDER MODEL is also able to correctly capture that VO is the optimal structure when the object is focused, as it is the only one that does not violate any of the constraints. However, again the model lacks the means to capture the severe unacceptability of the conditions in which a given element (here, the verb) carries sentence stress, resulting in a bad fit for the VO and OV conditions.

The COMBINED MODEL shows a very good fit here. In Czech and Slovak, it is visible that the predictions are better than in the case of the prosodic model, because the G<N constraint allows to lower the predicted means for the OV conditions, which the prosodic model predicted to be higher.

To sum up the findings, the strength of the PROSODIC MODEL lies in explaining the low acceptability of conditions in which a given expression carries sentence stress: the object-final condition in the *given object* experiment, the two conditions with stress on the object in the *stress shift (given O)* experiment, and the two conditions with stress on the verb in the *stress shift (focused O)* experiment. These conditions share the property that they violate *SG. Thus, a large weight can be consistently assigned to this constraint, resulting in a good model fit. However, the prosodic model is not able to completely capture the overall pattern in the *stress shift* experiment, and especially in *stress shift (focused O)*. The WORD ORDER MODEL, which does not include the *SG constraint, fails to capture the strong and consistent acceptability decrease of those conditions in which a given expression carries sentence stress. Furthermore, if any weight is assigned to the G<N constraint, the model predicts an effect of subject givenness in the *given object* experiment, which is not present in the data. The COMBINED MODEL, which includes both *SG and G<N, provides the best fit in all languages. It seems that adding G<N to the system helps to ameliorate some of the mismatches of the prosodic model in the *stress shift* experiment. However, we would like to draw attention to two problems that recur for the combined model across the experiments and discuss a way of modifying the relevant constraints/generalizations. The first problem is the lack of any effect of subject givenness. The second problem is that no consistent estimate of the weight of CWO could be found for Czech and Slovak, not just in the combined model but the prosodic and word order model, too. The experiments that involved the scrambling of a given object (*given object* and *stress shift (given O)*) suggest a very small or even zero weight of CWO, while the experiments that involved the scrambling of new objects (*all new* and *stress shift (focused O)*) suggest a larger weight of CWO.³² A possible solution to this problem is to formulate a more specific CWO for Czech and Slovak, namely one that only prohibits the scrambling of new/focused items. Such an adjusted constraint would come with independent empirical benefits. If we consider the *stress shift (focused O)* experiment, we can see that the violation profiles of CWO and G<N are identical. We can also see that the combined model fares better than the prosodic experiment thanks to the presence of G<N. This means that

³² The empirical situation in Czech and Slovak is reminiscent of German, for which the ban on scrambling new/focused objects was observed in Lenerz 1977.

if the weight of CWO is larger (which would be possible because of its more limited application), it could successfully model the benefits of G<N in the prosodic model (i.e., even in the absence of G<N). Replacing G<N by an adjusted version of the CWO would help to improve the fit for the *stress shift (given O)* experiment, too. The assumption that CWO applies only to new/focused elements would mean that it is never violated in this experiment (only the given object scrambles). This would raise the model's predictions for both OV conditions relative to the VO conditions and thus allow approximating the pattern of the actual means more closely. A proper evaluation of the empirical contribution and conceptual motivation of the modified CWO generalization is left for future work. Finally, we would like re-emphasize that our conclusions are premised on the assumption that violations of the respective generalizations lead to acceptability decrease in a linearly cumulative way. Also in this respect, future work could help to validate or re-evaluate our conclusions by taking into account different kinds of dependencies that could potentially hold between the constraints and perceived acceptability.

5. SUMMARY AND CONCLUSION. The present study sheds new light on the way information structure is expressed in three West Slavic languages: Czech, Slovak, and Polish. Our main conclusions can be summarized as follows:

- The canonical word order is SVO (based on the *all new* experiment).
- Given expressions consistently avoid sentence stress (*given object, stress shift*).
- Given expressions do not consistently precede new ones (*given object*).
- In Polish, scrambling is consistently penalized (*all new, given object, stress shift*).
- In Czech and Slovak, scrambling of given expressions applies freely (*given object, stress shift (given O)*), but scrambling of new/focused expressions is penalized (*all new, stress shift (focused O)*).

It is generally believed that the high degree of word order flexibility (reflected here by the relatively small weight of the CWO/CANONICAL WORD ORDER constraint) in West Slavic languages is utilized as the primary means of information structure expression, whereas other factors, including prosody, play a secondary or even a minor role (see e.g. Mathesius 1941 or Kučerová 2012). The results of our experimental and modeling study go in the opposite direction: They show a very clear and consistent interaction between information structure and prosody in all three languages (reflected by the large weight of the *SG/*STRESS GIVEN constraint and the relatively good fit of the prosodic model) and a much less clearly pronounced and less consistent interaction between information structure and word order (reflected by the smaller weight of the G<N/GIVEN BEFORE NEW constraint and the worse fit of the word order model). Our results further suggest that if information-structural manipulations lead to word order alternations, it should not only be attributed to a direct interaction between information structure and word order, but also (or even mostly, esp. in Polish) to the combined effect of the *SG constraint and the NSR (NUCLEAR STRESS RULE) constraint, which amounts to avoiding placing given constituents in the rightmost position, where they would receive sentence stress. This latter conclusion lends support to the so-called prosodic approaches to word order alternations, first proposed by Szwedek (1974a, 1974b, 1976/2011) for Polish and later independently proposed for many other languages (e.g. Reinhart 1995 or Zubizarreta 1998). Let us also point out that our results are in

agreement with the results of previous experimental studies (discussed in section 2.5) and thus further strengthen the theoretical position that prosodic expression of information structure takes primacy not only in relatively ‘fixed word order’ languages like English or Dutch, but also in ‘free word order’ languages like Czech, Slovak, and Polish.

The differences that we found between Polish and the other two languages concern the relative weight of NSR and CWO, or, in other words, the importance of the corresponding generalizations about canonical word order and default prosody. That there is cross-linguistic variation in this respect is a well-established fact. Adopting Vallduví and Engdahl’s (1995) terminology, languages differ in the *plasticity* of intonation in word order. For example, Vallduví and Engdahl analyze English as a language with plastic intonation and non-plastic word order. Thus, information-structural marking is more likely to involve deviations from default prosody than deviations from canonical word order. Catalan is analyzed as an instance of the reverse case: it has plastic word order and non-plastic intonation. In our study, Polish shows a tendency towards the English-type strategy of information-structural marking: non-default sentence stress is preferred over non-canonical word order in order to avoid sentence stress on a given object. Czech and Slovak, on the other hand, show the opposite tendency, towards the Catalan-type pattern. We do not intend to answer the question what deeper reasons might be responsible for this difference; it is, however, worth pointing out that a detailed analysis of gradient data helps to recognize that the observed cross-linguistic differences can be attributed to this kind of variation, whereas *SG is similarly strong and consistent in all three languages under consideration.

We should further point out that the present study concentrated systematically on the category of givenness (and newness) and has only touched upon other major information structural categories such as focus (and background) and topic (and comment). Focus was manipulated in the *stress shift* experiment and its prosodic and word order effects were subsumed in the present analysis under the constraints that involve givenness. This was possible because in our items the focused object was new and its background was given. A different study would be needed in order to disentangle any potential effects of focus that would be independent of givenness.³³ Topic was not manipulated in our experiments. The object in the *given object* experiment comes closest to what is usually considered topic: in the target sentences it is the only referential expression that is clearly established in the previous discourse. However, we avoided explicit topicality cues like clause-initial placement and marked intonation, so again, a different study would be needed to investigate the relation between topic-hood and word order.

Finally, we hope to have shown that experimental studies and statistical modeling procedures can be a helpful tool for comparing the descriptive adequacy of competing linguistic hypotheses. We would also like to point out that our models are not just descriptive but also predictive. The constraints and their weights determined in the modeling study can be applied to new data and the success of the individual models can be compared with each other as well as with new models.

³³ See Groeben, Šimík, & Kügler to appear for relevant experimental results.

APPENDIX

This appendix contains analyses of some additional factors that were included in the experimental design, but were not discussed and analyzed in the paper. Most of them were targeted manipulations, resulting in a balanced amount of items for each level (definiteness in the *all new* experiment, animacy in the *given object* experiment, verb contrast in the *stress shift (given O)* experiment). The motivation for this was two-fold: First, we wanted to level out potential confounds. Second, the additional variation made the experimental materials less tiring for experimental participants.

We also provide a post-hoc analysis of a factor which we annotated only after running the experiment (animacy in the *all new* experiment), and for which the numbers are therefore not fully balanced.

I. THE *ALL NEW* EXPERIMENT. The main factor of this experiment was word order (position of object relative to a PP, verb, and subject). Here we concentrate on two additional factors: definiteness of the object and the subject (definite vs. indefinite) and their animacy (human vs. non-human). These factors were manipulated between items. Object and subject definiteness were crossed and their levels balanced in number (yielding def S + def O, def S + indef O, indef S + def O, indef S + indef O conditions, each represented by 8 items). Object and subject animateness also varied, but their levels were not balanced in numbers (15 items with human S + human O, 10 with human S + non-human O, 3 with non-human S + human O, and 4 with non-human S + non-human O). The type of definiteness involved is the situational/uniqueness kind of definiteness (where, for instance, the bare NP ‘Czech president’ counts as definite). Organizations or conventional groups of human (such as ‘the parliament’) were considered human (by metonymy).

These factors have been shown to interact with word order in the Slavic languages (for a recent discussion see Titov 2012). The analyses presented here can thus be viewed as a further elaboration of the rather coarse ‘canonical word order’ generalization discussed in our paper – in general, an SVO order is preferred in the languages under investigation, but more fine-grained preferences can be detected if definiteness and animacy are taken into account.

Figure A1 shows the results of the *all new* experiment (for Czech, Slovak, and Polish respectively), taking into account the definiteness of the object (definite: filled points, indefinite: empty points) and the definiteness of the subject (definite: solid lines; indefinite: dashed lines). The statistical analysis is based on linear mixed models with random intercepts for subjects and items. We also report marginally significant interactions (with p-values between 0.05 and 0.1), because the observed trends might be worth further investigation. Forward difference contrast coding was used for the factors word order (i.e., adjacent levels of the factor were compared). Definiteness (and all other binary factors in the analyses) was effect-coded.

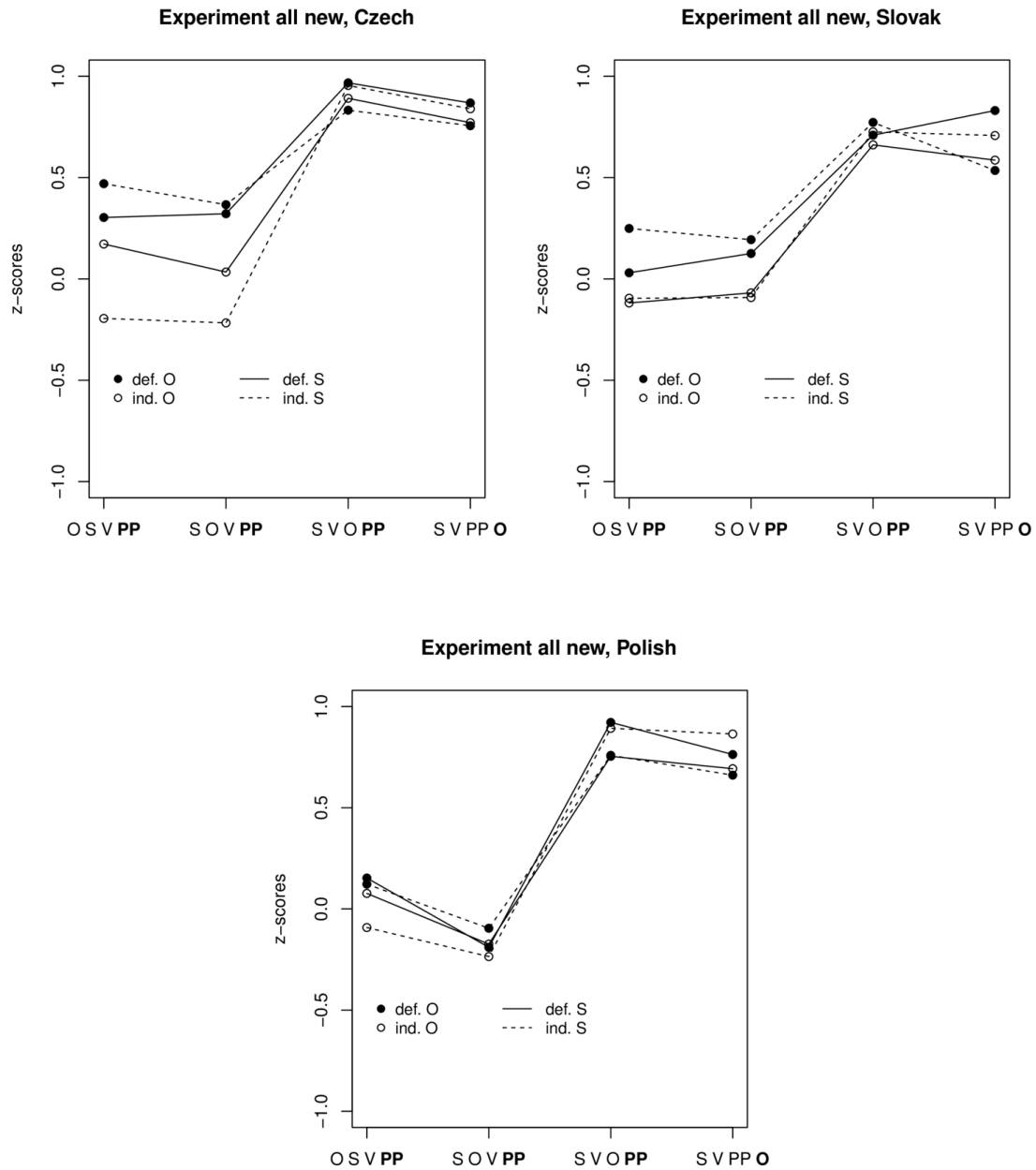


FIGURE A1. Results of the all new experiment, incl. the definiteness factor.

The largest impact of definiteness is found in CZECH. There, we find an interaction between the relative verb-object order (SVOPP vs. SOVPP) and object definiteness ($t = 4.1$, $p < 0.001$): the decrease in acceptability of preverbal objects is larger when they are indefinite. This is further qualified by a three-way interaction including subject definiteness ($t = 2.2$, $p = 0.03$): the decrease is even larger when the subject is also indefinite. In SLOVAK, we find two marginally significant interactions: first, the same interaction between verb-object order and object definiteness as in Czech ($t = 1.7$, $p = 0.09$); second, a three-way interaction between object-finality (SVPP O vs. SVOPP), object definiteness, and subject definiteness ($t = 1.8$, $p =$

0.07): in definite-object conditions, there is an acceptability decrease for rightmost objects (as compared to penultimate ones), but only in case the subject is indefinite. In POLISH, the only significant interaction was one between verb-object order, object definiteness, and subject definiteness ($t = 2.2$, $p = 0.03$): the acceptability decrease in conditions with preverbal indefinite objects, witnessed for Czech and marginally for Slovak, is visible in Polish, too, but only in conditions with indefinite subjects.

Figure A2 shows the results of the *all new* experiment, taking into account the animacy of the object (human: filled points, non-human: empty points) and the animacy of the subject (human: solid lines, non-human: dashed lines).

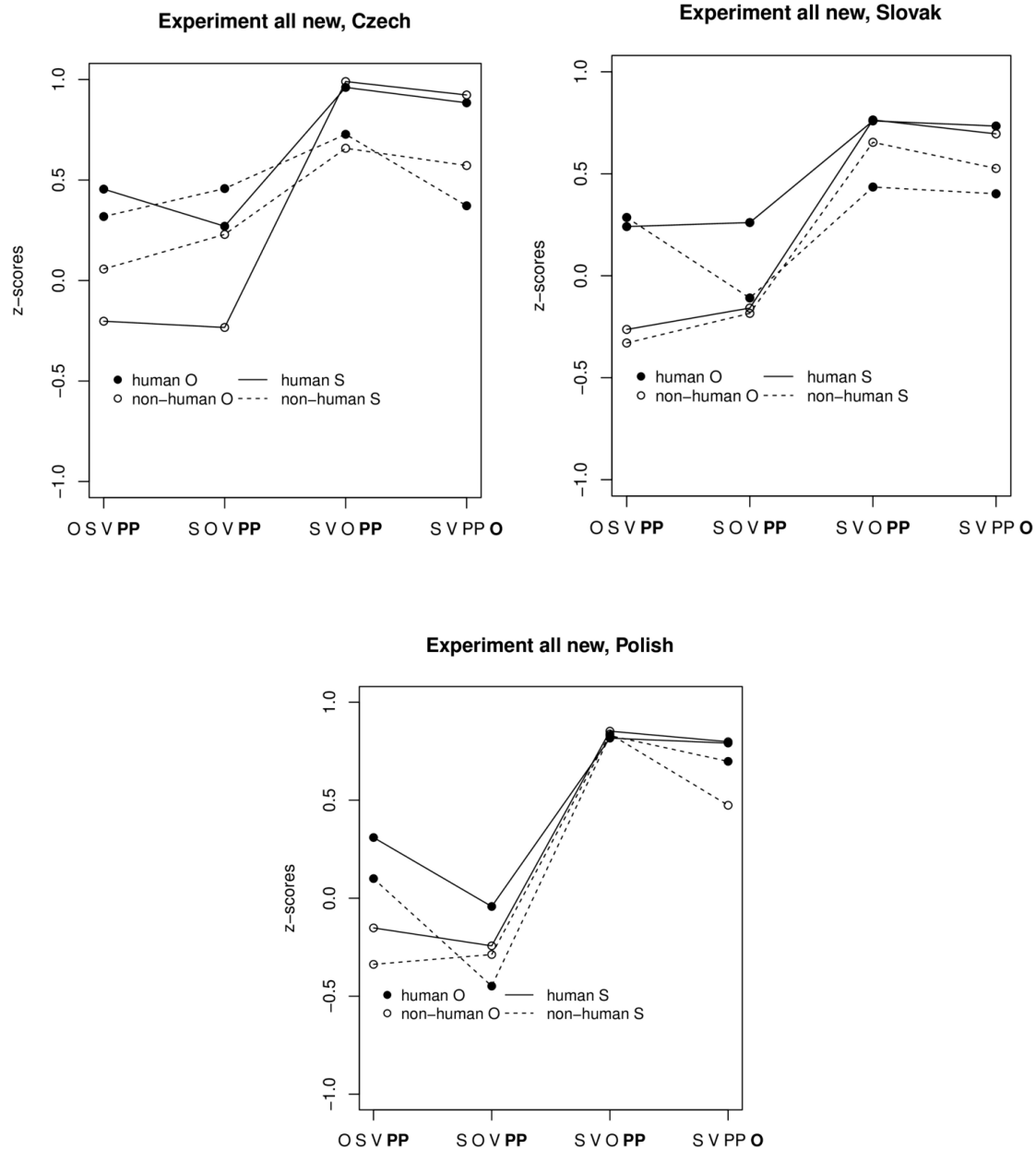


FIGURE A2. Results of the all new experiment, incl. the animacy factor.

In CZECH, we find three two-way interactions between word order and animacy. The strongest interaction is between verb-object order (SVOPP vs. SOVPP) and subject animacy ($t = 4.6$, $p < 0.001$): the acceptability decrease in conditions with preverbal objects is much larger for conditions with human subjects than for those with non-human subjects. The verb-object order also interacts with object animacy ($t = 2.6$, $p = 0.01$): the acceptability decrease in the preverbal position is larger for non-human objects than it is for human objects. Finally, there is a marginally significant interaction between the relative subject-object order (SOVPP vs. OSVPP) and subject animacy ($t = 1.9$, $p = 0.05$): the OS order is less acceptable (relative to the SO order), but only when the subject is non-human. In SLOVAK, we find two two-way interactions and one three-way interaction. First, there is the same interaction between verb-object order and object animacy as in Czech ($t = 2.5$, $p = 0.01$): the acceptability decrease in the preverbal position is larger for non-human objects than it is for human objects. Second, the relative subject-object order interacts with object animacy ($t = 2.3$, $p = 0.02$): there is an increase in acceptability in the OS order (relative to the SO order) if the object is human. This interaction is qualified by a marginally significant three-way interaction including subject animacy ($t = 1.7$, $p = 0.10$): this increase is only present if the subject is non-human. In POLISH, we find three two-way interactions and one three-way interaction. There is a strong interaction between subject-object order and object animacy ($t = 3.7$, $p < 0.001$): OS order is better than SO order when the object is human. The second interaction, albeit a marginally significant one, is found between object finality (SVPPPO vs. SVOPP) and subject animacy ($t = 1.8$, $p = 0.08$): object-final conditions are worse than object-penultimate ones if the subject is non-human. Third, verb-object order interacts marginally with subject animacy ($t = 1.9$, $p = 0.06$): the acceptability decrease of preverbal objects is larger if the subject is non-human. This interaction is qualified by a marginally significant three-way interaction including object animacy ($t = 1.8$, $p = 0.07$): the decrease is even larger when the object is human.

In summary, the additional analyses of definiteness and animacy in the all new experiment show that these factors do influence word order preferences in the investigated languages. The factor definiteness only affects the availability of preverbal orders in general (they are dispreferred with indefinite objects), but no significant effects on the relative ordering of subject and object were found. Thus, there is no evidence for an ordering preference of the form ‘definite < indefinite’.

In contrast, there is some evidence for such an ordering preference with respect to animacy (‘animate < inanimate’): at least in Slovak and Polish, an object-initial structure is especially acceptable when it serves the purpose of positioning a human object in front of a non-human subject. In addition, the following general tendency can be observed: deviations from canonical SVO order are less acceptable in the most common and prototypical case with respect to animacy (animate subject, inanimate object). Word order becomes more flexible in non-prototypical cases.

II. THE *GIVEN OBJECT* EXPERIMENT. The main factors of this experiment were word order (just like in the *all new* experiment) and subject givenness (given vs. new subject). Here we concentrate on the additional factor of object animacy (human vs. non-human). The factor was manipulated between items and its two levels were balanced in number (16 items involved human objects, 16 involved non-human objects).

Figure A3 shows the results of the *given object* experiment (for Czech, Slovak, and Polish respectively), taking into account the animacy of the object (human: filled points, non-human:

empty points). Solid and dashed lines encode the main factor of subject givenness, as in the paper.

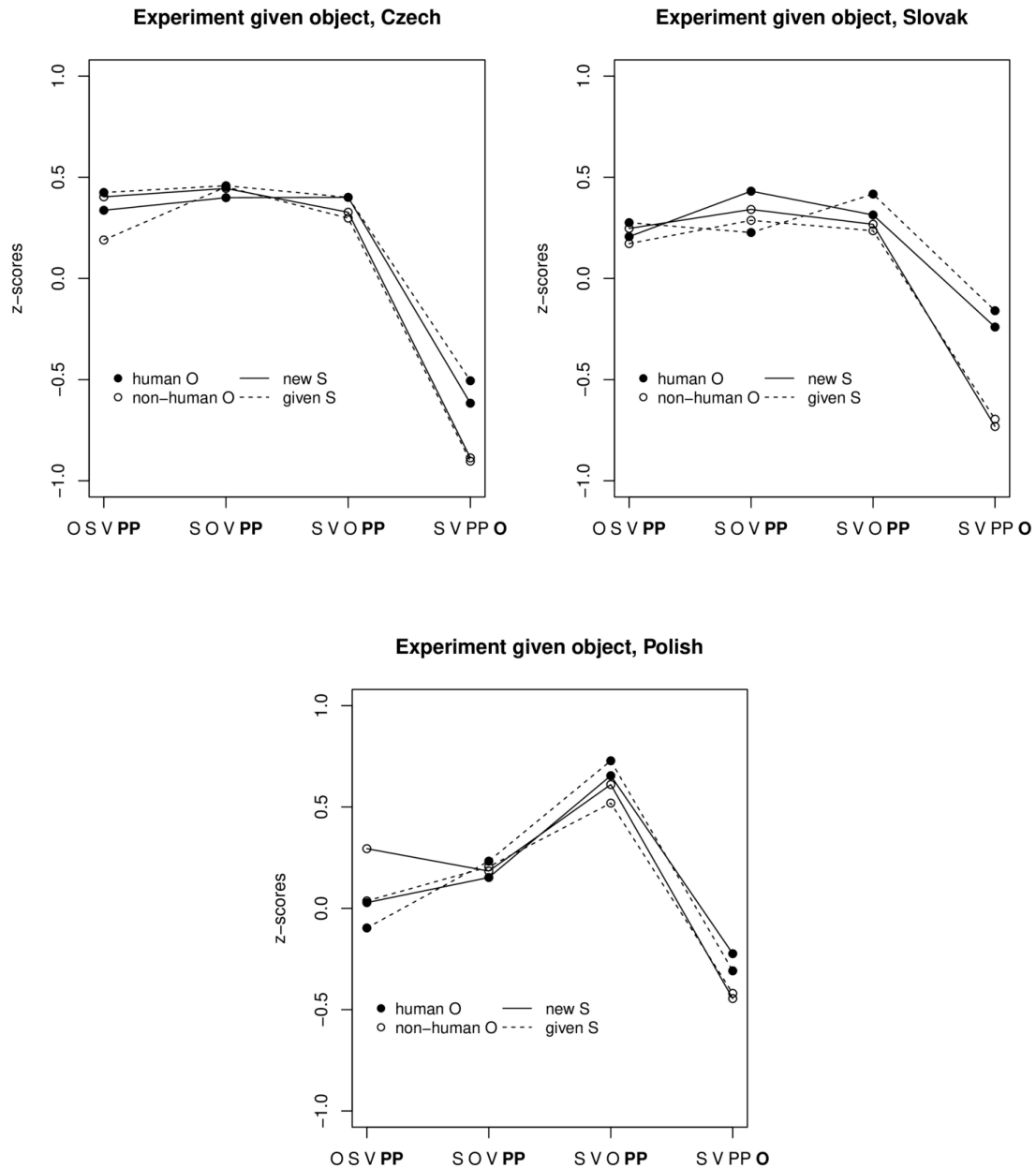


FIGURE A3. Results of the given object experiment, incl. the animacy factor.

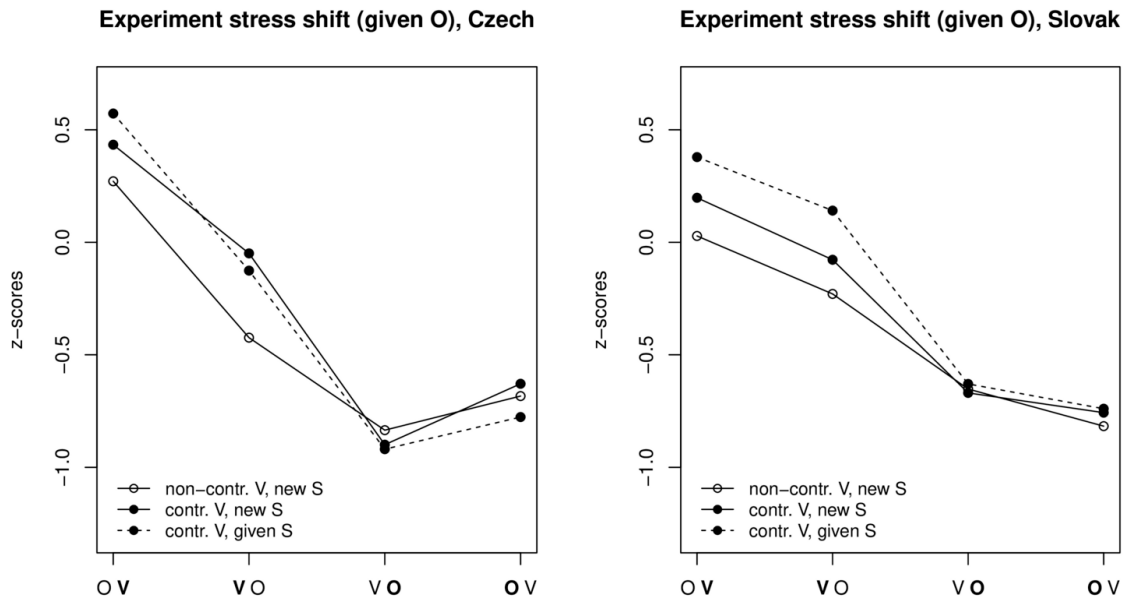
Both CZECH ($t = 2.4$, $p = 0.02$) and SLOVAK ($t = 3.4$, $p < 0.001$) exhibit a significant interaction between word order and object animacy. In particular, the decrease in acceptability witnessed in the object-final condition (due to the stress placed on the given object) is more pronounced for human objects than for non-human objects. Czech exhibits an additional, albeit marginally significant interaction between object animacy and subject givenness ($t = 1.7$, $p =$

0.09): a given subject tends to increase the acceptability of sentences with a human object, but tends to decrease the acceptability of sentences with a non-human object. In POLISH, we only find a marginal interaction between subject-object order (SOVPP vs. OSVPP) and object animacy ($t = 1.7$, $p = 0.09$): OS order exhibits a decrease in acceptability (as compared to the SO order), but only with human objects.

In summary, there is an interesting effect of object animacy with respect to the sentence-final, stressed position in Czech and Slovak; the same trend can be observed in Polish. We leave it for further research. Concerning the other word order options, animacy does not show the same systematic effect here as in the all new experiment: a human object does not increase the availability of OS structures.

III. THE *STRESS SHIFT (GIVEN OBJECT)* EXPERIMENT. In the paper, we considered only a part of this sub-experiment in order to avoid negative bias for one of the models. The factors involved were word order (SVO vs. SOV) and sentence stress position (stress on V vs. stress on O). Object givenness was held constant, as well as the newness of the subject and verb. Here we consider the results of the whole experiment, which involved variation in two additional factors: the contrastiveness of the verb (contrastive vs. non-contrastive/plain new V) and the givenness of the subject (given vs. new S). Subject givenness was manipulated within the contrastive verb condition.

Figure A4 shows the results of the *stress shift (given object)* experiment (for Czech, Slovak, and Polish respectively), taking into account the contrastiveness of the verb (filled points = contrastive verb, empty points = non-contrastive verb) and the givenness of the subject (solid lines = new subject, given lines = given subject).



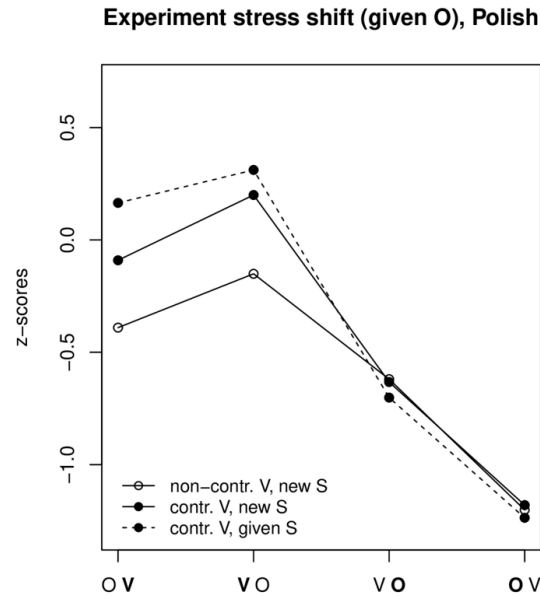


FIGURE A4. Results of the stress shift (given O) experiment, incl. the verb contrastiveness and subject givenness factors

In the analysis, we combined verb contrastivity and subject givenness into a single three-level factor with Helmert contrast coding, allowing us to compare the non-contrastive condition with the mean of the two contrastive ones, and the latter two with each other. All three languages – CZECH ($t = 3.8$, $p < 0.001$), SLOVAK ($t = 2.2$, $p = 0.03$), and POLISH ($t = 4.9$, $p < 0.001$) – exhibit an interaction between stress placement and verb contrastiveness: the conditions where the verb is stressed are more acceptable when the verb is contrastive (averaging over the two levels of the subject givenness factor). In Polish, in addition, we find a marginally significant interaction between stress placement and subject givenness ($t = 1.9$, $p = 0.06$): within the verb-contrastive conditions, subject givenness increases acceptability when the stress is placed on the verb.

In summary, sentence stress on the verb is more acceptable when there is additional information-structural motivation for its prosodic prominence in the verb itself (contrast), rather than merely motivation for not stressing the verb (givenness).

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Radek Šimik
radek.simik@hu-berlin.de

Marta Wierzba
wierzba@uni-potsdam.de