DEFINING CONSTRUCTION: INSIGHTS INTO THE EMERGENCE AND GENERATION OF LINGUISTIC REPRESENTATIONS

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DEFINING CONSTRUCTION: INSIGHTS INTO THE EMERGENCE AND GENERATION OF LINGUISTIC REPRESENTATIONS

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EDITORIAL
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Editorial: Defining Construction: Insights Into the Emergence and Generation of Linguistic Representations

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Editorial on the Research Topic

Defining Construction: Insights Into the Emergence and Generation of Linguistic Representations

INTRODUCTION

A universal goal and challenge in linguistic theorizing is to understand the abstract elements or representations that explain how human know and use language, and how those elements interact with one another. For the sake of exposition, we label such structures as CONSTRUCTIONS without making a commitment to any particular framework or set of assumptions. Some notion of construction seems to transcend across different frameworks (i.e., proof- vs. model-theoretic), across positions regarding the nature of human linguistic competence (i.e., nativist vs. emergentist) and also across different conceptions about performance biases and so-called third factor criteria (Chomsky, 2005).

The contributions to this Frontiers of Psychology Project, *Defining Construction: Insights Into the Emergence and Generation of Linguistic Representations*, address larger-scale questions concerning the emergence and classification of CONSTRUCTIONS both from specific theoretical points of view and in efforts to build on multiple perspectives toward new and useful synergies, raising new questions and pushing the traditional boundaries of research on linguistic structure. A particularly salient thread that finds its way into each of these contributions is the debate between the existence of language-particular constructions (Goldberg, 2006) and "universal" derivational procedures that act upon other axioms (i.e., features) of linguistic competence (Chomsky, 1977), and each of the contributions handles this thread in its own way.

SUMMARY OF CONTRIBUTIONS

In total, this Frontiers in Psychology Project contains nine contributions which address various aspects of current research on the notion of CONSTRUCTIONS.

Káldi et al. concentrate on focused elements in Hungarian in "*Hungarian structural focus: Accessibility to focused elements and their alternatives in working memory and delayed recognition memory*." Based on findings of enhanced activation of focused targets in working memory, but greater activation of alternatives after a short delay, they argue that preverbal focus temporarily

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enhances attention to the target, but that focused structures also broaden the scope of attention to alternatives.

Nicoladis and Sajeev investigate the role of surface-level and abstract representations in the developing grammar of bilingual children in "*Developing abstract representations of passives: Evidence from bilingual children's interpretation of passive constructions*." Their study confirms that the development of more abstract linguistic representations is closely tied with language usage.

Cannizzaro and Hendriks address the paramount question of whether production can in fact precede comprehension in L1 acquisition in "*Production before comprehension in the emergence and transitive constructions and Dutch child language*." Using the constraint-based paradigm of Optimality Theory, Cannizzaro and Hendriks model the conflict between constraints on word order and animacy that facilitate the successful acquisition of transitive structures.

Trotzke examines the domain-specific nature of cyclicity in Minimalism in, "*Constructions in Minimalism: A functional perspective on cyclicity*." Trotzke makes the case that "atomic" items in syntactic derivations can be of arbitrary length. As a result, the opposition between traditional "words" and larger units of constituency "phrases" is arbitrary. Focusing on examples of subextraction, Trotzke suggests the extant evidence supports that performance, rather than syntactic structure, is the primary culprit for ill-formedness.

Jackendoff and Audring present a novel approach to word structure in "*Relational Morphology: A cousin of Construction Grammar*." In Relational Morphology (RM), which they interpret as a framework closely related to Construction Grammar (CxG), the conceptualization of the traditional lexicon is extended and incorporated into the parallel architecture framework (Jackendoff, 1997). Here they demonstrate how their notion of *schema* enriches CxG's notion of *construction* in a number of important and conceptually-appealing ways.

Endresen and Janda provide a case study of grammatical constructions and how they function in a single language (Russian) in "*Taking Construction Grammar on step further: Families, clusters, and networks of evaluative constructions in Russian*." Endresen and Janda utilize the *Russian Constructicon*, a multi-word open-access resources shared between The Arctic University of Norway-UiT and the National Research University Higher School of Economics in Moscow.

In his article, "*What are constructions, and what else is out there? An associationist perspective*," Kapatsinski takes aim at evaluating the validity of bidirectional form-meaning associations in connection with language comprehension and production. Kapatsinski advances arguments in favor of bidirectional form-meaning associations from a Constructionist approach, showing that the complex interplay of both positive and negative form-meaning associations plus paradigmatic mappings provide nuanced insights into the properties of the *bez*-adjective construction in Russian.

Carlson et al. pose timely and important questions concerning the similarities and differences of how generative and usage-based approaches conceptualize the notion of "construction" in, "*How wide the divide? – Theorizing 'constructions' in generative and usage-based frameworks*." At the heart of this positional piece, Carlson et al. elucidate areas of commonality across these traditionally divergent approaches, while also pointing out key differences in the way both sets of scholars working within these frameworks interpret the ontology of "constructions."

Finally, the contributions to this project concludes with Michaelis and Hsiao's contribution entitled, "*Verbing and linguistic innovation*." In this study Michaelis and Hsiao home in on the process of *conversion*, according to which a lexical item's inflection and combinatory potential change while its internal composition does not. Michaelis and Hsiao take a closer look at denominal verbs in English, revisiting, and in some ways, reappraising the claims associated with Clark and Clark's (1979) seminal paper "When Nouns Surface as Verbs." These authors argue that "syntacticized" approaches to semantic representation fail to account for the full range of interpretable strategies used by English speakers in created denominal verbs, while at the same time pointing toward context-independent systematicity in this phenomenon.

The breadth of issues, perspectives, and questions that the articles contained in this collection address suggests an emerging, though complex picture, indicating that the problem is far from settled, but that the field will greatly benefit from a more intense cross-theoretical discussion. Findings showing that abstraction increases with usage (Nicoladis and Sajeev), production can precede comprehension in development (Cannizzaro and Hendriks), the explanatory power of negative associations within a construction-based view (Kapatsinski), context-dependent derivational processes (Michaelis and Hsiao), and the need for units of arbitrary size in syntactic derivations and the lexicon (Carlson et al.; Jackendoff and Audring; Trotzke) points toward an origin of abstraction in language-specific representations, often at a fairly large scale, with long-term (permanent?) traces on the associated grammars, i.e., constructions in something like the sense of Goldberg (2006). On the other hand, the role of context-independent processes (Michaelis and Hsiao), and systematicity in how abstraction develops (Cannizzaro and Hendriks) and is used (Carlson et al.; Endresen and Janda; Kaldi et al.; Trotzke), points toward cross-linguistic consistency the kinds of abstraction that operate to different degrees across development and maturity. In our opinion, this collection illustrates how all of this must be incorporated into our understanding of the nature and sources of abstraction in human language, pointing toward rich directions for research in the immediate future, which we hope this collection will encourage.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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PERSPECTIVE
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Constructions in Minimalism: A Functional Perspective on Cyclicity

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This article presents a perspective on syntactic cyclicity in minimalism that is compatible with fundamental ideas in construction–grammar approaches. In particular, I outline the minimalist approach to syntactic structure building and highlight that units of potentially any phrasal size can be atomic items in the syntactic derivation, showing that the opposition between simplex linguistic items ("words") and more complex ones ("phrases") in minimalism is in principle as artificial as in many construction–grammar approaches. Based on this perspective on structure building, I focus on the empirical domain of subextraction patterns out of complex subjects, adjuncts, and complements, and I demonstrate that the acceptability patterns in this domain can be explained by a functional approach to syntactic cyclicity: Unacceptable patterns are ruled out not for configurational (and hence syntactic) reasons, but rather they systematically follow from infelicitous interpretations at the syntax–discourse interface. This raises the question of whether syntactic cyclicity is (at least in part) motivated by performance (read: "language-in-use") constraints, which I consider another area for fruitful interaction between construction–grammar and usage-based accounts on the one hand and minimalism on the other hand.

Keywords: construction, cyclicity, derivation, discourse, minimalism, opacity, phases, syntax

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INTRODUCTION

Generative syntax and construction–grammar approaches share not only their history (Harris, 1993), but also many of their conceptual foundations (see, e.g., Goldberg, 2006, p. 4). I always viewed generative syntax and construction grammar as complementing each other. In this article, I show that "constructions" (read: "indivisible associations between form and meaning," Fried, 2015, p. 974) are already parts of basic structure building in minimalism. I will illustrate that the set of atomic or "indivisible" items in a derivation not only can consist of words and idiomatic expressions, but also potentially any phrasal unit can become such an atomic item. That is, the opposition between (non-complex, simplex) words and complex phrases is artificial in minimalist structure building too, just like in construction–grammar approaches. To be sure, complex items are generated in generative syntax, whereas they are partially or completely stored in construction grammars. However, "narrow syntax" in minimalism (i.e., the operation "Merge;" Trotzke and Zwart, 2014) in many cases deals with words and complex phrases alike (and relies on "labeling"/a "labeling algorithm" to do that; Chomsky, 2013; Rizzi, 2015). In other words, both words and phrases

can be treated as equally atomic for syntactic purposes after they have been merged (cf. also Chomsky's, 2005 No-Tampering Condition in this context), and I would like to point out in this contribution that this illustrates how the notion of *construction* could be incorporated in the minimalist framework.

The article is structured as follows. The section on *The Numeration and Derivation Layering* first introduces the account of syntactic structure building summarized in Trotzke and Zwart (2014). In the following section on "Syntactic Cyclicity and the Syntax–Discourse Interface," I focus on subextraction patterns because this empirical domain is one of the key phenomena where members of a separate derivational layer are invisible to syntactic operations in the next layer and can thus count as atomic/indivisible items. I provide a functional account for this chunking operation and argue that derivation layering in subextraction patterns is in many cases determined by discourse rather than by syntactic categories. The section *Conclusion and Outlook* concludes the article and suggests further conceptual overlaps with construction–grammar and usage-based accounts.

CONSTRUCTIONS IN MINIMALISM AND THEIR FUNCTIONAL MOTIVATION

While a lot of generative work has been published on how to best formulate the basic combinatorial operation Merge (see Fukui, 2011; Tanaka et al., 2019 for recent empirical work), there is less research on the question of where the elements to be merged actually come from (or, more accurately, the existing research on Merge and its domains has other ways to frame the question; see section "The Numeration and Derivation Layering"). Because clauses and complex phrases contain words, the simplest suggestion would be that the domain of Merge is the Lexicon. I will demonstrate that the domain of Merge must actually be a set of elements that is much more diverse than just a set of words: The set of elements can also contain phrasal *constructions* in the sense that these items might be internally complex, but are nevertheless dealt with as indivisible atomic items in the course of a derivation. In section "Syntactic Cyclicity and the Syntax–Discourse Interface," I ask whether "we" can identify a functional motivation of (at least some of) the cases where phrasal units are indivisible items in the derivation, and I will illustrate such a functional account for the empirical domain of subextraction patterns by showing that those patterns can be explained in pragmatic terms rather than in terms of syntactic categories.

The Numeration and Derivation Layering

In minimalism, the set of items syntactic derivations draw from is called "numeration" (Chomsky, 1993), to distinguish it from the simplistic concept of a lexicon. One obvious case showing that the domain of Merge can include not only words but also more complex items are idioms such as *kick the bucket*, which refers to an atomic concept (DIE), but nevertheless features regular verb-phrase syntax. There are many ways to deal with idioms in minimalism (see Nediger, 2017 for a recent overview). However, assuming the standard generative model of grammar, where syntax feeds two interface components dealing with sound and meaning, associating the phrase *kick the bucket* with the concept DIE cannot be derived from how the phrase is put together in the syntax. This already indicates that syntax might be connected to the interfaces not only at the end of a syntactic derivation, but also dynamically interacts with them throughout the whole derivation (see **Figure 1**, from Trotzke, 2015, p. 93). In what follows, I will use the term "derivation layering" for those interactions – a term that has been introduced by Zwart (2009, et seq.).

Crucially, a dynamic system where derivations can be layered and interact with each other via the interfaces is in accordance with minimalist approaches, which assume a cyclic organization of grammar (Nunes and Uriagereka, 2000; Stroik and Putnam, 2013; Trotzke and Zwart, 2014). In particular, in minimalism, "Merge always applies at the simplest possible form: at the root" (Chomsky, 1995, p. 248), and this "Extension Condition" determines that syntax often has to deal with more than one root syntactic object. Let us look at the following derivation of *The man left* (Trotzke and Zwart, 2014, p. 144–146), where we see that the Extension Condition prevents a derivation where *man* in (1d) first merges with *left* because in this case *the* would have to be merged with *man* in a non-cyclic manner, violating the Extension Condition. As a consequence, *the* has to be merged with *man* in a separate derivation layer to form the complex subject [*the man*] (1e)[1].

(1) a. N = {the$_1$, man$_1$, left$_1$}
b. N' = {the$_1$, man$_1$, left$_0$}
K = left
c. N" = {the$_1$, man$_0$, left$_0$}
K = left
L = man
d. N"' = {the$_0$, man$_0$, left$_0$}
K = left
L = man
M = the
e. K = left
N = [the man]
f. Verb phrase = [[the man] left]

[1]N is the "numeration" with which a derivation starts. The index number says how often an item occurs in the numeration; the number is zero once the item has been merged; K, L, and M refer to projected or unprojected lexical items (Chomsky, 1993). Note that postulating a numeration is not currently standard in all generative approaches. I will nevertheless use the notion of a numeration here in order to link the presentation to my previous work on this topic (cited above).

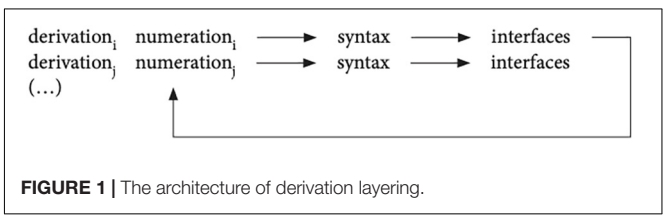

FIGURE 1 | The architecture of derivation layering.

Arguably, the layered derivation architecture shares basic assumptions with alternative frameworks where "combinatorial interface rules" can combine constituents of any size – "whether the constituent C is an utterance, a phrase, or a word" (Jackendoff and Wittenberg, 2014, p. 70); for more discussion, see Trotzke (2015, Chapter 5). In (1), this constituent is the complex subject [*the man*], and the crucial point is that it has to be merged into the derivation as an atom, just like single words (e.g., *left*) enter the derivation. As far as Merge is concerned, there is thus no categorial distinction between words and phrases because complex phrases can serve as atomic "syntactic objects" as well, once they have been derived separately and interpreted at the interfaces. The main idea in standard minimalist derivations like the one in (1) is that Merge is blind to the categorial status and the internal structure of the items it combines and that there is thus no opposition between simplex syntactic objects (also known as "words") and phrases in syntax proper. Given this perspective, *constructions* are an integral part of minimalist syntax too, as outputs of separate derivation layers – and I hasten to add that we find this core assumption in many more generative approaches, such as nanosyntax (Caha, 2009; Starke, 2010), distributed morphology (Harley and Noyer, 1999; Halle and Marantz, 2004), and related derivational approaches (Marantz, 1997).

The crucial question now is how this derivation layering is motivated on general grounds. Given minimalist methodology (Hornstein et al., 2005), we certainly do not want anything like an "intelligent" spell-out mechanism that would count as a separate module of the grammar. Rather, the numeration, as it is conceptualized in minimalism, is exhaustively determined before the derivation; i.e., it contains all the lexical items and even "subnumerations," determining opaque domains/"phases" (Chomsky, 2000). There are many questions as to how numerations are put together themselves (cf., e.g., Collins, 1997; Chomsky, 2000). However, this question need not concern us here: In what follows, I will point out how derivations (that only start out from numerations) create domains that are treated as opaque, and that these domains may not have to be defined by formal syntactic means, but follow from more functional (pragmatic and discourse-oriented) factors[2].

Syntactic Cyclicity and the Syntax–Discourse Interface

Let us now turn to the key phenomenon of subextraction patterns, which have also been investigated in construction–grammar frameworks (Goldberg, 2013). For reasons of space, I leave it to future research to explore whether the discourse-oriented approach presented here can be extended to related accounts (see Bianchi and Chesi, 2014; Szabolcsi and Lohndal, 2017; Kush et al., 2018, 2019).

The data in (3)–(5) have been used over and over in the generative literature to motivate a syntactic account of subextraction (e.g., Huang, 1982; Uriagereka, 1999). We see that subextraction out of subjects (3b) and adjuncts (4b) is illicit, whereas it is licit in complement cases (5b):

(3) a. [A picture of Mary] pleased John.
b. * Who$_i$ did [a picture of t$_i$] please John.
(4) a. Mary saw John [after meeting Eva].
b. * Who$_i$ did Mary see John [after meeting t$_i$].
(5) a. You saw [a picture of Mary].
b. Who$_i$ did you see [a picture of t$_i$].

However, many examples indicate that syntactic distinctions (like specifiers vs. complements) cannot be the whole story for explaining subextraction patterns at the clausal level. For instance, Stepanov (2007) has argued that subjects become opaque domains as a result of being moved. Accordingly, when subjects stay *in situ*, extraction out of subjects is allowed:

(6) Who$_i$ is there [a picture of t$_i$] on the wall?
(Stepanov, 2007, p. 92)

Also, we observe acceptable extractions out of adjuncts (7a) and unacceptable extractions out of complements (8):

(7) a. What$_i$ did John drive Mary crazy [whistling t$_i$]?
b.* What$_i$ did John work [whistling t$_i$]?
(Truswell, 2007, p. 16)
(8) * How$_i$ do you regret [that you behaved t$_i$]?
(Erteschik-Shir, 1997, p. 213)

Crucially, we cannot account for (6)–(8) by only referring to configurational criteria and the syntactic status of the extraction domain (i.e., complex left-branch elements such as subjects or adjuncts, or complex complements). Instead, I argue that the subextraction patterns are actually a consequence of discourse constraints.

Let us first turn to extraction out of subjects. I will illustrate my argument based on German data because German is rich in discourse-related syntactic operations (certain scrambling options) that can provide a more fine-grained view on explaining subextraction. The following data are experimentally confirmed by Jurka (2010, 2013): Extraction out of subjects that appear to the right of a German discourse particle such as *denn* (9a) is indeed more acceptable than out of subjects that appear to the left of such a particle (9b); *was-für* split is considered a reliable diagnostic for identifying extraction domains in German:

(9) a. ?? Was hat denn für eine Ameise den Beamten gebissen?
what has PART for an ant the clerk bitten
"What kind of ant bit the clerk?"
b. * Was hat für eine Ameise denn den Beamten gebissen?
what has for an ant PART the clerk bitten

Note that the different placement of the indefinite subject in (9a) vs. (9b) has a discourse effect: As soon as the indefinite

[2]Further research may show that (sub-)numerations are ultimately responsible for the specific structure so created, but this question is not addressed in this article.

subject appears to the left of the particle (9b), it receives a topical interpretation (Bayer and Obenauer, 2011; Bayer and Trotzke, 2015). My point is that the pattern in (9) could be taken to show that it is illicit to extract from a topical constituent. Witness also that Müller (2010) has shown that *was-für* splits out of external subjects improve when the object scrambles across the subject (10b). In this example, scrambling the object (*den Fritz*) results in a syntactic configuration that is preferred in cases where the subject (*was für Bücher*) is interpreted as focal; this is due to a complex interplay between syntax, prosody, and pragmatic interpretation (see Struckmeier, 2017 on this point):

(10) a. ?? Was haben denn für Bücher den Fritz beeindruckt?
what have PART for books the Fritz impressed
"What kind of books impressed Fritz?"
b. Was haben [den Fritz]$_i$ denn für Bücher t$_i$ beeindruckt? (Müller, 2010, p. 68)

Accordingly, one could also explain subextraction patterns out of subjects along the lines of recent construction–grammar approaches (Ambridge and Goldberg, 2008; Goldberg, 2013): in illicit subject extraction patterns such as the ones listed above, the speaker is treating an element as backgrounded and focal at the same time. This automatically follows if we assume that constituents conveying new information allow extraction the most easily, and elements occurring later in the string (usually the object) are canonically more likely to be interpreted as foci, whereas earlier constituents (usually the subject) are canonically interpreted as topics (see Goldberg, 2006, Ch. 7).

It is now easy to see that such a discourse-oriented approach in terms of backgrounded and focal information could also explain what we observe in the domain of extraction out of complements. Again, observe the following illicit subextraction patterns:

(11) a. You regret [that you behaved inappropriately].
b. *How$_i$ do you regret [that you behaved t$_i$]?

From a discourse-perspective, (11b) is odd because of the semantics of *regret* (and its factivity presupposition); there is a conflict at the syntax–discourse interface between treating an element as at once backgrounded and discourse-prominent. The manner component expressed by *inappropriately* and *how*, respectively, is part of the backgrounded information (the presupposition) and can thus not be highlighted as discourse-prominent in a *wh*-question like (11b). This illustrates that the conflict cannot be explained by syntactic notions such as specifier, adjunct, and complement, but rather the patterns seem to be the result of conflicts that are pragmatic in nature.

Last but not least, let us now see whether a discourse-based explanation can be used for explaining subextraction out of adjuncts as well. In the context of adjunct opacity such as (4) above, it has long been noted that not all adjuncts constitute syntactic islands (see Chomsky, 1982, p. 72):

(12) a. [The man]$_i$ that I went to England [without speaking to t$_i$].
b. * [The man]$_i$ that I went to England [after I spoke to t$_i$].

The facts we see in (12) can be explained by the distinction between untensed adjuncts and tensed adjuncts (Cinque, 1990). However, and interestingly, Truswell (2007, et seq.). reported the following patterns of extractability from untensed adjuncts ("Bare Present Participial Adjuncts"):

(13) a. * What$_i$ does John work [whistling t$_i$]?
b. What$_i$ did John drive Mary crazy [whistling t$_i$]? (Truswell, 2007, p. 16)

Because an explanation in terms of "tensed vs. untensed adjuncts" will not do the job for those differences, Truswell (2007, p. 150) formulated the "Single Event Condition," essentially stating that extracting out of an adjunct clause is possible when only a single event is asserted. Accordingly, in both (12b) and (13a), there is a clash at the syntax–discourse interface because the speaker places discourse prominence on a part of the utterance (referred to and highlighted by the pronoun *what*) that is not part of the "macroevent" [e.g., *working* in (13a)], but rather a component of a separate "microevent" (e.g., *whistling*). This microevent is certainly pragmatically backgrounded in the assertion of the macroevent, and so the same discourse conflict as in the cases of subextractions out of subjects and complements arises (see above).

To sum up, in the context of subject, adjunct, and complement opacity, the chunking of the derivation into opaque domains is determined by properties of the syntax–discourse interface: A single derivation layer cannot contain two syntactic objects whose interpretations clash at the syntax–discourse interface (pointing to something as discourse prominent and backgrounded at the same time). In contrast to common minimalist approaches to syntactic cyclicity (e.g., phase theory), I thus suggest that the opacity of a syntactic domain is not necessarily determined by that domain's *syntactic category*, but rather in many cases the result of the *discourse status* of that domain.

CONCLUSION AND OUTLOOK

The section on "Constructions in Minimalism and Their Functional Motivation" has indicated that the opposition between words and phrases in minimalism is artificial in the sense that elements of any size can serve as the building blocks of Merge. This is an assumption of current generative models of grammar. Crucially, this concept opens a path of defining *constructions* in minimalism: They are outputs of separate derivation layers.

Moreover, the perspective articulated here has suggested that certain domains of syntactic cyclicity should not be defined in syntactic terms (e.g., in terms of categorial status). Rather, I have illustrated that some (or perhaps many) of those domains can actually be characterized in functional terms such as their status in a discourse. In other words, the impact of how language is used in a context on syntax might not only be seen in marked word order, dislocations, etc. Rather, it also affects the cyclic organization of grammar itself and the domains Merge can operate on.

Last but not least, I would like to highlight in this context that not only "language-in-use" factors such as discourse and pragmatics seem to play a crucial role in minimalism, but also processing-based considerations. Specifically, minimalism often refers to derivations as "actual computations," and the notion of a "phase" basically (re)introduces the concept that derivations proceed in incremental chunks – and there are, in fact, some recent approaches trying to reconcile processing considerations with phase-based derivations (e.g., Chesi, 2015; Chesi and Canal, 2019). At a more conceptual level, Trotzke et al. (2013) have discussed cases where the nature of syntactic constraints suggests a direct link between grammar and performance systems (like memory constraints). Without having to claim that all of grammar is "usage-based," minimalists could therefore take seriously the role of the "performance interface," which might dovetail nicely with minimalist third-factor explanations.

DATA AVAILABILITY STATEMENT

All datasets presented in this study are included in the article/supplementary material.

AUTHOR CONTRIBUTIONS

AT confirms being the sole contributor of this article, and he has approved it for publication.

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Relational Morphology: A Cousin of Construction Grammar

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Relational morphology (RM) is a novel approach to word structure that bears a close relation to construction grammar (CxG). Based on the parallel architecture framework, its basic question is: what linguistic entities are stored in long-term memory, and in what form? Like CxG, RM situates the "rules of grammar" in an extended lexicon, right along with words, multiword expressions such as idioms and collocations, and meaningful syntactic constructions. However, its notion of *schema* enriches CxG's notion of *construction* in a number of respects, including (a) the possibility of purely formal schemas that lack meaning, (b) a more precise way of specifying relations among lexical items than standard inheritance, (c) the possibility of "horizontal" relations between individual words and between schemas, (d) a clearer characterization of the distinction between productive and nonproductive phenomena, and (e) more explicit integration with theories of language processing and of other domains of cognition.

Keywords: relational morphology, construction grammar, parallel architecture, lexicon, language processing, schema, interface, words and rules

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INTRODUCTION

Over the past decade, we have been developing an approach to linguistic structure called *relational morphology* (RM; Jackendoff and Audring, 2020). Its goal is a graceful integration of morphology with the rest of language and with the rest of the mind. RM is conceived of as a component and an enrichment of the *parallel architecture* (PA; Jackendoff, 1997, 2002, 2011); other major components are *conceptual semantics* (Jackendoff, 1983, 1990, 2007a) and *simpler syntax* (Culicover and Jackendoff, 2005). The present article is drawn primarily from Jackendoff and Audring (2020).

Relational morphology takes very seriously the term "knowledge of language," focusing on the question of what a speaker stores in long-term memory and, crucially, in what form. The outcome is a conception of language quite different from mainstream generative grammar, including the minimalist program (Chomsky, 1965, 1981, 1995; Berwick and Chomsky, 2016; for comparison, see works cited above). RM might be considered a close cousin of construction grammar (CxG; Goldberg, 1995, 2006, 2019; Croft, 2001; Hoffmann and Trousdale, 2013) and construction morphology (CxM; Booij, 2010, 2018). In some respects, it is related to HPSG

(Pollard and Sag, 1994) as well. Anticipating the discussion to follow, the areas of consilience (and of contrast with generative approaches) include the following:

- "Rules of grammar" are stated as declarative *schemas* (a.k.a. *constructions*) rather than as procedural rules.
- "Rules of grammar" are in the same basic format as words: structured relations of form and meaning. Hence there is no distinction between the "lexicon" and the "grammar"; both words and rules are treated as items in an "extended lexicon" or "constructicon."
- The basic combinatorial operation is Unification.
- Relations among lexical items are stated in terms of inheritance.
- Language acquisition is item-based.

On the other hand, there are some important differences between PA/RM and CxG. First, most varieties of CxG define a construction as an association between a form (syntax and phonology) and a function (semantics), i.e., a Saussurian sign. The PA, like CxG and unlike traditional generative grammar (including the minimalist program), argues that the grammar must include constructions that specifically link syntactic form to meaning, such as the *way*-construction (e.g., *Harry hiccupped his miserable way down the hall*). But it also admits the possibility of schemas/constructions that do not involve semantics, for instance phrase structure rules, phonotactics, meaningless morphological elements such as linking elements in compounds, and grammatical "glue" such as *do*-support and the *of* in *picture of Bill*. RM further extends the use of schemas to phenomena where meaning plays no role, such as the relation of phonology to orthography and the relation of poetic texts to a metrical grid (Jackendoff and Audring, 2020, ch. 8). Hence the PA views constructions that relate form and function as only a subset of a speaker's full knowledge of language.

A second difference between PA/RM and standard CxG concerns the repertoire of relations among lexical items. As mentioned above, the principal type of lexical relation in CxG (and HPSG) is *inheritance*, a relation between a word or construction and another, more abstract construction, such that the latter partially motivates the structure of the former. PA/RM admits such relations, but in addition it countenances direct "horizontal" or *sister* relations among words or among schemas, for which in many cases it is unattractive to posit an abstract "mother" that captures what they have in common. We illustrate below.

A third difference between the frameworks is in the formalism. We adopt the PA/RM formalism over the attribute-value matrices of HPSG and formal CxG, partly because it is easier to read, but also, more importantly, because it stresses the distinction between phonology, syntax, morphosyntax, and semantics. It also provides a way to exactly pinpoint what related items have in common, as well as a way to distinguish productive from nonproductive patterns. Again, these points will emerge from the discussion below.

A final, more philosophical point of divergence is that PA allows for the possibility of domain-specific principles of language, while CxG tends to view language entirely as a byproduct of more domain-general cognitive processes. PA is of course committed to minimizing the domain-specific aspects of language, but it does not assume them to be zero.

We believe that these points of difference can easily be grafted onto more standard versions of CxG, as what RJ's colleague Dan Dennett calls "friendly amendments." We are not going to specifically argue for these points. Rather, we wish to offer a general feel for the PA/RM framework, while pointing out the similarities to CxG – and the differences – as we go along.

Section "Parallel Architecture Basics" lays out the basic constructs of PA/RM, sections "Words and Rules in the Lexicon" and "'Bound Roots,' Sisters and Sister Schemas" lay out the RM approach to a number of morphological phenomena, in particular the use of schemas both to generate novel forms and to establish explicit relations among items stored in the lexicon. Section "Sister Schemas in Phrasal Syntax" sketches extensions of the latter function to syntactic phenomena. Section "Lexical Access in the Extended Lexicon" shows how the constructs of RM can be incorporated directly into a theory of language processing. Finally, section "Beyond Language" suggests that these constructs are useful in thinking about memory in other cognitive domains such as music and the conceptualization of physical objects.

PARALLEL ARCHITECTURE BASICS

The most basic premise of the PA is that linguistic structure is not determined entirely by syntax, as it always has been in standard generative grammar. Nor is it determined entirely by meaning, as some practitioners of cognitive grammar advocate. Rather, linguistic structure is determined by independent systems for phonology, syntax, and semantics, plus the linkages (or *interfaces*) between them, as in **Figure 1**. The double-headed arrows in **Figure 1** are meant to represent *correspondences* between components rather than *derivations* from one component to another.

A well-formed sentence has well-formed structures in each domain, plus well-formed links among the structures.

Following the lead of CxM, RM treats morphology as the grammar of words (Booij, 2012). Like phrasal grammar, morphology involves phonology, syntax, and semantics, but *inside* of words. Thus the picture in **Figure 1** can be elaborated along the lines of **Figure 2**.

In the RM architecture, then, morphology encompasses the structure of morphosyntax, plus its interfaces to phrasal syntax and to the phonology and semantics of words. (Antecedents for

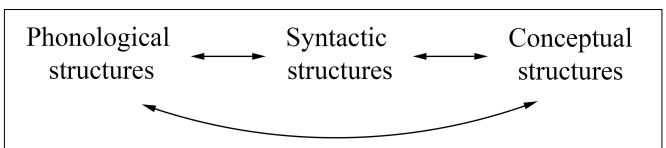

FIGURE 1 | The parallel architecture.

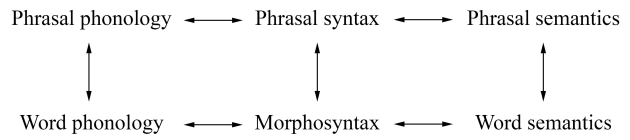

FIGURE 2 | The parallel architecture, incorporating relational morphology.

this view include Bach, 1983; Ackema and Neeleman, 2004; Van der Hulst, 2006.)

On this view, there is a degree of continuity between morphosyntax and phrasal syntax. For instance, both involve X^0 syntactic categories and headed hierarchical structure, and both deal with inflectional categories such as number and case, though in different ways. On the other hand, there are differences as well: only phrasal syntax has XPs and long-distance dependencies; while (arguably) only morphosyntax has affixes and such phenomena as noun incorporation and templatic inflection. In other words, morphosyntax does not reduce to a form of phrasal syntax, as it does in, say, distributed morphology (Embick and Noyer, 2007; Siddiqi, 2019). But it is also not entirely distinct from syntax, as it is in, say, paradigm function morphology (Stump, 2019).

An important corollary to this conception of grammatical architecture is that it extends naturally to the relation between language and other cognitive domains. For instance, in order to talk about what we see, there has to be an informational conduit between high-level visual representations and linguistic semantics. It cannot be modeled in terms of a derivation from syntax to vision or vice versa, but it can be readily envisioned as a set of correspondences linking visual representations and linguistic structures.

Where is the lexicon in this architecture? For the simplest sort of example, a word such as *cat* consists of a piece of semantic structure (the meaning of the word), a piece of phonological structure (/kæt/), and the syntactic category Noun. The bundling of these components into a lexical unit is conventionally notated by enclosing them in large square brackets. We instead notate their relation by co-subscripting, as in (1). The subscripts can be thought of as marking the ends of association lines between the components; in other words, they denote what we will call *interface links*. (Jackendoff, 1997, 2002 calls them *correspondence rules*.)

(1) Semantics: $[\text{CAT}_1]$
Syntax: N_1
Phonology: $/\text{kæt}_1/$

A word, then, consists of a collection of representations, linked across the three levels. Hence the lexicon, where stored words live, cuts across multiple components of the architecture in **Figure 2** – including the links *between* components.

This conception of words has an immediate interpretation in terms of language processing. In comprehension, upon hearing /kæt/, the existence of (1) allows the hearer to posit a noun and the meaning CAT in the linked syntactic and semantic structures under construction. In production, (1) allows the speaker to express the intended message CAT as a noun pronounced /kæt/. There is nothing very unusual here, except that the distinctions among levels and the links among them are foregrounded. We return to processing below.

WORDS AND RULES IN THE LEXICON

An important respect in which constraint-based theories such as CxG, CxM, HPSG, and the PA differ from traditional generative linguistics is the status of rules of grammar. For instance, consider the regular plural in English. In a traditional generative grammar, the formation of plurals is governed by a *rule* roughly of the form "To form the plural of a noun, add *-s*." The counterpart in the PA is a *schema* of the form (2); CxG and CxM would think of it as one way of formalizing the "English plural noun construction."

(2) Semantics: $[\text{PLUR}\ (\text{X}_x)]_y$
Morphosyntax: $[\text{N}_x\ \text{PLUR}_2]_y$
Phonology: $/\ldots_x\ \text{s}_2/_y$

Like the word in (1), schema (2) consists of a piece of semantics, a piece of morphosyntax, and a piece of phonology; the three are linked by subscripts. (2) differs from (1) in that parts of its structure are variables: it says that a multiplicity (PLUR) of any sort of entity (X) can be expressed by a noun (N) plus a plural affix (PLUR); in phonology, the combination is pronounced however that noun is pronounced, followed by the phoneme /s/. Given this schema, the plural form *cats* can be produced by instantiating the variables in (2) with the corresponding pieces of (1), resulting in the structure (3). (2) can be similarly instantiated with newly encountered nouns, to spontaneously produce novel expressions such as *wugs* and *coelacanths*.

(3) Semantics: $[\text{PLUR}\ (\text{CAT}_1)]_3$
Morphosyntax: $[\text{N}_1\ \text{PLUR}_2]_3$
Phonology: $/\text{kæt}_1\ \text{s}_2/_3$

The parallel architecture, like CxG and CxM, proposes that all rules of grammar are to be stated in schema (i.e., constructional) form: they are in essentially the same format as words, except that some of their structure is made up of variables. Blurring the distinction further, a verb's subcategorization feature amounts to a syntactic variable that must be instantiated; and a selectional restriction similarly amounts to a semantic variable.

This approach to rules of grammar extends even to syntactic phrase structure rules, such as that for the English transitive verb phrase, approximated in (4). This is a piece of linguistic structure that involves only one level of structure and that consists *entirely* of variables. One can think of it as a "treelet" in the sense of Fodor (1998) and Tree-Adjoining Grammar (Joshi, 1987).

(4) Syntax: $[_{\text{VP}}\ \text{V NP} \ldots]$

Lacking intrisic meaning, a schema like (4) is not generally countenanced in CxG, but CxG can easily assimilate it by relaxing the stricture that every construction is a form-function pair. This

seems correct. The fact that English canonically has SVO order while Turkish has SOV order does not reflect any difference in meaning between the two languages. It is a purely syntactic fact.

In essence, then, there need be no further distinction between lexical structure and rules of grammar: they belong together in a single system that might be called the "extended lexicon"; CxG sometimes uses the term "constructicon" in the same sense (Hoffmann and Trousdale, 2013). Schemas fulfill the traditional function of rules – creating an unlimited number of novel structures – through the operation of *unification* (Shieber, 1986). Unification instantiates a schema's variables with further phonological, syntactic, and/or semantic material, as seen in the structure of *cats* above. Hence, the composition of a word or sentence involves clipping together stored pieces in such a way that every element of the composed structure is accounted for in terms of one stored piece or another. A schema that permits the productive instantiation of its variable(s) serves what we call a *generative function*.

However, unlike traditional rules, schemas have a second function, which we will call the *relational function*. This function is often implicitly invoked for CxG's constructions, though it is not usually recognized as distinct from the generative function. In order to explain the relational function, we first have to supplement interface links with a second sort of links: *relational links*.

Toward that end, consider a pair of words like *hate* and *hatred*. The string *-red* looks like a deverbal suffix tacked onto *hate*. However, *hatred* is the only word with this suffix. Other such cases of words with unique affixes include *bombard*, *comparison*, *knowledge*, and *laughter*. (They are admittedly rare.) It would be peculiar to posit a traditional word formation rule along the lines of "to form a noun based on *hate*, add *-red*." A rule that applies only to a single item is no rule at all. However, the relation between *hate* and *hatred* can be captured in the RM notation, as shown in (5) (semantics approximate).

(5) Semantics: a. $[\text{HATE}_4]$ b. $[\text{EMOTION-OF } ([\text{HATE}_4])]_5$
Morphosyntax: V_4 $[_N\ V_4\ \text{aff}_6]_5$
Phonology: /hejt$_4$/ /hejt$_4$ rəd$_6$/$_5$

Subscript 4 links the three levels of *hate*, and similarly, subscript 5 links the three levels of *hatred*. But subscript 4 also links *hate* to the base of *hatred*, marking the two as the same. This connection is what we call a *relational link*. This link is not used to derive *hatred*; rather, it simply marks what the two lexical items share. The link thereby "supports" or "motivates" *hatred*: it makes it less arbitrary than a word such as *ibex* that lacks internal structure. *Hatred* is easier to learn, then, because it has a previously known part; and it is easier to process, because of the extra activation that comes from *hate*.

We note that CxG typically does not concern itself with relations between words like *hate* and *hatred*. The focus tends to be inheritance relations between either words or constructions and more abstract constructions. Nevertheless, it would not be difficult to add word-to-word relations to the CxG lexicon. We elaborate this point below.

We now return to the functions of schemas. They too can take part in relational links. Consider the idiomatic expressions in (6), which all contain the plural *-s* suffix.

(6) raining cats and dogs, odds and ends, best regards, make amends, . . .

The meanings of these expressions cannot be built up from the meanings of their parts, so the expressions must be learned and stored. But that does not entail that they are stored as holistic unstructured units. In particular, the plural nouns are still standard plural nouns, even though they are not spontaneously generated. RM captures this generalization by establishing relational links between the plural schema (2) and these idiomatic stored plurals. In this case, the connection is not between shared subscripts, but rather between variable subscripts in the schema and constant subscripts in its instances. Again, the intuition is that the relational link to the schema makes these idioms easier to learn and process.

There is an important consequence: a schema can be used not only in a generative function, to create novel structures, but also to motivate items that are stored – its *relational function*. The novel plural in *wugs* and the stored plurals in *raining cats and dogs* invoke the very same plural schema (2), just used differently: generatively in the former case and relationally in the latter. A similar situation arises with the transitive VP schema (4): it is used generatively in novel VPs such as *throw the pail*, but also relationally, in VP idioms such as *chew the fat*. This twofold use of schemas contrasts with the rules of traditional rule-based approaches, which play only a generative role. Idiomatic uses of productive patterns, if addressed at all, are often dismissed as unsystematic exceptions (see Jackendoff and Audring, 2020, section 2.1 for examples).

We next observe that not all schemas have these two uses. Many of them can perform only the relational function. An example is the family of deadjectival verbs such as *darken*, *widen*, *harden*, *tighten*, and *sharpen*. There is clearly a pattern: an adjective serves as base; it is followed by the affix *-en*; and the composite is a verb that means "(cause to) become A." This family is supported by schema (7).

(7) Semantics: $[<\text{CAUSE}>\ \text{BECOME}\ (Z_z)]_w$
Morphosyntax: $[_V\ A_z\ \text{aff}_7]_w$
Phonology: /. . .$_z$ ən$_7$/$_w$

Unlike the plural schema, (7) is at best uncomfortable with the generative function. English speakers do not produce or accept novel applications of (7) such as **louden* ("make/get louder"), **crispen*, or **colden*, as the generative function would predict. Apparently, (7) can be used only to motivate items that are stored, i.e., it has only the relational role. Such patterns are the norm in English derivational morphology, rather than the exception.

Nonproductive patterns occur in syntax as well, though not as pervasively as in morphology. (8) Illustrates two of them; more such "syntactic nuts" appear in Culicover (1999).

(8) a. N-P-N: day *after* day, week *by* week, face *to* face.
BUT *gun *beside* gun, *doll *in(side)*
doll [as in Russian dolls].

b. [$_{Det}$ X a]: *what* a job, *such* a job, *many* a job.
BUT **who* a professor, **few* a job.

In the N-P-N construction, the choice of possible prepositions is fixed and must be learned; in the determiner construction, the set of possible "predeterminers" is similarly idiosyncratic. Yet there is a clear pattern, captured by a schema that can only be used relationally.

To sum up, the extended lexicon is a single system that stores not only words, but also grammatical schemas. Like CxG and HPSG, it also stores idioms and common collocations such as *red as a beet* and "prefabs" such as *I think so* (Wray, 2002; Jackendoff, 1997). Under this conception, the traditional role of rules of grammar is taken over by schemas, employed in their generative function. In turn, schemas are stated in the same terms as words, namely as pieces of linguistic structure – semantics, (morpho)syntax, and phonology – connected by interface links where appropriate. They differ from words in that they have variables that must be instantiated in constructing an utterance.

Relations among stored words are expressed by relational links, which mark parts of related items as the same. Relational links also connect schemas to their stored instances. In this role, they do the work traditionally ascribed to nonproductive lexical redundancy rules. Furthermore, many schemas have *only* the relational function.

Reframing these conclusions, it becomes evident that *all* schemas can function relationally, while only *some* schemas can function generatively. One can think of the latter, then, as schemas that have so to speak "gone viral."

The formal distinction between productive and nonproductive schemas is marked on the schemas' variables: a "closed" (i.e., nonproductive) variable requires its instances to be listed in the lexicon, while an "open" (productive) variable can be freely applied to produce novel instances. There may be a cline between fully closed and fully open variables, with intermediate cases that allow new instances under special conditions (e.g., *Trumpification*). (It is unclear to us exactly what factors lead a language learner to determine whether a schema is productive or not; for discussion, see Jackendoff and Audring, 2020, pp. 45–50, 228–231.)

This treatment of the distinction between productive and nonproductive schemas has major consequences for linguistic theory. First, it eliminates the distinction between "grammatical rules" and "lexical rules" as separate components of grammar; the difference is reduced to a featural distinction within schemas. A larger moral is that the focus of linguistic theory ought to expand beyond the subset of generative patterns to encompass all patterns, productive or not. Again, it is not hard to envision an enrichment of standard CxG that incorporates these innovations.

"BOUND ROOTS," SISTERS AND SISTER SCHEMAS

With this sketch of PA/RM in hand, we next illustrate some of the descriptive power of the RM formalism. This will put us in a position to think about some broader questions in the next sections, as well as some challenges for standard CxG.

A first case is words that have a well-established suffix attached to a base that is not a word on its own. These are sometimes called "bound roots." They are often noticed in the literature, only to be quickly set aside as a minor glitch in the system. But in fact English has hundreds of them, for instance those in (9), so the theory disregards them at its peril.

(9) a. Gorgeous, impetuous, arduous, meretricious, salacious, . . .
b. Accumulate, abrogate, assimilate, speculate, obfuscate, . . .
c. Commotion, contraption, ovation, trepidation, constellation.

Here is the structure of *gorgeous*.

(10) Semantics: $BEAUTIFUL_8$
Morphosyntax: $[_A - aff_9]_8$
Phonology: /gɔrdʒ əs$_9$/$_8$

The affix *-ous* in phonology is marked in morphosyntax as an affix (coindex 9). But morphosyntax has nothing that can link to the *gorge* part, since *gorge* (in the relevant sense) is not a word on its own and hence has no syntactic category. We notate this absence of morphosyntax with a dash. Furthermore, the meaning of *gorgeous* cannot be divided into the meaning of the base plus the meaning of the affix, so semantics doesn't have any internal links either. Hence the internal linkages are confined just to the structure of the affix. We think this is exactly what one would want to say about the structure of this word. To use Anderson's (1992) term, *gorgeous* is partly a-morphous: *-ous* is a morpheme but *gorge-* is not.

Next we need to say that there are a lot of these *-ous* words with bound roots. This can be expressed with a schema along the lines of (11).

(11) Semantics: $PROPERTY_w$
Morphosyntax: $[_A - aff_9]_w$
Phonology: /. . . əs$_9$/$_w$

The semantics of (11) says that an *-ous* word denotes a property, which is essentially the basic meaning of any adjective. Morphosyntactically and phonologically, the whole word is an adjective that ends in an affix, pronounced /əs/ (coindex 9). And that's all: (11) says nothing about the form, the syntactic category, or the meaning of the base.

For the next case, consider the relation between *assassin* and *assassinate*. From a morphological perspective, *assassin* is contained in *assassinate*, just as *hard* is contained in *harden*. But from a semantic perspective, an *assassin* is someone who assassinates people, so the meaning of *assassinate* is contained in that of *assassin*. This presents a paradox to traditional word-formation rules, since the "direction of derivation" is mixed: neither can serve as the base for the other. It also presents a difficulty for the traditional view of inheritance as an asymmetrical relation, "X inherits structure from Y." In the case of *assassin* and *assassinate*, each word has to inherit part of its structure from the other.

The RM notation overcomes this problem by formulating their relation as (12). (The semantics is very approximate.)

(12) a. *assassin:*
Semantics: [PERSON WHO [MURDERS POLITICIAN]$_{11}$]$_{10}$
Morphosyntax: N_{10}
Phonology: /əsæsən/$_{10}$

b. *assassinate:*
Semantics: [MURDER POLITICIAN]$_{11}$
Morphosyntax: [$_V$ N_{10} aff$_{12}$]$_5$
Phonology: /əsæsən$_{10}$ ejt$_{12}$/$_{11}$

Here, both words contain the phonological base *assassin*, coindexed 10; this is the whole of *assassin* and part of *assassinate*. Similarly, both words contain the semantics "murder a politician," coindexed 11; this piece of semantics forms part of *assassin* and the whole of *assassinate*. Thus the notation captures exactly what one would want to say about this pair. We'll use the term *sisters* for such pairs of words, in which neither can be derived from the other, and there is no overarching "mother" that they can both inherit from. Other examples of this sort are *critic* ∼ *criticism* and *linguist* ∼ *linguistics*.

Another sort of sister relation appears in (13): *ambition* and *ambitious* share a nonlexical base but have different affixes. Other such pairs include *contagion* ∼ *contagious* and *cognition* ∼ *cognitive*.

(13) a. *ambition*
Semantics: DESIRE$_{13}$
Morphosyntax: [$_N$ – aff$_{15}$]$_{13}$
Phonology: /æmbɪ$_{14}$ ʃən$_{15}$/$_{13}$

b. *ambitious*
Semantics: [HAVING (DESIRE$_{13}$)]$_{15}$
Morphosyntax: [$_A$ – aff$_9$]$_{15}$
Phonology: /æmbɪ$_{14}$ ʃəs$_9$/$_{15}$

As with *gorgeous*, the morphosyntax of the base has no syntactic category and is not linked to anything. However, the two words share the phonology of the base (coindex 14); and the meaning of *ambition* is contained in the meaning of *ambitious* (coindex 13). Finally, each of the words has its own affix (coindices 15 and 9, respectively).

A traditional treatment of these words in terms of word formation rules would have to capture the relation between them by positing an abstract form *ambi(t)* from which the two words would be derived. This form would somehow have to stipulate that it can be pronounced only if attached to either *-tion* or *-ous*, a highly artificial solution. Alternatively, it might be proposed that *ambitious* is derived from *ambition* by deleting *-tion* to form *ambit-* and then appending *–ous* – an equally ugly solution. An account in terms of inheritance would similarly require an abstract construction that contributed */æmbi(t)/* and DESIRE but left the affix open, yet again not an optimal solution. In contrast, the sister relation in the RM formalism again says exactly what needs to be said.

(12) and (13) illustrate sister relations between *words*. The story gets more interesting when we consider what Booij (2010) and Booij and Masini (2015) call *second-order schemas* and what we call *sister schemas*: pairs of systematically related patterns, as in (14). Each individual pair is connected by a shared base. Some of the shared bases are independent words (14a), and some are not (14b). (To be sure, some of the relations in (14b) are historically derived from Latin or Italian roots. However, we are modeling the synchronic knowledge of an ordinary speaker who has no awareness of their etymology.)

(14) a. Marxism Marxist
impressionism impressionist
behaviorism behaviorist
b. pacifism pacifist
altruism altruist
solipsism solipsist

As with *ambition/ambitious*, the relation is bidirectional. The left-hand member of each pattern contains the suffix *-ism* and denotes an ideology or world view, while the right-hand member contains the suffix *-ist* and denotes an adherent of that very ideology or world view. The *-ism* member of the pair can be considered "primary" in the sense that its meaning is contained in that of the corresponding *-ist* word. But *deriving* the *-ist* word from the *-ism* word faces the same difficulties as deriving *ambitious* from *ambition* or vice versa.

This interweaving of patterns is formulated as the sister schemas in (15).

(15) Semantics: a. IDEOLOGY$_{\alpha,x}$ b. [ADHERENT (IDEOLOGY$_\alpha$)]$_y$
Morphosyntax: [$_N$ <N$_\beta$> aff$_{16}$]$_x$ [$_N$ <N$_\beta$> aff$_{17}$]$_y$
Phonology: /. . .$_\beta$ ɪzəm$_{16}$/$_x$ /. . .$_\beta$ . . .ɪst$_{17}$/$_y$

(15a) is the schema for the left-hand words in (14); variable subscript *x* links the semantics, morphosyntax, and phonology, as usual. The morphosyntax and phonology of the suffix *-ism* are linked by coindex 16. Similarly, (15b) is the schema for the right-hand words, with variable subscript *y* tying the three levels together; and the suffix *-ist* is tied together by coindex 17. The optional N in morphosyntax is present for the cases like (14a) with a lexical base; if it is absent, we get the cases with a nonlexical base such as (14b).

So far, then, we have two independent schemas, (15a) for the *-ism* words and (15b) for the *-ist* words. However, there is more to say, namely that the two schemas are related to each other as sisters. This relation is notated by the Greek letter coindices α and β, which denote variables that are shared between the two schemas. They say that if there is a word that denotes an ideology and ends in *-ism*, there is likely to be a word that has the same phonological base (coindex β), denotes an adherent of that same ideology (coindex α), and ends in *-ist*. In other words, Greek letter coindices denote a third sort of relational link, in addition to links between words and links between a schema and its instances. (Note that *-ist* words that do not denote ideologies

do not participate in this alternation. For instance, the fact that there is a word *trombonist*, denoting a person who plays the trombone, does not motivate a possible word **trombonism*.).

Sister schemas prove to be ubiquitous in such morphological phenomena as paradigmatic relations, inflectional categories, stem allomorphy, reduplication, and systematic truncation (Jackendoff and Audring, 2020, chapters 4–6). Moreover, it is significant that the treatment of sister schemas is a simple formal extension of sister *words*. This constitutes another reason for eliminating the distinction between the lexicon and the grammar, treating both as denizens of the extended lexicon, with similar formal properties. And again, the notion of sister schemas is available neither to traditional word-formation rules nor to standard notions of inheritance.

SISTER SCHEMAS IN PHRASAL SYNTAX

Thinking more broadly, we might ask whether phrasal syntax also makes use of sister schemas. The appropriate configuration would be two constructions (a) which share significant structure, but (b) neither of which can be derived from the other, and (c) for which it is implausible to posit a common "mother" construction from which both can be derived (or, in CxG terms, from which both can inherit). Such configurations have been introduced tentatively in CxG (Cappelle, 2006; Van de Velde, 2014; Zehentner and Traugott, 2019). In fact, they were recognized by Harris (1957), whose notion of transformation amounted to a systematic correspondence between two patterns – quite different from the transformations in his student Chomsky's (1957) *Syntactic Structures*.

One example of this sort of relationship is the English particle alternation: *look up the answer* vs. *look the answer up*. Cappelle (2006), in a CxG framework, treats these as "allostructions" of a more abstract common mother. In the RM formalism, the common mother is unnecessary. Rather, the two alternatives are treated as sister schemas, as in (16). (See Audring, 2019 for a fuller discussion of when sisters suffice and when a "mother" is needed.)

(16) a. Semantics: $X_{x,\delta}$
Syntax: $[_{VP}\ V_\alpha\ Prt_\beta\ NP_\gamma\ ]_x$
b. Semantics: $X_{y,\delta}$
Syntax: $[_{VP}\ V_\alpha\ NP_\gamma\ Prt_\beta\ ]_y$

These schemas share their meaning (linked variable δ), their verb (linked variable α), their particle (β) and their object (γ); they differ only in the linear order of the latter two. Through the linking of the variables, the schemas in effect say that if a verb and particle appear in one of these patterns, they can be predicted to appear in the other.

Another candidate for sister schemas, also involving particle verbs, is their relation to their nominalizations, as in (17) (see Booij and Masini, 2015 for parallels in Dutch).

(17) X blows up — blowup
X picks Y up — pickup
X throws Y away — throw-away
X knocks Y out — knockout

The nominals have the usual semantics for nominals: either the process involved in the event denoted by the verb (e.g., *blowup* denotes the process or action of blowing up) or the Patient of the event denoted by the verb (e.g., *throw-away* denotes something that is thrown away). However, as shown by Chomsky (1970), it is impossible in general to derive the nominals from the verbs; and it is not clear how one would formulate a more abstract form or construction from which both forms could inherit. (18) shows how the syntactic part of the relation can be formulated in terms of sister schemas.

(18) a. Syntax: $[_{VP}\ V_\alpha\ Prt_\beta\ \langle NP \rangle\ ]$
b. Morphosyntax: $[_{N}\ V_\alpha\ Prt_\beta\ ]$

Here the verb and particle are shared (coindices α and β). But in (18a) they are combined into a VP with a possible direct object, while in (18b) they are combined into a noun. In other words, the sister relationship here is between a phrasal schema and a morphological schema.

Jackendoff and Audring (2020) analyze numerous syntactic, morphological, and phonological phenomena in terms of sister schemas. Accordingly, we find it plausible that all alternations that have been formulated in terms of derivations can instead be treated in terms of sister schemas – in other words, Harris was right! Exploring this possibility is a major undertaking for future research.

LEXICAL ACCESS IN THE EXTENDED LEXICON

One desideratum for the PA and RM is that they should make contact with issues in language processing. To that end, we sketch how the PA/RM theory of linguistic representations can be embedded in a theory of language processing. The overall burden of the argument is that constructs that are familiar from standard accounts of processing can be interpreted readily in the terms of the representational theory. Hence PA/RM allows for a graceful connection between competence and performance. (For more detail, see Jackendoff, 2002, 2007b; Jackendoff and Audring, 2020; Huettig, Audring, and Jackendoff, Prediction as pre-activation: a linguistically and psychologically plausible theory of language processing, in preparation.)

To recapitulate, a fundamental point of PA/RM is that schemas are stored in the extended lexicon, right alongside of words. Both consist of pieces of linguistic structure – stored declarative knowledge – and both involve interface links that connect their levels, as well as relational links to other lexical items. The consequence for processing is that all principles of lexical activation and lexical access apply to schemas in the same way as they apply to words. This is not possible in traditional accounts, in which the lexicon and the grammar are quite distinct. For instance, while the character of lexical access is taken to be a central concern, the literature does not typically recognize the parallel issue of "rule access," i.e., choosing what rule to apply in a derivation. Rather, standard accounts are stated in terms of choosing among *structures* – the *outputs* of rule application, such as high vs. low PP attachment in *the woman saw the man with a*

telescope. This is quite a different process from accessing words. By contrast, in the PA/RM framework, constructing or parsing a sentence involves activating and selecting pieces of structure such as the transitive verb phrase schema – through the very same process that activates and selects words. Thus choosing among structures is altogether natural.

A second basic point is that the brain does not explicitly keep track of the frequency of lexical items. Rather, in concurrence with much of the psycholinguistic and neuroscience literature (e.g., Collins and Loftus, 1975; Bybee, 1995; Baayen et al., 1997; Pinker, 1999), we take frequency in a corpus as a proxy for "resting activation." Any use of a word augments its resting activation, such that it responds more quickly and/or more robustly to further activation (e.g., McClelland and Elman, 1986; Norris et al., 2000), such that it can (somewhat stochastically) outcompete other items for "what is being heard" (e.g., Marslen-Wilson, 1987; O'Donnell, 2015).

Putting these two points together, it follows that more frequent *schemas* (e.g., more frequent syntactic constructions) likewise have a higher resting activation than less frequent ones, making their response more robust in both comprehension and production. This appears to be in line with evidence in the psycholinguistic literature (e.g., MacDonald et al., 1994).

The general course of processing takes place along lines suggested earlier for the comprehension and production of *cat* in example (1). In language comprehension, phonological input leads to activation of identical (or sufficiently similar) pieces of phonological structure in the lexicon (Marslen-Wilson and Tyler, 1980; McClelland and Elman, 1986). These in turn pass activation – through interface links – to corresponding syntactic and semantic structures in the lexicon. The processor attempts to integrate these structures with the syntactic and semantic structures that have been built so far on the basis of previous input.

Language production is the mirror image: the desired message, encoded in semantic/conceptual structure, activates identical (or sufficiently similar) pieces of semantic structure in the lexicon. These in turn pass on activation to corresponding syntactic and phonological structures in the lexicon (Levelt et al., 1999), through interface links. The processor then attempts to integrate these structures with the syntactic and phonological structures built in response to earlier parts of the intended message.

Activation does not just spread "vertically," via interface links, to other levels of representation. It also fans out "horizontally," in what the literature generally calls spreading activation (Collins and Loftus, 1975): activation of one item activates similar or related items. However, we can be more precise: activity spreads specifically through relational links. Hence the intensity of activity that spreads from one item to another is determined not only by the level of activation of the "donor" item, but also by the degree to which the items in question are linked relationally. Therefore, we predict that more activation will be spread between items whose relation is relatively transparent, such as *joy/joyous*, compared to a less closely related pair such as *malice/malicious*, whose phonological relation is more tenuous, thanks to the differences in stress and vowel quality. This prediction is borne out experimentally (Pinker, 1999).

Given the status of schemas, activation spreads not only between words, but also from words to the schemas that they are instances of. For instance, activating *widen* triggers not only the word *wide* but also to some degree the *-en* schema (7). These activations reinforce that of *widen*, increasing the processor's commitment to this as "the word being heard," and thereby the judgment is faster and/or more robust. (In probabilistic terms such as in O'Donnell, 2015; the independent activity of the parts increases the probability that the word being heard is *widen*.) Such morphological priming is attested in the experimental literature (Baayen and Lieber, 1991; Feldman, 2000; Koester and Schiller, 2008; Smolka et al., 2014).

Again in concurrence with much of the literature, we take it that the course of processing is *opportunistic* or *incremental*, in the sense that information is brought to bear whenever it becomes available (Marslen-Wilson, 1975; Tanenhaus et al., 1995). Thus we expect that in comprehension, phonological information will be available for processing before it activates syntactic and semantic information, and that the aspects of semantics that do not depend on syntax, such as word meaning, may become available before syntax is. Moreover, consistent with a wealth of evidence from the "visual world" paradigm, even visual information can be brought to bear on syntactic parsing, if available in time (Tanenhaus et al., 1995; Huettig et al., 2011). On the other hand, passing activation through interface and relational links does take time, which affects the overall time-course of processing. For example, in comprehension, activation cannot spread to a word's semantic associates until the word's own semantics has been activated by its phonology.

On this conception, priming of all sorts amounts to transient enhancement of activation. Identity priming occurs when an activated item does not decay immediately to resting level, so it takes less "energy" to reactivate it. Neighborhood priming occurs by virtue of spreading activation through relational links. Semantic priming is neighborhood priming on the semantic level, which is linked to overall understanding of the current linguistic and nonlinguistic context. Morphological priming, as mentioned above, is enhanced activation of a morphologically complex word through concurrent activation of a schema of which the word is an instance. Finally, since syntactic phrase structure schemas like the transitive verb phrase schema are stored items, we can understand structural (a.k.a. syntactic) priming as identity priming on syntactic treelets, albeit perhaps with different strength and time course from word priming (Bock and Loebell, 1990; Ziegler et al., 2018).

Summing up, the PA/RM approach to linguistic representation has direct counterparts in an account of processing. What is stored in memory is a network of linguistic structures, connected by interface links and relational links of varying strengths, along which activation spreads. Thus the theory of representation ("competence") and the theory of processing ("performance") can be brought closely into alignment. Again, it is probably straightforward to incorporate CxG into a similar account of processing. A crucial part would be the addition of relational links, which make possible spreading activation, neighborhood effects, and the ability of schemas to facilitate processing of their instances.

BEYOND LANGUAGE

Relational morphology focuses on the question of what a speaker stores, and in what form. It can therefore be viewed as a theory of one department of long-term memory. It is intriguing to speculate whether the approach can be extended to other mental faculties, setting as a prospect for future research the possibility of unifying theories of cognition across major components. Our conjecture is that memory is memory is memory – that many of the principles of organization in the language network can be found throughout a variety of cognitive domains. On this view, the differences among domains lie in the formal properties of the mental representations involved and in the interfaces between one domain and the next.

To sum up some of the characteristics we have in mind (for more details and discussion, though equally speculative, see Jackendoff and Audring, 2020, chapter 8):

- Knowledge of language involves a vast lexicon, with tens (or even hundreds) of thousands of items, ranging in size from affixes, through words, to idioms, collocations, and even longer stretches of language such as poems and song lyrics.
- It involves multiple levels of representation – phonological, syntactic, and semantic, coordinated by interface links, with further links to auditory structure (for speech perception), motor representation (for speech production), to orthographical representations, and general conceptual representation.
- Stored items can have hierarchical constituent structure.
- There are both free forms (e.g., *cat*) and bound forms (e.g., *-ous*).
- Stored items can be assembled recursively into larger novel structures, using schemas that allow a generative role.
- Regularities across items are encoded by schemas and relational links among sisters.

For comparison, consider knowledge of music, another universal but culturally varying human activity (Lerdahl and Jackendoff, 1983; Patel, 2008; Schlenker, 2017; Fitch and Popescu, 2019; Mehr et al., 2019). As with language, we can ask what is stored, and in what form, even if what is stored is entirely different from linguistic knowledge. The basic units of musical knowledge are rhythms and pitches (or intervals) rather than phonemes and syntactic categories; there is no semantics in the sense of propositional meaning. One can recognize hundreds if not thousands of popular songs, folk songs, nursery rhymes, hymns, and, for some people, 45-minute symphonies and the like – to the extent that one can identify them immediately on hearing a few random seconds of music, say, upon turning on the radio. Thus one might consider this knowledge a sort of musical lexicon.

One's knowledge is not just a string of notes: Lerdahl and Jackendoff (1983) and Jackendoff and Lerdahl (2006) show that musical cognition involves multiple hierarchical levels of representation: grouping structure, which is domain-general; metrical structure, which is partially shared with stress systems in language; and tonal hierarchy or "prolongational reduction," apparently unique to music and cross-culturally widespread. These levels are interconnected by a rich system of (in present terms) interface links; thus the system of music cognition can be considered another sort of PA. In addition, of course, musical structure has to be linked to auditory input. In individuals who sing or play an instrument, musical structure also has to be linked to motor patterns for production. And let us not forget dance as a motor and visual activity closely linked to musical structure.

Stored pieces of music as well as novel pieces partake of these elements of musical structure. However, the distinction between free and bound forms is not so clear in music. Perhaps a candidate for a bound form would be the appoggiatura, a dissonant note, usually on a strong beat, that cannot stand on its own, but has to resolve to a consonance, usually on a weak beat.

Regularities across pieces of music can be captured by schemas (Lerdahl and Jackendoff's well-formedness and preference rules). Musical schemas, like the basic units and hierarchical representations of music, have little to do with the corresponding components of language. However, just as different languages have different grammars (now a collection of schemas), different genres of music can be characterized in terms of differences in their repertoire of rhythmic, melodic, and harmonic schemas. Music can also establish relational links between individual pieces that share bits of structure ("oh, that song reminds me of this other song!"). More importantly, relational links in music can occur internally to a piece. For instance, the second line of *Happy Birthday* is the same as the first, except that the last two notes are one step higher – and this is part of what makes the song coherent and memorable. Such internal relational links are ubiquitous in music. They occur in language only in special phenomena such as reduplication and rhyme.

The upshot of this admittedly superficial comparison of language and music is that the general organization of memory is shared between the two, while the structures built and stored in memory are of quite different character.

For quite a different domain, consider one's knowledge of physical objects. There is a vast "lexicon," containing representations of all the many thousands of objects one knows about: tables, chairs, shoes, shirts, buttons, combs, toothbrushes, pianos, drums, plates, forks, doors, doorknobs, windows, carpets, books, newspapers, cars, trucks, airplanes, roads, rocks, trees, clouds, potatoes, bananas, laptops, televisions, cats, lizards, etc. Each of these involves linked levels of representation: how it looks, how it feels, perhaps how it smells, how you use it (for artifacts – an action representation), and/or how it moves (for animates and vehicles – a different kind of action representation).

Most of these sorts of objects have some hierarchical constituent structure, perhaps along the lines of Marr's (1982) 3D model or Biederman's (1987) geons. For instance, a cat has legs, a tail, and a head with eyes, ear, nose, and mouth. A car has wheels and doors; the wheels have tires and hubcaps; the hubcaps may have spokes; the doors have handles; the handles may have keyholes.

There are free and bound items. Most of the objects named above are free. But a stripe is physically bound: there can't be a stripe without a surface. Holes, cracks, and dents likewise are bound: there can't be a hole without a volume in which it is situated. A button may be physically free – you can buy

individual buttons – but it is functionally bound, in that it only achieves its proper function in the context of a buttonhole and two surfaces to be attached.

There are relational links among items that pick out shared structure. For instance, one can appreciate the similarities in function between radically different forms of bottle openers, lamps, or faucets. And any sort of prototype representation (e.g., a Marr or Biederman model) is in effect a schema. Schemas can pick out generalizations about the layout of parts, for instance windows are normally placed in walls, not floors. Rumelhart (1980) uses the term *schema* in precisely this sense, speaking for instance of a schema for a face, with subschemas for noses and eyebrows and so on.

In short, although this domain of knowledge is built out of qualitatively different components from language, and although it has a different collection of interfaces to other perceptual and cognitive domains, its overall organization, like that of music, can be characterized in terms that are compatible with the PA/RM account of language. Jackendoff and Audring (2020) add two other domains to this list: social cognition and geography/spatial layout. To a considerable extent this collection of domains intersects with Spelke's (2000) and Carey's (2009) "domains of core knowledge."

CONCLUSION

On one hand, the PA/RM approach to language can be regarded as a close relative of CxG and especially CxM. Like them, it regards rules of grammar as inhabitants of the extended lexicon (or constructicon); and its schemas are similar in spirit and content to CxG's constructions. We have stressed two main differences. First, CxG regards constructions as uniformly consisting of systematic pairings of form (phonology and syntax) and function (semantics). PA/RM also incorporates schemas that consist only of a syntactic template, as well as schemas that establish a connection between two or more nonsemantic levels of structure. This richer range of possibilities enables PA/RM to extend into new territories of morphology, syntax, and orthography, as treated in far greater detail in Jackendoff and Audring (2020).

The second major difference between the two frameworks is in the repertoire of relations among lexical items, whether words or schemas. CxG until recently has relied on inheritance as the sole mechanism for relating one item to another: either one is subordinate to the other and inherits structure from it, or they both inherit structure from a more abstract common ancestor. It recently has begun to include tentative paradigmatic links between words and schemas on the same level of representation. PA/RM in contrast places great importance on relational links as a fundamental organizing construct in the lexicon, permitting direct relations between words and between schemas, in both cases pinpointing the regions of correspondence through coindexation. This opens up another broad range of relations among morphological and syntactic patterns that are not available to inheritance.

From a wider perspective, the PA lends itself to a gracefully integrated theory of the language faculty – phonology, morphology, syntax, and semantics – and of the interfaces between language and other cognitive domains. At the same time, the overall character of the network of linguistic knowledge appears to parallel that of other cognitive domains (to the extent that we know anything about them). Speculative though these parallels may be, they are an intriguing step in integrating the language faculty with the rest of the mind. To the degree that the linguistic theory invites such integration, bringing with it a host of deep questions that could not previously be envisioned before, it encourages us to think we are on the right track.

DATA AVAILABILITY STATEMENT

All datasets presented in this study are included in the article/supplementary material.

AUTHOR CONTRIBUTIONS

RJ and JA jointly carried out the research on this project. RJ wrote the article. Both authors contributed to the article and approved the submitted version.

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Production Before Comprehension in the Emergence of Transitive Constructions in Dutch Child Language

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Although 2-year-old English- or Dutch-speaking children tend to use correct subject-object word order in their own utterances, they appear to make a substantial number of word order errors in their comprehension of other people's utterances. This pattern of adult-like production but poor comprehension is challenging for linguistic theory. While most approaches to language acquisition explain this pattern from extra-linguistic factors such as task demands, the constraint-based approach Optimality Theory predicts this asymmetry between production and comprehension to arise as a result of the linguistic competition between constraints on word order and animacy. This study tests this prediction by investigating how children's comprehension and production of word order in transitive constructions develop, and to what degree their comprehension and production are influenced by animacy. Two- and three-year-old Dutch speaking children (n = 32) and adult controls (n = 41) were tested on their comprehension and production of simple transitive sentences, in which the animacy of the grammatical subject and object were manipulated. Comprehension was tested in a picture selection task and a preferential looking task, and production was tested in a parallel sentence elicitation task. Children's comprehension of transitive sentences in the picture selection task was found to be less accurate than their production of the same sentences in the sentence elicitation task. Their eye gaze in the minimally demanding preferential looking task did not reveal a more advanced understanding of these sentences. In comprehension, children's response accuracy, and to a lesser extent their eye gaze, was influenced by the animacy of subject and object, providing evidence that their poor comprehension is due to the competition between word order and animacy, as predicted by the constraint-based approach. In contrast, animacy may have a facilitating effect on children's production of transitive sentences. These findings suggest that the mature form and meaning of a transitive construction are not acquired together. Rather, the form-meaning pairings of transitive constructions seem to arise gradually as the by-product of acquiring the constraint ranking of the grammar. This leads to the gradual alignment of forms and meanings in child language and hence to the emergence of linguistic constructions.

Keywords: animacy, child language, Dutch, eye-tracking, language acquisition, production-comprehension asymmetry, transitive constructions, word order

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INTRODUCTION

A central task for children acquiring their native language is learning how the language expresses who is doing what to whom. This is marked by word order in English: in active transitive sentences, the first noun phrase is the subject and the second one is the direct object. For example, in the sentence *The car is pushing the cow* the first noun phrase *the car* is the grammatical subject (and hence the agent performing the action), and the second noun phrase *the cow* is the direct object (and hence the patient that is acted upon).

English-speaking children between the ages of one and two have been found to already be sensitive to the word order of English (e.g., Hirsh-Pasek and Golinkoff, 1996; Gertner et al., 2006; Candan et al., 2012). However, 2-year-old English-speaking children still make a large number of word order errors in their interpretation of simple transitive sentences when word order conflicts with other potential cues for interpretation (Chapman and Miller, 1975; McClellan et al., 1986; Thal and Flores, 2001; Chan et al., 2009). Specifically, young children show large variability in their interpretations when other cues are present. For example, they may interpret the most animate noun phrase (e.g., *the cow* in the example above) as the subject of the sentence and the agent performing the action, rather than the first-mentioned noun phrase (Chapman and Miller, 1975).

Contrasting with their variable interpretations, 2-year-old English-speaking children appear to be surprisingly consistent in their use of word order in their own utterances. Their production of simple transitive sentences is largely adult-like, regardless of the animacy properties of the noun phrases or the probability of the events (Chapman and Miller, 1975; Angiolillo and Goldin-Meadow, 1982; McClellan et al., 1986). Thus, in the acquisition of transitive constructions, 2-year-olds' production seems to be ahead of their comprehension.

This raises the question how poor comprehension coupled with adult-like production of transitive sentences should be explained. Several studies (e.g., Bates et al., 1995) have dismissed the finding of poor comprehension as a confound of the complex task demands of the comprehension tasks used, which may underestimate children's knowledge of word order. At the same time, children's knowledge of word order may be overestimated in production tasks, according to Bates et al. (1995). Children's production may only appear to be adult-like because they are simply repeating forms that they have heard before and have memorized. Consequently, the observation of a production-comprehension asymmetry may merely be an artifact of the experimental tasks used. On the other hand, it is possible that there is an actual asymmetry between production and comprehension as children acquire word order. If so, this will have important implications for our view of the emergence of transitive constructions in child language, given that most linguistic theories assume that production and comprehension of a construction develop in parallel.

This paper addresses the question of how children's comprehension and production of word order in transitive constructions develop, and to what degree their comprehension and production of these constructions are influenced by animacy. It focuses on Dutch. To answer these questions, young Dutch-speaking children are tested on their comprehension and production of simple transitive sentences in which the animacy of the subject and the object are manipulated. Comprehension is tested in a picture selection task and a minimally demanding preferential looking task in which children's eye gaze during sentence interpretation is tracked. Production is tested in a parallel sentence elicitation task. Before presenting this experiment in Section "Experiment," we will review relevant previous experimental findings as well as the conflicting theoretical perspectives on the acquisition of transitive constructions.

BACKGROUND

Children acquiring English have been found to already be sensitive to word order from an early age (e.g., de Villiers and de Villiers, 1973; Hirsh-Pasek and Golinkoff, 1996; Gertner et al., 2006; Candan et al., 2012). For example, using the intermodal preferential looking paradigm, Hirsh-Pasek and Golinkoff (1996) showed that English-speaking children are sensitive to the order of subject and object already at the age of 17 months old. In this paradigm, children see two videos showing two events presented side-by-side on television monitors, while a sentence is played, for example *Where is Cookie Monster washing Big Bird?* All sentences contained a reversible verb and two animate noun phrases. Therefore, word order was the only cue for interpretation. The matching video showed the event with the first noun phrase as the agent, and the non-matching video showed the event with the second noun phrase as the agent. The rationale for this task is that children pay more attention to the video that matches what they are hearing. Because the children in their study looked more at the matching video than at the non-matching video, Hirsh-Pasek and Golinkoff concluded that the children were guided by word order in their interpretation of the sentence. Later studies also using preferential looking tasks confirmed these results (e.g., Candan et al., 2012; and, testing novel verbs, Gertner et al., 2006). This suggests that word order is available as a cue to sentence interpretation before age 2 in English.

However, studies in which word order was not the only cue for interpretation found that 2-year-old English-speaking children still make a large number of word order errors with simple transitive sentences and show variability in their interpretation (Chapman and Miller, 1975; McClellan et al., 1986; Thal and Flores, 2001; Chan et al., 2009). For example, in Chapman and Miller's (1975) act-out study with English-speaking children between the ages of 1;8 and 2;8, children's interpretations as acted out with toys were largely correct when the subject was animate and the object was inanimate. However, when the subject was inanimate and the object was animate, for example in the sentence *The boat is pulling the girl*, children's interpretations were correct only about half of the time. The incorrect responses revealed that the children interpreted the animate noun phrase as the subject, rather than the first noun phrase. In addition to this comprehension task, Chapman and Miller's children carried out a parallel production task in which they had to describe events

that the experimenter acted out with toys. The same children who showed poor comprehension now produced utterances with correct word order in over 80% of cases, without much variation between the animacy conditions. From this, Chapman and Miller concluded that young English-speaking children's competence of subject-object word order is less advanced and different in comprehension than in production. McClellan et al. (1986) found a similar asymmetry between comprehension and production in an act-out task with English-speaking 2-year-olds, although their children did not base their comprehension on animacy but instead selected the most probable event as the sentence meaning.

This pattern in English has also been found in Dutch. The 2-year-old Dutch-speaking children Cannizzaro (2012) tested with an act-out task (in an experiment with animals and vehicles and another experiment with humans and vehicles) also performed more poorly in comprehension (59 and 62% correct) than in production (85 and 81% correct). The 3-year-olds in her study performed overwhelmingly well in comprehension (92 and 83% correct) as well as in production (100 and 95% correct). An animacy effect on comprehension was found when 3-year-olds interpreted sentences with humans, but not with animals; with 2-year-olds, no animacy effects were found at all.

However, later studies criticized Chapman and Miller's (1975) conclusion and argued that the poor comprehension that the children exhibited must be due to experimental artifacts (e.g., Bates et al., 1995). Most studies demonstrating poor comprehension of simple transitive sentences used act-out tasks, which require children to act out their interpretation of a heard sentence with toys. However, act-out tasks are cognitively demanding and have been shown to result in response biases (Goodluck, 1996). Thus, the studies using act-out tasks may have underestimated children's knowledge of word order in transitive constructions (Bates et al., 1995). To our knowledge, no studies have been carried out to test the same children's comprehension and production of simple transitive sentences using a less demanding comprehension task.

A large body of research on children's development of transitive constructions in recent years has focused on an issue that is largely independent of the existence of a production-comprehension asymmetry, namely whether children's early knowledge of transitive constructions is abstract and rule-like, as is assumed in parameter-based or generativist approaches, or driven by concrete items and gradual, as is assumed in usage-based or constructivist approaches. According to parameter-based approaches (e.g., Guasti, 2002; Franck et al., 2013), the abstract universal principles of language are innately specified, and children only have to acquire the language-specific parameter settings. As soon as the relevant parameters for subject-object word order, such as the head direction parameter, are set on the basis of specific language input, their production of word order will be adult-like. Because syntactic representations form the input to the interpretation module, children's comprehension of word order is then expected to be adult-like too. Thus, parameter-based approaches do not predict any asymmetries between production and comprehension in child language, apart from performance errors such as those due to the demands of the experimental tasks (Grimm et al., 2011, p. 2).

According to usage-based approaches (e.g., Abbot-Smith and Tomasello, 2006; Ambridge and Lieven, 2015), children first acquire concrete representations that are tied to specific words and their meanings on the basis of the language input they receive. From these rote-learned form-meaning mappings, using general cognitive skills children then develop lexically specific 'slot-and-frame' schemas such as for transitive sentences. These schemas may initially still be quite fragile, but gradually develop into fully abstract adult-like constructions. Although schemas represent syntactic as well as semantic knowledge and could thus result in a parallel development of production and comprehension, usage-based approaches also assign a central role to cognitive processes and heuristics. Theakston et al. (2012, p. 122) speculate that animacy may explain why children's early knowledge of transitive constructions in comprehension around age 2;0 precedes their knowledge in production, which is the inverse of the asymmetry discussed above. Ambridge and Lieven (2011, p. 236) suggest that cognitive processes may explain this comprehension-before-production pattern, referring to a connectionist simulation study by Chang et al. (2006). However, as this simulation study modeled comprehension as predicting the next word in the sentence, it is doubtful whether this connectionist simulation study accurately reflects children's comprehension processes. Also, it has yet to be determined how heuristics and cognitive processes can explain this early comprehension-before-production asymmetry and at the same time explain the later production-before-comprehension asymmetry that is the focus of this study. As it is still an open question in usage-based linguistics to which extent children draw on the same heuristics in production and comprehension (Lieven, 2016, p. 354), usage-based approaches do not, in and of themselves, make *a priori* predictions about where asymmetries occur in child language.

Contrasting with these two approaches, the constraint-based approach Optimality Theory (Prince and Smolensky, 1993/2004) predicts that for certain linguistic forms comprehension precedes production (Smolensky, 1996), whereas for other forms production precedes comprehension (Hendriks, 2016), depending on the linguistic constraints involved. According to Optimality Theory, the realization and interpretation of words and sentences follows from the interplay between conflicting constraints of various sorts. These constraints express general tendencies in the language that can be in conflict with one another and can be violated in order to satisfy other, stronger, constraints. The constraints may either be innately specified or functionally motivated (see Lestrade et al., 2016; van de Weijer, 2019, for discussion). The optimal output is the output that satisfies the constraints of the grammar best, and is the realized output (i.e., the produced form or selected interpretation). Optimality Theory models production and comprehension as different directions of optimization based on the same constraints. In production, the input is a meaning and the output is the optimal form from a set of potential forms for expressing this meaning. In comprehension, the input is a form and the output is the optimal meaning from a set of potential meanings for that form. Asymmetries between production and comprehension arise from the different

directions of optimization in production and comprehension (Smolensky, 1996; Hendriks, 2014, 2016). Because the constraints are output-oriented and either evaluate the output in relation to other outputs (markedness constraints), or evaluate the output in relation to the input (faithfulness constraints), the same output-oriented constraints can have different effects in production and comprehension, as the output differs in production and comprehension. For example, a constraint evaluating meanings will only have an effect in comprehension, when the output is a meaning, but not in production, when the output is a form. This is illustrated below.

To account for word order phenomena within Optimality Theory, two violable constraints have been argued to play an essential role, namely a constraint pertaining to word order and a constraint pertaining to animacy. The word order constraint requires subjects to linearly precede objects (cf. Greenberg's language universal 1, Greenberg, 1966, p. 61) and has been motivated independently to account for the interaction between word order, case, and animacy in sentence comprehension in German and Dutch (de Hoop and Lamers, 2006); patterns of word order variation and word order freezing in various languages (e.g., Lee, 2001; Bouma and Hendriks, 2012); and the acquisition of wh-questions in Dutch and German (Schouwenaars et al., 2014, 2018). The second constraint is an animacy constraint that requires the subject to be animate and the object to be inanimate (Aissen, 2003), or, in a slightly stronger formulation, requires the subject to be higher in animacy than the object on a scale of animacy ranking humans above animals, and animals above inanimate entities (de Hoop and Lamers, 2006; de Hoop and Malchukov, 2008; de Swart, 2011; de Swart and van Bergen, 2019).

This relational animacy constraint, relating the animacy of subject and object in comparison to one another, must be distinguished from the inherent animacy bias that is familiar from the sentence processing literature and holds that animate entities are conceptually more accessible than inanimate entities (e.g., Bock and Warren, 1985; Branigan et al., 2008). The animacy constraint, but not the inherent animacy bias, plays a role in Optimality Theory accounts of word order phenomena and is functionally grounded in the need to distinguish the subject from the object when the sentence is potentially ambiguous (Aissen, 2003; de Hoop and Malchukov, 2008; de Swart, 2011). In languages such as Dutch that encode who is doing what to whom by means of word order, the animacy constraint does not have grammatical effects, although it is argued to have effects on sentence processing in these languages (e.g., de Hoop and Lamers, 2006; de Swart and van Bergen, 2019). In contrast, in languages such as the Papuan language Awtuw, the animacy constraint has grammatical effects and interacts with other aspects of grammar (de Swart, 2011). In Awtuw, a noun phrase that is highest in animacy will be interpreted as the subject, unless it bears object case marking. Because of its potential to have grammatical effects, in Optimality Theory the animacy constraint is considered to be a constraint of the grammar, on a par with the word order constraint. It is this animacy constraint that has been argued to give rise to different effects in comprehension and production in child language (Hendriks et al., 2005; Hendriks, 2014, 2016).

A basic tenet of Optimality Theory is that linguistic variation – such as that between Awtuw and English, but also between child language and adult language – is characterized by a different ranking of the same constraints. Hence, language acquisition is considered a process of constraint reranking (e.g., Legendre, 2006). Several constraint reranking algorithms have been proposed to specify this process (e.g., Tesar and Smolensky, 1998; Boersma and Hayes, 2001), all showing how the linguistic input the child is exposed to leads to a (step-wise or gradual) reranking of constraints. In the adult grammar of English, the word order constraint must be stronger than the animacy constraint. This explains why English-speaking adults always select the first noun phrase as the subject in comprehension, thereby satisfying the stronger word order constraint but sometimes violating the weaker animacy constraint. If English-speaking children entertain a different ranking of the constraints and incorrectly assume the animacy constraint to be the strongest of the two constraints, the interaction between these two constraints will give rise to non-adult-like performance in comprehension, but adult-like performance in production (Hendriks et al., 2005; Hendriks, 2014, 2016). In comprehension, the stronger animacy constraint will be satisfied even if this would result in violation of the weaker word order constraint, resulting in selection of the animate noun phrase as the subject. This will yield a correct interpretation if the first noun phrase is animate, but an incorrect interpretation if the first noun phrase is inanimate. In production, in contrast, children's immature constraint ranking will not give rise to non-adult-like performance because the animacy constraint, pertaining to meanings, is irrelevant for selecting the optimal form. As only the word order constraint is relevant in production, children, like adults, are expected to satisfy this constraint. Thus, the Optimality Theory account predicts a production-comprehension asymmetry in child language.

This study focuses on Dutch. In Dutch, like English, the dominant word order in active transitive main clauses is subject-verb-object (SVO), although main clauses allow for alternative word orders, and subordinate clauses have SOV word order. Also like English, Dutch only has overt case marking on pronouns, not on full noun phrases. According to a corpus study by Bouma (2008) using the Spoken Dutch Corpus (CGN, 2004), 70% of all Dutch main clauses begin with the subject. When a main clause begins with the direct object, which is true for 8% of main clauses if the direct object is a definite full noun phrase (Bouma, 2008), this results in object-verb-subject (OVS) word order. However, OVS word order occurs in specific discourse contexts only and requires special intonation. To explain the availability of variation between SVO and OVS word order in some contexts, as well as the lack of variation in other contexts (so-called "word order freezing"), it has been argued that constraints pertaining to information structure and definiteness are relevant as well (see Bouma and Hendriks, 2012, for an Optimality Theory account of word order in Dutch, and a corpus study testing its predictions). However, since we will only be concerned with transitive sentences in isolation with two definite arguments, these additional constraints do not play a role in the

present study. In isolation, sentences like the Dutch counterpart of *The car is pushing the cow* are interpreted by Dutch adults as expressing SVO word order only, with the car doing the pushing and the cow being pushed.

Based on the theories of language acquisition just presented, we can formulate predictions about how Dutch children will comprehend and produce simple transitive sentences. In this study, children acquiring Dutch are tested on their comprehension of transitive sentences in a picture selection task and a preferential looking task, and on their production of transitive sentences in a parallel sentence elicitation task. Picture selection tasks are considered to be less demanding than act-out tasks and can be used with children starting at age 20–24 months (Gerken and Shady, 1996). Preferential looking tasks place even fewer task demands on children, since they do not require an overt response, and have been successfully used for investigating sentence comprehension with children as young as 17 months old (e.g., Hirsh-Pasek and Golinkoff, 1996; Candan et al., 2012). Based on the Optimality Theory account, we expect 2-year-old and perhaps also 3-year-old children to still make word order errors in their interpretation of transitive sentences in the picture selection task and to base their responses on the animacy of the subject and the object. In particular, they are predicted to perform best if the subject is animate and the object is inanimate. At the same time, in the sentence elicitation task, we expect these children to conform to Dutch SVO word order in their produced utterances. Alternatively, if children's non-adult-like performance in the picture selection task is caused by task demands rather than a non-adult constraint ranking, they are expected to show better performance in the preferential looking task than in the picture selection task and to not be systematically influenced by animacy in either comprehension task.

EXPERIMENT

Participants

Thirty-two monolingual Dutch-speaking children participated in the study, divided into a group of fifteen 2-year-olds (age range 2;5–3;2, M = 2;9, 5 male) and a group of seventeen 3-year-olds (age range 3;3–4;1, M = 3;8, 7 male). In addition, forty-one native Dutch-speaking adults (M = 22 years, 12 male) served as controls. The study was carried out in accordance with the recommendations of the Research Ethics Committee CETO of the University of Groningen. The protocol was approved by CETO (review 72201140). All adult participants and parents of all child participants gave written informed consent in accordance with the Declaration of Helsinki. For each child, vocabulary scores were collected using the normed Dutch adaptation N-CDI (Zink and Lejaegere, 2003) of the MacArthur Communicative Development Inventory (MCDI; Fenson et al., 2000) for the younger age group, and KINT (Koster et al., 2004) for the older age group.

Materials and Methods

Participants were tested on their comprehension and production of transitive sentences in four conditions, illustrated by the following sentences (sentences are in Dutch, with English translations in italics; S = subject, O = object):

(1) De koe duwt de hond. [S +animate; O +animate]
the cow is pushing the dog.
(2) De hond duwt de bus. [S +animate; O –animate]
the dog is pushing the bus.
(3) De auto duwt de koe. [S –animate; O +animate]
the car is pushing the cow.
(4) De bus duwt de auto. [S –animate; O –animate]
the bus is pushing the car.

The variables manipulated are subject animacy (+animate or –animate) and object animacy (+animate or –animate). Comprehension was tested in two tasks: a picture selection task and a preferential looking task (the latter task with children only). Production was tested in a sentence elicitation task. In addition to response accuracy in the picture selection task and produced utterances in the sentence elicitation task, gaze data was collected during all tasks for children and adults.

In the two comprehension tasks, the same sentence materials were used, which are identical to those used in Cannizzaro's (2012) act-out experiment involving animals and vehicles. The two tasks featured 4 test items per sentence type, so 16 items in total. Half of the test sentences contained the transitive verb *trekken* ('pull'), and the other half contained the transitive verb *duwen* ('push'). These two verbs are reversible and are felicitous with animate as well as inanimate subjects and objects. The subjects and objects were animals and vehicles familiar to young children. Each test sentence was accompanied by two colored animated pictures appearing side-by-side on a computer screen (see **Figure 1**). The target picture showed the action corresponding to the SO (Subject-Object) interpretation (with the first noun phrase as the subject and the second noun phrase as the object), and the distractor picture showed the same action but corresponding to the OS (Object-Subject) interpretation (with the first noun phrase as the object and the second noun phrase as the subject).

For the comprehension tasks, two versions of the sentences were created that differed in the order of the two noun phrases, to avoid effects of event probability. In addition, the items were arranged in two different orders, to avoid order effects. This resulted in a total of four lists. Each participant only saw one list. Furthermore, direction of action within the pictures and side of the target picture on the screen were balanced across conditions. In addition to the 16 test items, the comprehension tasks included 6 practice items and 4 filler items for children, and 3 practice items and 16 filler items for adults. For children, filler items were included to verify that they understood the task. For adults, filler items were included to mask the goal of the experiment.

The production task elicited the same 16 sentences that were used in the comprehension tasks. The pictures used for sentence elicitation were the target pictures of the picture pairs used in comprehension. In addition to the 16 test items, the production task included 6 practice items but no filler items for children, and 3 practice items and 16 filler items for adults.

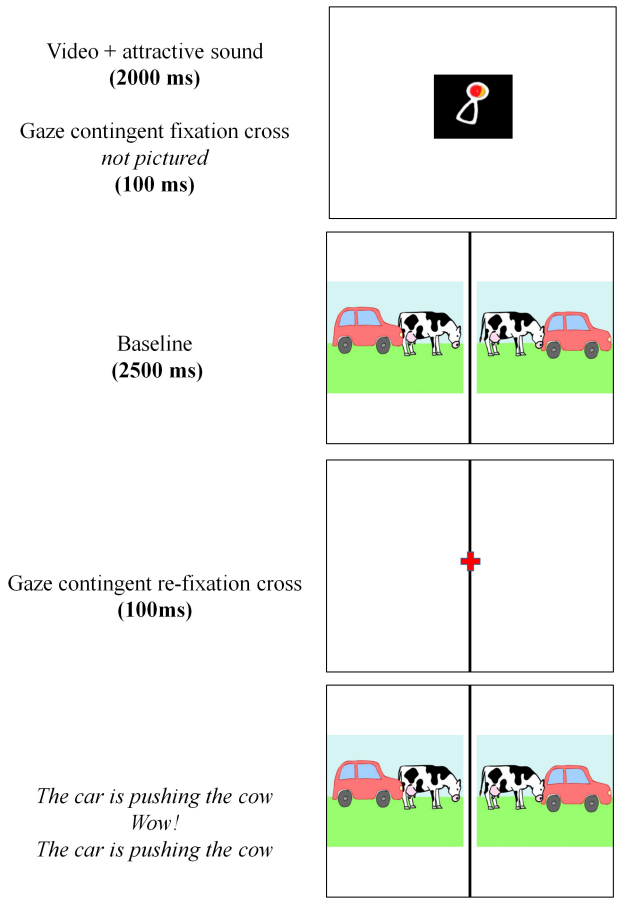

FIGURE 1 | Timeline of a trial in the picture selection task and the preferential looking task.

Procedure

The children were tested individually in the Eye Lab at the University of Groningen by two experimenters. Each child was tested in two sessions, about 1 week apart. The first session started with two pre-tests, in which naming of the animals and vehicles and of the pulling and pushing actions were practiced, without modeling word order. No child had problems naming the objects and actions. Then the preferential looking task was administered, followed by the sentence elicitation task. This order allowed us to model, through the preferential looking task, the sentence frame for the sentence elicitation task, without having to provide feedback on produced forms or repeat trials. The two tasks tested the same verb, so either *trekken* ('pull') or *duwen* ('push'), to avoid suboptimal performance due to confusion between the two verbs. Next, the picture selection task was administered with the other verb. The second session followed the same procedure with the remaining test items and had the same order of tasks. Gaze data in all three tasks was collected using a Tobii T120 remote eye-tracker at a frame rate of 60 Hz.

In the picture selection task, the child heard a sentence and was instructed to point to the picture that matched the sentence. **Figure 1** shows the timeline of a trial in the picture selection task. Each trial was preceded by an attention-getting image and sound for 2000 ms. Subsequently, a gaze contingent fixation cross appeared in the center of the screen. Once the child had fixated on the cross for 100 ms, the two animated pictures appeared on the screen without auditory input. This baseline of 2500 ms was followed by a second fixation cross. This cross had to be fixated on by the child for 100 ms before the pictures were displayed again, this time with the prerecorded test sentence, an exclamation (e.g., "Look!"), and a repetition of the test sentence. The pictures remained visible until the child made a decision by a pointing gesture. The pointing gestures were scored by both experimenters.

In the preferential looking task, the child heard a sentence and merely had to watch the animated pictures, without having to give a response. Apart from this, the timeline of a trial in the preferential looking task was the same as in the picture selection task. The pictures remained visible on the screen for 7000 ms.

In the sentence elicitation task, the child heard no audio and saw only a single animated picture on the full screen. The child was instructed to tell a hand puppet who had closed his eyes what was happening in the picture. All elicited sentences were audio recorded. In addition, we measured the participant's voice onset latency (VOL), which is the time between the presentation of a visual stimulus and the beginning of the speaker's sentence (Bock et al., 2004). VOLs were used to synchronize the collected gaze data to the onset of the elicited sentence.

The procedures described above were specifically tailored to optimally test young children. The procedures used for adults were adapted accordingly, since the main reason for testing adults was to establish the target pattern of production and comprehension of simple transitive constructions in isolation, given the variation in word order in Dutch main clauses. Adult participants were tested on comprehension and production in one session. They did not receive a preferential looking task, because the task was believed to be too simple and boring for adults, potentially giving rise to task-unrelated looking behavior. The order of the two tasks was balanced, with half the adults receiving the picture selection task first and the other half receiving the sentence elicitation task first. In the sentence elicitation task, adults were instructed to describe the animated picture in a short sentence (with no hand puppet necessary). In the picture selection task, adults were instructed to press one of two marked keys to indicate which of the two pictures matched the sentence they heard. In addition to their responses and gaze data, their reaction times (RTs) were recorded.

Scoring

The participants' responses in the picture selection task were categorized as *SO interpretation*, *OS interpretation*, or *Unscorable*. A response was categorized as SO interpretation if the participant chose the target picture reflecting the SO interpretation. A response was categorized as OS interpretation if the participant

chose the distractor picture reflecting the OS interpretation. Unscorable responses included items for which the child pointed to both pictures, did not give any response, or did not give a clear response; items not administered due to a technical error were also categorized as unscorable. Only SO interpretations and OS interpretations were included in the analysis.

The produced utterances in the sentence elicitation task were first transcribed by the first author. The utterances of 10% of the participants were transcribed by a second transcriber, resulting in 91% agreement on the adult utterances and 90% agreement on the child utterances. Next, the first author and a second scorer independently categorized all utterances. If there was a disagreement between the two scorers, a third scorer made a final decision. Produced utterances were categorized as *SO word order* (with the subject preceding the object), *OS word order* (with the object preceding the subject), or *Unscorable*. Scorable utterances did not have to be complete utterances but, when incomplete, did require a finite verb to allow us to distinguish the SVO word order of Dutch main clauses from the SOV word order of Dutch non-finite clauses. If a participant produced SVO word order, or SV or VO word order with a finite verb, this was categorized as SO word order. Utterances with OVS word order, or OV or VS word order with a finite verb, were categorized as OS word order. Unscorable utterances included insufficient or unclear responses in which word order could not be determined, missing responses, and responses that did not contain the target verb or a synonym. Utterances with a non-finite verb and only one noun or passives were also categorized as Unscorable. Inter-scorer agreement in categorizing the produced utterances was high (adults: Cohen's $\kappa = 0.94$; children: Cohen's $\kappa = 0.90$).

RESULTS

In this section we present the results of the study (see also Cannizzaro, 2012), starting with adults' and children's response accuracy and adults' RTs in the picture selection task. This is followed by adults' and children's produced utterances in the sentence elicitation task. We then present the gaze patterns in the picture selection task (for adults) and the preferential looking task (for children), and the gaze patterns for both groups in the sentence elicitation task. Finally, we compare the scorable responses in the picture selection and sentence elicitation tasks.

The results were analyzed using linear mixed-effects modeling (e.g., Baayen, 2008; Baayen et al., 2008). We compared different models using a simplification procedure to determine the model with the best fit. This procedure starts with creating a maximal model including all possible three-way and two-way interactions and main effects. This maximal model is then compared to a simpler model without the three-way interaction using a chi-square test that evaluates each model's goodness of fit (Baayen, 2008; Matuschek et al., 2017). If a simpler model has a significantly lower goodness of fit than the more complex model, removal of the interaction or factor is not justified. This model comparison procedure is repeated until the model with the best fit has been determined. The analyses were carried out using the software package R (R Core Team, 2020), version 2.13. The *lmer* function in the package lme4 was used to obtain coefficient estimates for all data, and additionally *p*-values for binary data; *z*-statistic is reported (Bates, 2007). The *pvals.fnc* function in package languageR was used to obtain *p*-values for continuous data using Markov Chain Monte Carlo sampling; *t*-statistic is reported (Baayen, 2008; Baayen et al., 2008).

Results of the Picture Selection Task

Participants were excluded from the analysis of the picture selection task if they did not contribute at least two scorable responses per sentence type. For this reason, two of the fifteen 2-year-olds were excluded. The comprehension results of the adults are presented in **Table 1**, and of the children in **Table 2**.

Of the responses in the picture selection task, 655 of the 656 responses of the adults were scorable (only one response was unscorable due to a technical error), and 195 of the 208 responses of the 2-year-olds and 266 of the 272 responses of the 3-year-olds were scorable.

To determine whether animacy affected response accuracy in adults' comprehension, the binomial data (SO vs. OS interpretation) was fit to a linear mixed-effects model with subject animacy (animate vs. inanimate) and object animacy (animate vs. inanimate) as fixed factors, and participants and items as random factors. Since there was no significant two-way interaction [$\chi^2(1) = 0.46$, $p > 0.1$], we checked for main effects in the baseline model. There was no main effect of object animacy [$\chi^2(1) = 2.19$, $p > 0.1$], but there was a main effect of subject animacy [$\chi^2(1) = 4.65$, $p = 0.03$], with lower response accuracy on sentences with an inanimate subject ($\beta = -0.61$; $z = -2.08$; $p = 0.04$). The inclusion of the control factors test verb (*push* vs. *pull*), first task (comprehension first vs. production first), target side, and list did not significantly explain more variance in the data. Thus, Dutch adults gave SO interpretations to the sentences they heard 97% of the time, and were more likely to do so when the subject was animate.

To determine whether animacy affected response accuracy in children's comprehension, the binomial data (SO vs. OS interpretation) was fit to a model with subject animacy, object animacy, and age group as fixed factors, and participants and items as random factors. There were no significant three-way [$\chi^2(1) = 2.37$, $p > 0.1$] or two-way [$\chi^2(3) = 2.68$, $p > 0.1$] interactions between the fixed predictors. Since including

TABLE 1 | Adults' mean proportions of SO interpretations (and standard deviations) in the picture selection task (Comprehension) and their mean proportions of SO word order (and standard deviations) in the sentence elicitation task (Production), per animacy condition.

Sentence Type	Comprehension	Production
	Adults (*n* = 41)	**Adults (*n* = 38)**
[S +animate; O +animate]	0.98 (0.08)	1.00 (–)
[S +animate; O –animate]	0.99 (0.04)	1.00 (–)
[S –animate; O +animate]	0.94 (0.12)	1.00 (–)
[S –animate; O –animate]	0.96 (0.09)	1.00 (–)
Total	0.97 (0.04)	1.00 (–)

TABLE 2 | Children's mean proportions of SO interpretations (and standard deviations) in the picture selection task (Comprehension) and their mean proportions of SO word order (and standard deviations) in the sentence elicitation task (Production), per animacy condition and age group.

Sentence type	Comprehension		Production	
	2-year-olds (*n* = 13)	3-year-olds (*n* = 17)	2-year-olds (*n* = 5)	3-year-olds (*n* = 16)
[S +animate; O +animate]	0.40 (0.25)	0.73 (0.23)	1.00 (–)	0.93 (0.18)
[S +animate; O –animate]	0.72 (0.26)	0.79 (0.25)	0.90 (0.22)	0.96 (0.17)
[S –animate; O +animate]	0.48 (0.27)	0.54 (0.28)	0.60 (0.25)	0.92 (0.18)
[S –animate; O –animate]	0.54 (0.29)	0.71 (0.27)	0.73 (0.28)	0.88 (0.21)
Total	0.54 (0.10)	0.70 (0.18)	0.81 (0.13)	0.92 (0.17)

interactions was not justified, we checked the baseline model for main effects. There were three distinct main effects that were significant predictors of response accuracy. There was a main effect of age group [$\chi^2(1) = 8.20$, $p = 0.004$], with the older children more likely to choose SO interpretations than the younger children ($\beta = 0.37$; $z = 3.06$; $p = 0.002$); a main effect of subject animacy [$\chi^2(1) = 5.67$, $p = 0.02$], with all children more likely to choose SO interpretations when the subject was animate ($\beta = 0.24$; $z = 2.39$; $p = 0.02$); and a main effect of object animacy [$\chi^2(1) = 12.58$, $p < 0.001$], with all children more likely to choose SO interpretations when the object was inanimate ($\beta = -0.36$; $z = -3.54$; $p < 0.001$). The inclusion of the control factors gender, test verb, target side, list and vocabulary score did not significantly explain more variance in the data.

Thus, 3-year-olds were more likely to choose SO interpretations (70%) than 2-year-olds (54%), children were more likely to choose SO interpretations when the subject was animate, and children were more likely to choose SO interpretations when the object was inanimate.

In addition to responses, for the adults we also collected RTs. Items with OS interpretations ($n = 21$) or extreme RTs ($n = 2$) were removed from the RT analysis. Extreme RTs were considered those outside 3 standard deviations of the participant's personal mean. Mean RTs on the four sentence types are shown in **Table 3**.

To determine whether animacy affected RTs in the picture selection task, the log transformed RTs were fit to a model with subject and object animacy as fixed factors, and participants and items as random factors. Since including an interaction was not justified [$\chi^2(1) = 0$, $p = 1$], we checked the baseline model for main effects. There was no main effect of object animacy [$\chi 2(1) = 0.10$, $p > 0.1$], but there was a main effect of subject animacy [$\chi^2(1) = 15.68$, $p < 0.001$]. The adults had longer RTs when the subject was inanimate ($\beta = 0.07$; $t = 4.35$; $p < 0.001$). The inclusion of the control factors test verb, first task, target side, and list did not significantly explain more variance in the data.

Thus, adults were faster to select the SO interpretation when the subject was animate.

TABLE 3 | Adults' mean reaction times in ms (and standard deviations) for giving SO interpretations in the picture selection task (Comprehension), per animacy condition.

Sentence type	Reaction times (sd)
	Adults (*n* = 41)
[S +animate; O +animate]	2001 (392)
[S +animate; O –animate]	1973 (391)
[S –animate; O +animate]	2301 (526)
[S –animate; O –animate]	2294 (591)
Total	2140 (451)

Results of the Sentence Elicitation Task

Participants were excluded from the analysis of the sentence elicitation task if they did not contribute at least two scorable responses per sentence type. For this reason, three of the 41 adults were excluded due to too many utterances that did not contain the target verb or a synonym. Furthermore, ten of the fifteen 2-year-olds were excluded (including the two who were also excluded from the picture selection analysis), and one of the seventeen 3-year-olds. In **Tables 1**, **2**, the production results of the remaining adults and children are presented.

In the sentence elicitation task, 577 of the 608 responses of the adults were scorable (29 were unscorable because of the use of a non-target verb, and 2 because of the use of a passive), and 70 of the 80 responses of the 2-year-olds and 232 of the 256 responses of the 3-year-olds were scorable.

Because the adults used SO order 100% of the time, their production data was not further analyzed.

To determine whether animacy affected response accuracy in children's production, the binomial data (SO vs. OS order) was fit to a model with subject animacy, object animacy, and age group as fixed factors, and participants and items as random factors. The maximal model was not fit due to complete collinearity between the three-way interaction of the fixed predictors and the two-way interaction between age group and subject animacy. The three-way interaction was therefore not included in the model, as a strategy to reduce this severe collinearity (Baayen, 2008, p. 183). There were no significant two-way interactions [$\chi^2(3) = 1.93$, $p > 0.1$]. In the baseline model, there was no main effect of object animacy [$\chi^2(1) = 1.94$, $p > 0.1$]. Subject animacy was a significant predictor [$\chi^2(1) = 8.87$, $p = 0.003$], with the children more likely to use SO order when the subject was animate ($\beta = 0.81$; $z = 2.97$; $p = 0.003$). The inclusion of the control factors gender, test verb, direction of action, list and vocabulary score showed that both test verb [$\chi^2(1) = 12.20$, $p < 0.001$] and direction of action [$\chi^2(1) = 4.63$, $p = 0.03$] significantly explain more variance in the data, with the children more likely to use SO order when the

verb was *push* (β = 0.90; $z = 3.18$; $p = 0.001$) as well as when the direction of the action was to the left (β = 0.54; $z = 2.05$; $p = 0.04$).

So in general children were more likely to produce SO word order when the subject was animate.

Gaze Patterns in Sentence Comprehension

Because the picture selection task required an overt response (pointing) that could have been demanding for the children, we also investigated their gaze patterns in a task not requiring an overt response, namely a preferential looking task. We compare children's gaze patterns in this task to adults' gaze patterns collected in the picture selection task.

For adults, items that had track loss of both eyes for more than 33% of the trial from presentation to button press were removed from the gaze analysis. For children, we used a less conservative threshold than for adults and removed items that had track loss of both eyes for more than 33% of the four-second time interval after presentation of the auditory stimulus. Even with this less conservative threshold, children's gaze data in the picture selection task could not be used due to too much track loss because they moved around a lot when pointing. Therefore, we only analyzed children's gaze data gathered during the preferential looking task. These data are compared to the adults' gaze data gathered during the picture selection task.

All adult and child participants were included in the gaze analyses: the adults in the gaze analyses of the picture selection task and the children in the gaze analyses of the preferential looking task. Before analysis, we removed test items of adults with too much track loss ($n = 3$), OS interpretations ($n = 21$), and extreme RTs ($n = 2$) from the gaze analysis of the picture selection task. Due to too much track loss, we removed 70 test items of children from the gaze analysis of the preferential looking task.

Areas of interest (AOIs) in the pictures were labeled as *Target picture*, *Distractor picture*, and *Not on AOI*. To determine the effects of animacy on sentence processing, we looked at the participants' eye gaze for each of the four sentence types in four time windows: Time window 1 runs from the start of the trial to the offset of the sentence subject and has a duration of about 600 ms, and time windows 2, 3, and 4 are subsequent intervals of 1000 ms following the offset of the sentence subject.

The general adult pattern of looks to target and distractor in the picture selection task over the course of a trial, synchronized to the offset of the sentence subject, is shown in **Figure 2**. The adults show a pattern of looking at the target within the first 1000 ms following the offset of the subject.

For children, we first inspected their eye gaze during the 2500 ms baseline for any initial preference for either target or distractor picture. Neither age group showed an initial preference for target or distractor picture in any of the four animacy conditions during the baseline. The children's general pattern of looks to target and distractor during the preferential looking task over the course of a trial, synchronized to the offset of the subject, is shown in **Figure 3** for the 2-year-olds, and in **Figure 4** for the 3-year-olds. These gaze plots show that, in general, children's mean proportions of looks to the target did not reach above 0.60 during the 3000 ms following the offset of the subject.

The mean proportions of looks to target per animacy condition in each of the four time windows are plotted in **Figure 5** (adults), **Figure 6** (2-year-olds), and **Figure 7** (3-year-olds).

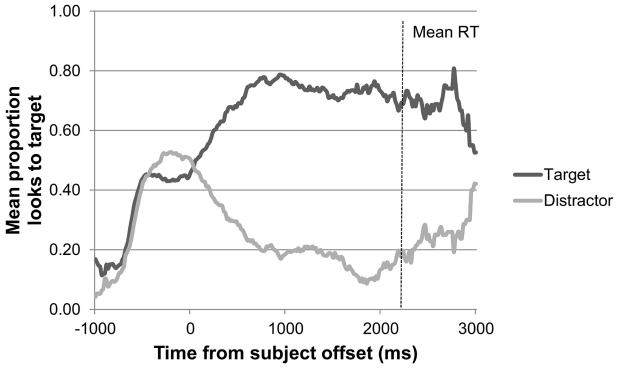

FIGURE 2 | Adults' pattern of looks to target versus distractor over the course of a trial in the picture selection task ($n = 41$).

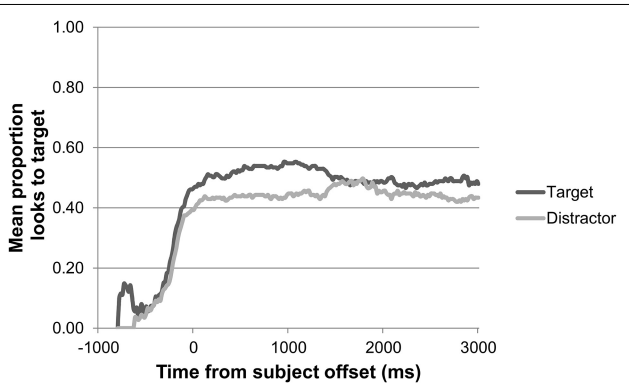

FIGURE 3 | 2-year-olds' pattern of looks to target versus distractor over the course of a trial in the preferential looking task ($n = 15$).

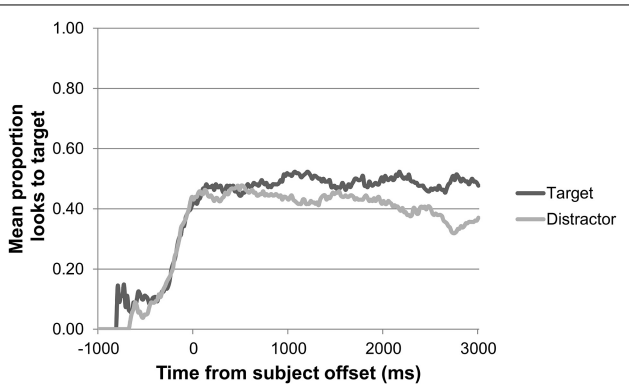

FIGURE 4 | 3-year-olds' pattern of looks to target versus distractor over the course of a trial in the preferential looking task ($n = 17$).

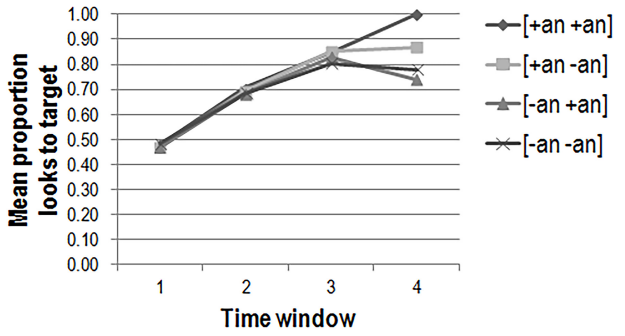

FIGURE 5 | Adults' mean proportions of looks to target per condition in each of the four time windows in the picture selection task (n = 41).

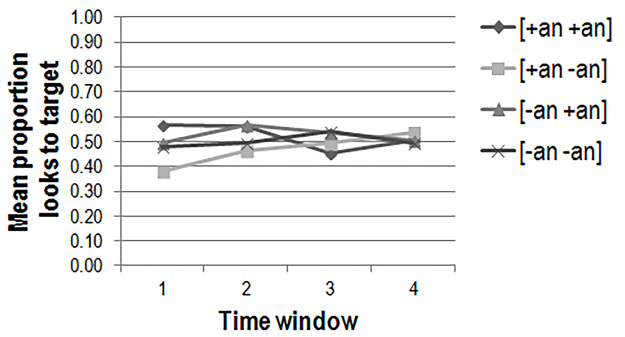

FIGURE 6 | 2-year-old's mean proportions of looks to target per condition in each of the four time windows in the preferential looking task (n = 15).

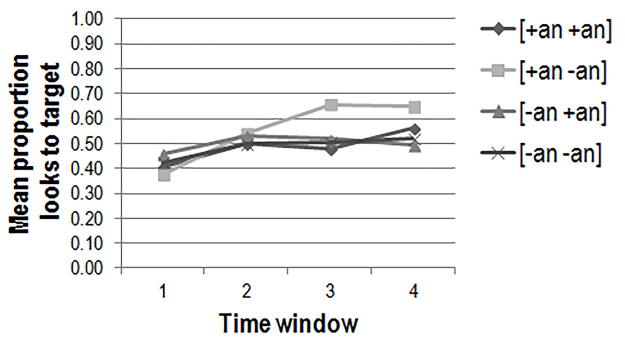

FIGURE 7 | 3-year-old's mean proportions of looks to target per condition in each of the four time windows in the preferential looking task (n = 17).

To investigate the effects of animacy on sentence processing, we first consider adults' gaze. To determine whether animacy affected which AOI was fixated on by the adults during picture selection, the empirical logit transformed (Agresti, 2002, p. 87; Jaeger, 2008, p. 442) mean looks to target were fit to a model with subject animacy, object animacy, and time window as fixed factors, and participant and item as random factors. There was no significant three-way interaction between the fixed predictors [$\chi^2(1) = 0.18$, $p > 0.1$]. There was a significant interaction of time window and subject animacy [$\chi^2(1) = 11.90$, $p < 0.001$] as well as a significant main effect of time window [$\chi^2(1) = 711.94$, $p < 0.001$]. Thus, the adults looked increasingly toward the target picture as time progressed ($\beta = 1.98$; $t = 30.09$; $p < 0.001$), but did so to a significantly lesser degree when the subject was inanimate ($\beta = -0.22$; $t = 3.45$; $p < 0.001$). The inclusion of the control factors test verb, first task, target side, and list showed that target side significantly explained more variance in the data [$\chi^2(1) = 38.66$, $p < 0.001$], with participants more likely to fixate on the target picture if it was on the left ($\beta = 0.48$; $t = 8.04$; $p < 0.001$). The inclusion of an interaction of target side and time window was also a significant improvement [$\chi^2(1) = 101.71$, $p < 0.001$], indicating that the effect of target side decreased as time progressed ($\beta = -0.64$; $t = 10.24$; $p < 0.001$).

We carried out the same analysis for the gaze data collected for 2-year-old children in the preferential looking task. There were no three-way [$\chi^2(1) = 0.07$, $p > 0.1$] or two-way [$\chi^2(1) = 1.10$, $p > 0.1$] interactions between the fixed predictors. In the baseline model there was only a significant effect of time window [$\chi^2(1) = 19.58$, $p < 0.001$], indicating that the 2-year-olds looked increasingly toward the target picture as time progressed in general ($\beta = 0.34$; $t = 4.45$; $p < 0.001$). The inclusion of the control factors gender, test verb, target side, and list showed that target side significantly explains more variance in the data [$\chi^2(1) = 21.36$, $p < 0.001$], with children more likely to fixate on the target picture if it was on the left ($\beta = 0.68$; $t = 5.05$; $p < 0.001$). Target side appeared not to interact with time window [$\chi^2(1) = 0.10$; $p > 0.10$], as it had for adults.

The same analysis was also carried out for the 3-year-olds. There was no three-way [$\chi^2(1) = 0.97$, $p > 0.1$] interaction between the fixed predictors. There was a two-way interaction between time window and subject animacy [$\chi^2(1) = 4.39$, $p = 0.04$]. Together with the main effect of time window [$\chi^2(1) = 27.61$, $p < 0.001$], this indicates that the 3-year-olds looked increasingly toward the target picture as time progressed in general ($\beta = 0.36$; $t = 5.29$; $p < 0.001$) and that this effect was intensified when the subject was animate ($\beta = 0.14$; $t = 2.10$; $p = 0.04$). The inclusion of the control factors gender, test verb, target side, and list did not significantly explain more variance in the data.

Summarizing, as the sentence unfolds, adults look more toward the target picture reflecting the SO interpretation, but this effect is less strong when the subject is inanimate. Children also look more toward the target picture as the sentence unfolds. However, while this effect is intensified in 3-year-olds when the subject of the sentence is animate, no effect of animacy is found in 2-year-olds.

Gaze Patterns in Sentence Production

Gaze data was also collected from adults and children during the sentence elicitation task. Only those adults and children who remained in the accuracy analyses of the sentence elicitation task were included in the gaze analyses of this task. One additional adult was excluded from the gaze data analysis due to extreme track loss. Of the data from the remaining 37 adults, test items with extreme track loss (n = 8) or extreme VOLs

(n = 5) were removed. Extreme VOLs were considered those outside 3 standard deviations of the participant's personal mean. Furthermore, one 3-year-old child was excluded from the gaze analysis of the production task because he did not have at least two validly tracked items on at least two sentence types. Of the data from the remaining 20 children (15 fifteen 3-year-olds and five 2-year-olds), test items with extreme track loss (n = 56) as well as incorrect OS utterances (n = 30) were removed from the analysis.

Within each picture, AOIs were labeled as *Agent*, *Patient* and *Not on AOI*. Analysis was done over two time windows: Time window 1 is the interval of 1000 ms prior to the onset of the subject, and time window 2 is the interval of 1000 ms after the onset of the subject. For each time window, we calculated the difference between the proportion of looks to the agent and the proportion of looks to the patient (the so-called "agent advantage score").

Figure 8 shows a gaze plot of the general adult pattern of looks to agent and patient over the course of a trial, synchronized to the onset of each participant's sentence. The gaze plot shows that the adults looked first to the agent, expressed as the subject of the sentence, prior to starting a sentence, and then to the patient, expressed as the object of the sentence.

As **Figures 9**, **10** show, the 2-year-olds and 3-year-olds also looked first to the agent and then to the patient while producing the sentence. The 2-year-olds took about 750 ms and the 3-year-olds took about 250 ms after starting their sentence to shift their gaze from agent to patient. Thus, the eye gaze of the Dutch-speaking adults as well as the children reflect a search for agent followed by a search for patient.

To determine whether animacy affected which AOI was fixated on by adults during sentence planning and production, the empirical logit transformed mean agent advantage scores from each time window were fit to a model with subject animacy, object animacy, and time window as fixed factors, and participant and item as random factors. There was a significant three-way interaction between the fixed predictors [$\chi^2(1) = 5.89$, $p = 0.02$], which could be interpreted in light of a significant effect of time window [$\chi^2(1) = 260.69$, $p < 0.001$]. In all sentence types, there was a decrease in the preference for agent over patient from the first to the second time window ($\beta = -4.16$.; $t = 17.18$; $p < 0.001$), but to a significantly lesser degree in the sentences with an animate subject and an inanimate object ($\beta = -0.58$; $t = -2.43$; $p < 0.02$). Thus, the adults looked more to the patient as the sentence unfolded, but less so for sentences with an animate subject and an inanimate object. The inclusion of the control factors test verb, first task, direction of action, and list showed that the inclusion of the two-way interaction between verb and time window significantly explained more variance in the data [$\chi^2(1) = 94.44$, $p < 0.001$], with greater looks to the agent over patient in the first time window when the verb was *pull* ($\beta = 4.26$.; $t = 9.01$; $p < 0.001$).

To determine whether animacy affected which AOI was fixated on by the 2- and 3-year-olds during sentence planning and production, the empirical logit transformed mean agent advantage scores from each time window were fit to a model with subject animacy, object animacy, time window, and age group as fixed factors, and participant and item as random factors. There were no significant four-way [$\chi^2(1) = 0.07$, $p > 0.1$], three-way [$\chi^2(4) = 1.30$, $p > 0.1$], or two-way [$\chi^2(6) = 5.57$, $p > 0.1$]

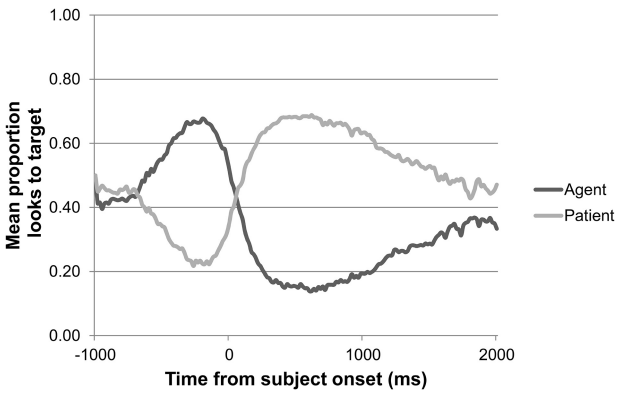

FIGURE 8 | Adults' pattern of looks to agent versus patient over the course of a trial in the sentence elicitation task (n = 37).

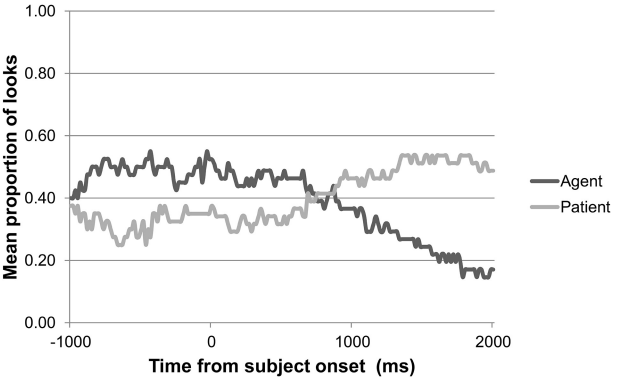

FIGURE 9 | 2-year-olds' pattern of looks to agent versus patient over the course of a trial in the sentence elicitation task (n = 5).

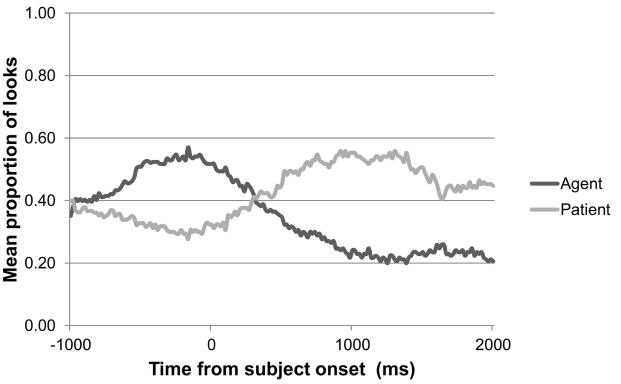

FIGURE 10 | 3-year-olds' pattern of looks to agent versus patient over the course of a trial in the sentence elicitation task (n = 15).

interactions between the fixed predictors. In the baseline model there was no effect of subject animacy [$\chi^2(1) = 1.10$; $p > 0.1$] or object animacy [$\chi^2(1) = 0.31$; $p > 0.1$]. There was a significant main effect of time window [$\chi^2(1) = 16.51$; $p < 0.001$], with the agent advantage score decreasing from the first to the second time window ($\beta = -1.68$; $t = -4.09$; $p < 0.001$).

As we should be cautious in our interpretation of the 2-year-olds' gaze data in production because of the considerable data loss, we ran a second analysis with only the 3-year-old children. Again, there were no significant three-way [$\chi^2(1) = 0.03$; $p > 0.1$], or two-way [$\chi^2(3) = 3.93$; $p > 0.1$] interactions between the fixed predictors. In the baseline model there was no effect of subject animacy or object animacy, but there was a significant main effect of time window [$\chi^2(1) = 503.21$; $p < 0.001$], with the agent advantage score decreasing from the first to the second time window ($\beta = -1.95$; $t = -4.37$; $p < 0.001$). Thus, the results of the 3-year-olds only are similar to the results of the children including the five 2-year-olds.

The inclusion of the control factors gender, test verb, direction of action, and list showed that the test verb significantly explained more variance in the data. For both the model with the 2-year-olds [$\chi 2(1) = 12.17$; $p < 0.001$] and the model without the 2-year-olds [$\chi 2(1) = 12.88$; $p < 0.001$], there were greater looks to the agent when the verb was *pull* ($\beta = 1.11$; $t = 3.51$; $p < 0.001$ and $\beta = 1.05$; $t = 3.67$; $p < 0.001$, respectively).

Summarizing, adult speakers look less to the agent and more to the patient when producing the subject of the sentence, but this effect is less strong when the subject is animate and the object is inanimate. No effects of animacy are found for children's eye gaze during sentence production.

Comparing Comprehension and Production

To determine whether there was a difference between children's use of word order in comprehension and production, in a separate analysis we compare children's SO interpretations in comprehension with their produced SO word order in production. However, since scorability appeared to be higher in the picture selection task than in the sentence elicitation task, we first need to rule out the possibility that scorability influenced our results, since variation in children's ability to produce scorable responses could be due to animacy. Therefore, we need to establish whether there was an effect of animacy condition on scorability in comprehension or production.

Mean scorability in the picture selection task, based on the children who had been included in the analysis of this task, was high and ranged between 92 and 100% per animacy condition. To determine whether animacy affected scorability on this task, the binomial data (scorable vs. unscorable) were fit to a linear mixed-effects model. Subject animacy, object animacy, and age group were included as fixed factors, and participants and items as random factors. There were no significant three-way or two-way interactions between the fixed predictors, so only baseline results were inspected for the factors age group, subject animacy, and object animacy. Results showed that neither age group [$\chi 2(1) = 3.53$, $p = 0.06$] nor subject [$\chi 2(1) = 1.23$, $p > 0.1$] or object animacy [$\chi 2(1) = 0$, $p > 0.1$] had a significant influence on scorability in the picture selection task.

Mean scorability in the sentence elicitation task, based on the children who had been included in the analysis of this task, ranged between 80 and 95% per animacy condition. The same analysis was run as described for the picture selection task. There were no significant three-way or two-way interactions between the fixed predictors. Overall, there was no effect of age group [$\chi 2(1) = 1.53$, $p > 0.1$] nor of subject [$\chi 2(1) = 0.17$, $p > 0.1$] or object animacy [$\chi 2(1) = 1.41$, $p > 0.1$] on scorability in production.

Thus, in production as well as comprehension, the unscorable items were distributed evenly across animacy conditions. We interpret this as justification that the results from the picture selection task and the sentence elicitation task can be compared, although the tasks may place different demands on the children. The analysis that follows is based on the items for which in both comprehension and production the child gave a scorable response. The SO and OS responses (i.e., selected interpretations and produced word orders) for these items per age group are shown in **Table 4**.

In order to determine whether there was a difference in performance between the sentence elicitation task and the picture selection task on the basis of these items, the binomial data (SO vs. OS) was fit to a model with task and age group as fixed factors, and participant and item as random factors. There was no significant interaction of task and age group [$\chi^2(1) = 2.40$, $p > 0.1$]. In the baseline model, there was a significant effect of task [$\chi^2(1) = 48.20$, $p < 0.001$], with children more likely to give SO responses in production than comprehension ($\beta = 0.74$; $z = 6.57$; $p < 0.001$). There was also a significant effect of age group [$\chi^2(1) = 4.95$, $p = 0.03$], with older children more likely to give SO responses than younger children ($\beta = 0.34$; $z = 2.33$; $p = 0.02$).

In sum, the older children were more likely to give SO responses than the younger children, and all children were more likely to give SO responses in production than in comprehension.

DISCUSSION

This study investigated how 2- and 3-year-old Dutch-speaking children use word order in their comprehension and their production of transitive constructions, and to what degree their use of word order is influenced by the animacy of the grammatical

TABLE 4 | Children's responses in numbers (and percentages) of items for which they gave a scorable response for both comprehension and production, as SO versus OS interpretations in the picture selection task (Comprehension) and SO versus OS word order the sentence elicitation task (Production), per age group.

Response	Comprehension		Production	
	2-year-olds	3-year-olds	2-year-olds	3-year-olds
SO	55 (61.8%)	166 (70.9%)	72 (80.9%)	217 (92.7%)
OS	34 (38.2%)	68 (29.1%)	17 (19.1%)	17 (7.3%)

subject and object. The children in this study did not yet show adult-like comprehension of transitive sentences in the picture selection task: the 2-year-olds performed more poorly than the 3-year-olds and selected the correct subject-object interpretation in only 54% of cases, while the 3-year-olds did so in 70% of cases. At the same time, both age groups seem to show more advanced performance on their production of transitive sentences in the sentence elicitation task: the 2-year-olds produced subject-object word order in 81% of cases, and the 3-year-olds even did so in 92% of cases.

Comparing children's performance on items for which they gave a scorable response in both comprehension and production, they were found to give more accurate responses corresponding to SVO word order in production than in comprehension. These results are mainly based on the 3-year-olds, since many of the 2-year-olds did not produce a sufficient number of scorable responses in production to be included in this comparison. This suggests that this asymmetry between production and comprehension is a pattern that is still firmly present in Dutch-speaking 3-year-olds. Note that the asymmetry observed in this study is not caused by differences in scorability between the conditions in the two tasks, nor by differences in children's vocabulary development, as none of our analyses showed an effect of vocabulary score. The results of the picture selection task and the parallel sentence elicitation task thus confirm the results of earlier studies using an act-out methodology (Cannizzaro, 2012, for Dutch; Chapman and Miller, 1975; McClellan et al., 1986, for English) that also observed an asymmetry between children's production and their comprehension of word order.

If this asymmetry between production and comprehension were an artifact of picture selection tasks and act-out tasks caused by their cognitive demands, we would expect children's eye gaze in the minimally demanding preferential looking task to show an adult-like pattern. The adults looked more toward the target picture corresponding to the correct interpretation within the first 1000 ms following the offset of the subject, with a mean proportion of looks to this picture of almost 0.80. Like the adults in the picture selection task, the children in the preferential looking task also looked more toward the target picture as the sentence unfolded. This indicates that the children possess some knowledge of the SVO word order of Dutch main clauses. Nevertheless, the children's mean proportions of looks to the target picture did not exceed 0.60 during the entire 3000 ms time window that was analyzed, suggesting only a weak preference for subject-object word order in comprehension. However, it cannot be ruled out that the different gaze patterns of adults and children are an effect of the different comprehension tasks used: the adults' gaze data was collected in a picture selection task, while the children's gaze data was collected in a preferential looking task. Although the preferential looking task was included because its task demands are believed to be low, it may have given rise to task-unrelated looking behavior in the older children, thus explaining their deviant gaze pattern compared to adults'. Indeed, according to Ambridge and Lieven (2011, p. 234–235) preferential looking tasks are seldom used with 3-year-olds because children this age find the task too easy and hence fail to pay attention. But note that the 3-year-olds in our study still did not show ceiling performance in the picture selection task, which does not suffer from this shortcoming. So although the 3-year-olds in our study may have found the preferential looking task too easy, the linguistic aspects of the task are still challenging for them.

In the picture selection task as well as the preferential looking task, children saw two animated pictures side-by-side on a computer screen, while they only saw one animated picture in the sentence elicitation task. However, it is unlikely that the simultaneous presentation of two animated pictures made these comprehension tasks too demanding for the children in our study, as several studies have successfully used intermodal preferential looking tasks with children well below age 2 (e.g., Hirsh-Pasek and Golinkoff, 1996; Candan et al., 2012). In fact, the first successful application of this task was with 4-month-old infants, who saw two events while hearing a non-linguistic auditive stimulus matching one of the events (Spelke, 1979). Thus, the comprehension tasks do not seem to be more difficult for children than the sentence elicitation task, which is supported by the higher scorability of children's responses in comprehension compared to their responses in production.

The observed asymmetry between production and comprehension cannot be explained by an overestimation of children's knowledge of word order in production (cf. Bates et al., 1995) either. First, the design of the sentence elicitation task was such that a correct response could not be given by merely repeating sentences that were heard before. Second, the animated pictures did not provide any clues for word order, only for agenthood. And third, in the sentence elicitation task the gaze patterns of the children who correctly produced utterances with subject-object word order were similar to the adults' gaze patterns, but merely delayed in time. Both children's and adults' gaze patterns reflected a search for the agent followed by a search for the patient, as was also found by Griffin and Bock (2000) for adult speakers of English. This suggests that the underlying processes of production in adults and children are the same.

Taken together, the two comprehension tasks and the production task thus reveal an asymmetry between production and comprehension in children's acquisition of transitive constructions in Dutch that does not seem to be explained by task effects. The finding of more advanced production than comprehension is in line with the predictions of the constraint-based Optimality Theory account of children's acquisition of word order in transitive constructions (Hendriks et al., 2005; Hendriks, 2014, 2016). In contrast, this asymmetry is not predicted by generative and constructivist approaches and may be challenging for them to explain. The observation of this production-comprehension asymmetry in children's acquisition of transitive constructions suggests that the form and the meaning of a transitive construction (for example, the form and the meaning of the transitive frame for pushing) are not acquired together. Instead, the form of the transitive construction seems to be acquired partly independently of its meaning. This follows from an Optimality Theory account, where production proceeds partly independently from comprehension (Smolensky, 1996; Hendriks, 2014, 2016). In this account, the pairing of form with meaning that characterizes linguistic constructions (e.g.,

Goldberg, 2006) gradually emerges as the by-product of acquiring the constraint ranking of the language. Only when the mapping from an input meaning to the optimal form in production and the mapping from an input form to the optimal meaning in comprehension result in the same form-meaning pairing, as happens under the adult ranking of the constraint but not yet young children's (e.g., Hendriks, 2016), is the result a consistent form-meaning mapping and hence a construction.

In addition to a production-comprehension asymmetry, the Optimality Theory account also predicts an effect of animacy on children's comprehension of transitive sentences due to the competition between word order and animacy, namely that children perform best if the subject is animate and the object is inanimate. No interaction effect of subject animacy and object animacy was found in the picture selection task, which would have been in accordance with the stronger version of the relational animacy constraint that requires subjects to be higher in animacy than objects (e.g., de Swart, 2011; de Swart and van Bergen, 2019). However, children were more likely to select the correct interpretation when the subject was animate and additionally were less likely to select the correct interpretation when the object was animate. This is in accordance with the weaker version of the relational animacy constraint (cf. Aissen, 2003). Crucially, the results are not explained by the inherent animacy bias, which predicts that all animate entities are activated and retrieved more easily, and hence incorrectly predicts that animate direct objects should show a processing advantage compared to inanimate direct objects.

Animacy effects in children's online comprehension in the preferential looking task were somewhat less pronounced but largely corroborate the offline findings, as a preference for animate subjects was found in the gaze patterns of the 3-year-olds (but not the 2-year-olds). The finding of animacy effects in offline and online comprehension thus confirms the results of earlier studies on Dutch and English that used an act-out methodology (on Dutch: Cannizzaro, 2012, Experiment 2; on English: Chapman and Miller, 1975; Thal and Flores, 2001; Chan et al., 2009; but see McClellan et al., 1986). The presence of animacy effects in both comprehension tasks provides evidence that children's poor comprehension of transitive sentences is not caused by the demands of the experimental tasks used. This is unexpected from the perspective of generative approaches, which would have to explain the poor comprehension by task demands, but is compatible with usage-based approaches that consider animacy a heuristic in language use.

Interestingly, animacy effects were also present in adults' response accuracy, RTs and gaze patterns in the picture selection task: adults were less likely to choose the subject-object interpretation, were slower to respond, and looked toward the picture reflecting this interpretation less strongly, when the subject was inanimate. This finding supports the view that animacy is not merely a heuristic that children rely on because of insufficient linguistic knowledge, but rather is a constraint of the adult grammar, albeit a weak constraint in Dutch that is generally overridden by the stronger word order constraint. It is also consistent with interactive sentence processing models in which animacy is considered an integral part of the form-to-meaning mapping, that is functionally equivalent to syntactic information such as word order (e.g., Bornkessel-Schlesewsky and Schlesewsky, 2009).

Not only did we find the predicted effects of animacy in comprehension, but we also found effects of animacy on children's produced forms – but not on their gaze patterns – in the sentence elicitation task, that were not predicted by the Optimality Theory account. Although the children produced sentences with subject-object word order in over 80% of cases, they were more likely to do so when the subject was animate. The effect of animacy on children's produced utterances could be due to the inherent animacy bias, which is argued to facilitate retrieval of animate entities from memory in sentence production (Bock and Warren, 1985; Branigan et al., 2008). If true, animacy has distinct effects in comprehension and production and competes with word order in children's comprehension of transitive sentences, giving rise to poor understanding, but has a facilitating effect in children's production of transitive sentences regardless of word order, leading to adult-like utterances.

In addition to effects of animacy, we also found effects of test verb, direction of action and side of the target picture. In the sentence elicitation task, children were more likely to produce subject-object order when the verb was *push* than when the verb was *pull*. Since the pre-test showed that the children could name the actions of pushing and pulling, it seems unlikely that this effect is caused by children's weaker knowledge of the verb *pull*. Possibly, the action of pulling may have been less salient in the pictures compared to the action of pushing, as the action of pulling could only be identified by seeing the rope between the puller and the one being pulled. This explanation is supported by the similar looking behavior of adults and children: they all looked more to the agent when the verb was *pull*, although for adults this looking pattern was limited to the first time window, consistent with their overall faster processing. In the same task, the children, but not the adults, were also more likely to produce subject-object order when the direction of the action was to the left. In addition, the adults in the picture selection task and the 2-year-olds but not the 3-year-olds in the preferential looking task were more likely to look at the target picture if it was on the left, although for adults this effect decreased over the course of the trial. It is not obvious how these effects could be related to our experimental materials, as direction of action and side of the target picture were balanced across conditions. Possibly, the preference of adults for pictures on the left is related to the left-first response bias observed by Koranda et al. (2020) for adults in the action domain, which they suggest could be due to the fact that reading in English (and therefore also in Dutch) leads to eye fixations being ordered from left to right. Because Dutch parents and their young children read picture books from left to right too, this could also explain the 2-year-olds' preference, which however did not surface in the 3-year-olds.

A limitation of this study is the severe data loss in the sentence elicitation task, in particular for the 2-year-olds. They produced a large number of unscorable utterances, which is not uncommon in sentence elicitation

tasks with 2-year-olds that aim to elicit syntactic as opposed to lexical data (see, e.g., Chapman and Miller, 1975; Verhagen and Blom, 2014). Necessarily, the analyses of the produced utterances and gaze data of the 2-year-olds in the sentence elicitation task should be interpreted with caution. But note that the general pattern of elicited production of our 2-year-olds appears to be in line with observations about spontaneous production at this age: although Dutch 2-year-olds still frequently omit subjects and objects, they already correctly use word order in their spontaneous speech (e.g., de Haan and Tuijnman, 1988).

This is the first study comparing offline and online comprehension and production of transitive sentences in the same Dutch-speaking children as well as adult controls. As we pointed out in Section "Background," the majority of main clauses in Dutch have SVO word order. The remaining main clauses in Dutch have other word orders, including OVS order. The accuracy results of the picture selection task confirm that Dutch-speaking adults interpret transitive sentences in isolation as SVO, as the adults in our study gave subject-object interpretations to the sentences they heard in 97% of cases. The offline and online results of the picture selection task and the preferential looking task additionally show that Dutch-speaking 2- and 3-year-old children still have difficulty using SVO word order consistently in their interpretations and are influenced by the animacy of subject and object.

In this study, we only looked at transitive sentences in isolation containing two definite full noun phrases. However, in natural conversations, features of the discourse context such as topicality or accessibility and formal and semantic features of the subject and object noun phrases such as definiteness or anaphoricity also play a role and may license word orders other than canonical SVO order. These context-dependent features of Dutch word order are expected to interact with canonical word order and animacy and to be acquired later. More research is needed to chart the developmental path of the use of these features in the production and comprehension of canonical and non-canonical word orders in the acquisition of Dutch.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This study involving human participants was reviewed and approved by Commissie Ethische Toetsing Onderzoek (CETO), University of Groningen. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

GC and PH contributed to the conception and design of the study, developed the coding guidelines, interpreted the results, and wrote the manuscript. GC carried out the experiment and performed the statistical analysis. Both authors read and approved the submitted version.

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Taking Construction Grammar One Step Further: Families, Clusters, and Networks of Evaluative Constructions in Russian

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We present a case study of grammatical constructions and how their function in a single language (Russian) can be captured through semantic and syntactic classification. Since 2016 an on-going joint project of UiT The Arctic University of Norway and the National Research University Higher School of Economics in Moscow has been collecting and analyzing multiword grammatical constructions of Russian. The main product is the Russian Constructicon (https://site.uit.no/russian-constructicon/), which, with over two thousand two hundred constructions (and more being continuously added), is arguably the largest openly available constructicon resource for any language. The combination of this large size with depth of analysis, containing both syntactic and semantic tags, makes it possible to view the interrelation of constructions as families and to discover trends in their behavior. Our annotation includes 53 semantic tags of varying frequency, with three tags that are by far more frequent than all the rest, accounting for 30% of the entire inventory of the Russian Constructicon. These three semantic types are Assessment, Attitude, and Intensity, all of which convey a speaker's evaluation of a topic, in contrast to most of the other tags (such as Time, Manner, and Comparison). Assessment and Attitude constructions are investigated in greater detail in this article. Secondary semantic tags reveal that negative evaluation among these two semantic types is more than twice as frequent as positive evaluation. Examples of negative evaluations are: for Assessment *VP tak sebe*, as in *Na pianino ja igraju tak sebe* "I play the piano so-so [lit. thus self]"; for Attitude *s PronPers-Gen xvatit/xvatilo (NP-Gen)*, as in *S menja xvatit* "I'm fed up [lit. from me enough]." In terms of syntax, the most frequent syntactic types of constructions in the Russian Constructicon are clausal constructions [constituting an independent clause like *s PronPers-Gen xvatit/xvatilo (NP-Gen)*] and constructions with the anchor in the role of adverbial modifier (like *VP tak sebe*). Our semantic and syntactic classification of this large body of Russian constructions makes it possible to postulate patterns of grammatical constructions constituting a radial category with central and peripheral types. Classification of large numbers of constructions reveals systematic relations that structure the grammar of a language.

Keywords: constructions, constructicon, Russian, semantics, syntax, classification

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INTRODUCTION

We focus our analysis on two large and partially overlapping networks of grammatical constructions in Russian, namely the Evaluative constructions used to express Assessment and Attitude. While Assessment and Attitude will be defined and elaborated in more detail below, suffice it to say here that Assessment is an evaluation of an item external to the speaker, whereas Attitude is an expression of how the speaker feels about something. Our analysis shows how grammatical constructions function as a structured system, in which the forms of constructions are motivated by their meanings, and meanings together with syntax and anchor words connect constructions to each other.

Our aim is to represent the Assessment and Attitude networks of constructions in terms of their internal structure, as given by the families and clusters defined below. This analysis will show both hierarchical relationships within the networks of constructions, as well as lateral relationships across families, clusters, and networks. These relationships will be modeled as radial categories. While strictly speaking our conclusions are limited to this dataset, given the large size of our sample—the largest analyzed in this way thus far—we suggest that it is likely that both the remainder of Russian constructions as well as constructions in other languages can be modeled in a similar way.

Before turning to our analysis, we explain our theoretical approach in terms of construction grammar and the larger project that has given rise to this analysis, known as the Russian Constructicon, described in the section "The Russian Constructicon." Our approach and the project provide a rich context for the analysis of the Assessment and Attitude constructions that follow in sections "A Network of Assessment Constructions: 4 Clusters and 25 Families" and "A Network of Attitude Constructions: 4 Clusters and 18 Families." The section "Overlap of Assessment and Attitude Networks of Constructions" focuses on the ways in which the networks of Assessment and Attitude constructions overlap, and our conclusions are gathered in the section "Conclusions." The result is a detailed demonstration of how grammatical constructions interact and in aggregate shape a linguistic system, with profound implications for the psychology of language.

Construction Grammar and Cognitive Linguistics

Our approach is informed by construction grammar, which is itself a subfield within cognitive linguistics. Three assumptions about the nature of language characterize cognitive linguistics (Langacker, 2008; Janda, 2015). The first is the minimal assumption that language phenomena emerge from general cognitive strategies. In other words, we can explain the behavior of language in terms of what is otherwise established in the fields of neurobiology and psychology about the behavior of the brain. This assumption obviates any need for a strict division between grammar and lexicon, since both are explained by the same cognitive system. The second assumption is that generalizations about language emerge from observations of language data. Consequently, cognitive linguistics is "usage based" (Diessel, 2015; Janda, 2019), meaning that cognitive linguistics makes no strict division between "langue" and "parole," and takes the latter as the basis for analysis. Therefore, corpora and other samples of language production are the focus of investigation. Finally, the third assumption asserts the central role of meaning for all language phenomena. Meaning is understood as grounded in human experience and elaborated by metaphor, metonymy, and blending, which supply the links in polysemous networks.

All three assumptions have direct consequences for construction grammar. In accordance with the minimal assumption, constructions cohere as a structured system following the same characteristics observed in cognitive categories, where there can be central and peripheral members (called "radial categories," see Rosch, 1973a,b), and members of different categories can overlap and be multiply motivated because the system is strongly interconnected. Grammar and lexicon are analyzed in a unified manner. The investigation of constructions is carried out by collecting usage data, particularly from corpora, and extracting patterns that emerge from that data, and therefore construction grammar is also usage-based. Because meaning is central, the semantic pole is an essential part of the definition of a construction, explained in detail immediately below.

Defining the Construction

Following Goldberg (1995, 2005), Croft (2001), Fried and Östman (2004), and Langacker (2008), we define the construction thus:

> Constructions are entrenched language-specific form-meaning pairings available at all levels of linguistic complexity.

More specifically, a construction consists of a semantic pole (its meaning), a phonological pole (its form), and a symbolic relationship between the two poles (Langacker, 2008). An example is the Russian construction *najti-Pst NP-Acc!*[1], literally "found X!" as in *Našli razvlečenie!* "What a bad way to amuse yourself! [lit. Found amusement!]." The semantic pole of this construction can be described thus: "The construction expresses the speaker's dissatisfaction with the interlocutor(s), who behave incorrectly (from the speaker's perspective) given the present situation." The phonological pole is a past tense form of the verb *najti* "find" followed by an accusative form of a noun which serves as a direct object. This example illustrates the often non-compositional and language-specific nature of constructions. The elements of this construction ("found" + a direct object) do not in themselves indicate dissatisfaction; the whole is something that cannot be predicted on the basis of the parts[2]. This construction

[1]For details about abbreviations and our system of naming constructions see the Appendix.

[2]It should be noted, however, that this construction has a specific prosodic contour that combines overall exclamatory intonation with additional stress on the verb. However, it is not clear whether this suprasegmental characteristic is necessarily associated with expressing dissatisfaction (and indignation in this case) rather than emphasizing the verb and the construction as a whole. We leave this issue for future investigation.

is specific to Russian: we do not expect to find an exact parallel in other languages, and in fact if we want to translate this construction into English, we need to render it in a variety of ways in different contexts. Three examples from the Russian National Corpus illustrate this.

(1) – *Vy, značit, emu den'gi poslali?* – ***Našli duru!*** *Ni kopejki.*
'– So, in other words, you sent him money? – **Do you take me for a fool?! [lit. Found fool!]** Not a kopeck.'

(2) *Provodil ja Sonju, vernulsja domoj, i mama govorit:* – ***Našel krasotku!*** *Odna štukaturka.*
'I walked Sonja to her place and when I got home, mom says: – **Some beauty you found yourself!! [lit. Found beauty!]** She's just plastered [with makeup].'

(3) *Xvatit smejat'sja v biblioteke.* ***Našli mesto!***
'Enough laughing in the library. **This is not the right place!! [lit. Found place!]**'

Note, however, that neither compositionality nor language-specificity are criteria for identifying a construction. All entrenched form-meaning pairings are constructions. The point of this example is rather to show that constructions can be non-compositional and language-specific.

From the perspective of construction grammar, the construction is the basic unit of language, and, conversely, a language is a system of constructions, also known as a "constructicon" (Fillmore, 2008; Fillmore et al., 2012). The construction is basic in the sense that it is the structure that is found throughout language, at all levels where meaning is expressed. This includes, at the minimal level, the morpheme, such as the prefix *na* (in *našli* "found"), which expresses perfective aspect[3]. Combinations of morphemes to form words are likewise constructions, as in *našli* "found," which contains three more morphemes: *š* here indexes the root "find," *l* marks past tense, and *i* marks plural. Our example *najti-Pst NP-Acc!* is of course a multi-word construction. Words and multi-word constructions combine to form phrases and sentences, which are also complex constructions. Further complexity is found at the discourse level with the structure of units such as requests, complaints, instructions, and the like. In its current form our Russian constructicon resource (described in more detail in the section "The Russian Constructicon" below) focuses on multi-word constructions, although in principle it would be possible to represent constructions at all levels from phonology to discourse.

The constructicon of a language is not merely an inventory. Constructions are related to each other, not just in terms of smaller parts (morphemes) being combined into units, but also in terms of relations between constructions. The idea that constructions form networks of related members was suggested by Goldberg (2005), using the example of English Subject Auxiliary Inversion, which is present in a wide range of constructions, among them questions (*Did he go?*), wishes/curses (*May you live a good life!*), negative conjuncts (*Never had she seen anything like it*), and positive rejoinders (*So do I*). Goldberg demonstrates that these constructions constitute a family based on semantic similarities, by sharing some or all of the following characteristics: the meaning of these constructions differs from that of a positive declarative sentence in that the framing is negative and/or non-declarative and/or narrowly focused and/or dependent on other clauses.

Our *najti-Pst NP-Acc!* construction belongs to a family of over a dozen constructions that signal disapproval of behavior, and in turn this family of constructions is multiply motivated, belonging to both the Assessment and the Attitude networks of constructions and thus forming a link between the two. The way in which families of constructions structure and link these two networks is described in more detail in sections "A Network of Assessment Constructions: 4 Clusters and 25 Families," "A Network of Attitude Constructions: 4 Clusters and 18 Families," and "Overlap of Assessment and Attitude Networks of Constructions" below. In aggregate, structured relationships like these constitute the constructicon that represents the language as a whole.

Further properties of the form and meaning of constructions that we observe in construction grammar include their idiomaticity, relationships to specific lexemes, and coercion of meaning.

Construction grammar views idiomaticity as a scalar phenomenon, with all constructions lying somewhere along a continuum between maximal idiomaticity, where a construction has fixed words and idiosyncratic syntax, to maximal schematicity, where a construction has open slots with few restrictions and typical syntactic patterns. For example, the English phrase *all of a sudden* is maximally idiomatic since it has fixed words that cannot be replaced or changed, and a syntactic pattern (quantifier + preposition + article + adjective) otherwise uncharacteristic of English. Moving slightly away from maximal idiomaticity is a phrase like *curiosity killed the cat*, where there are still absolute restrictions on the words and their forms, but the construction follows a canonical syntactic pattern, namely that of a transitive clause. Slightly further along the idiomatic <-> schematic scale we find items like *kick the bucket*, where most lemmas are fixed, but allow variation in grammatical categories, so one can use different forms of the verb, like past (*He kicked the bucket last week*) and imperative (*Go kick the bucket!*). Notice that the subject of *kick the bucket* is an open slot allowing all human (and possibly some animal) referents, and that this construction also follows the canonical transitive pattern. Also on this scale is a construction like *the X-er the Y-er* (as in *The bigger the better*), partly schematic because it has open slots albeit with some restrictions (they have to be adjectives referencing scalar qualities), but idiosyncratic syntax. Maximally schematic would

[3]Although morphemes are certainly "conventional, learned form-meaning pairings" (Goldberg, 2013, p. 17) and therefore can be treated as constructions, for some scholars it is debatable whether morphemes represent constructions on their own. The influential approach of construction morphology proposed by Booij (2010) treats morphemes not as constructions in their own right but rather as constituents of morphological constructions. For example, the English derivational suffix *-able* is analyzed as part of the construction [V_{tr} -able] (where V_{tr} stands for a transitive verb that attaches the suffix *-able* to produce a deverbal adjective).

be something like *NP + V + NP*, which represents a canonical transitive clause in English, consisting of only a pattern and open slots with few restrictions.

We can locate our *najti-Pst NP-Acc!* construction on the scale between idiomaticity and schematicity by observing its slots and syntax. Our construction has two slots: one slot that has a fixed lemma *najti* "find" that is restricted to past tense forms but allows variation in gender and number[4], and one slot that is open and can be filled with any referent that can appear as a direct object of the verb. In terms of syntax, this construction is mostly aligned with standard Russian syntax for a transitive clause (with a finite verb form and a direct object in the Accusative case), but deviates slightly in that the subject is necessarily elided[5] (in Russian it is sometimes possible to elide subjects, but not usually required to do so). In short, the *najti-Pst NP-Acc!* construction is partially idiomatic (one filled slot, restrictions on grammatical categories, requires elision of subject who is also the addressee) and partially schematic (one open slot, mostly follows usual structure of a transitive clause). Although everything on the spectrum from idiomatic to schematic is part of the constructicon of a language, our Russian Constructicon resource focuses on the items that are not at the extreme poles. In other words, we do not focus on constructions that are maximally idiomatic or maximally schematic. The reason for this is that the two poles of the continuum are already well represented in standard resources. Maximally idiomatic constructions are collected in phraseological dictionaries, and maximally schematic patterns are described in grammars. It is the constructions in between (termed "partially schematic" in Ehrlemark et al., 2016) that are the focus of our study.

Aside from the maximally schematic patterns, any given construction will usually have a special relationship to one or more lexemes. These special relationships come in two types: anchor words and common fillers. An anchor word is a fixed lemma in a construction, such as all the words in *all of a sudden* and *curiosity killed the cat*. Some anchor words participate in a large number of constructions, such as *time* in English (*time BE up*, *It's high time VP*, *This is not the time for VPing*). Common fillers are words that typically appear in the construction, such as *bigger*, *sooner* for the first slot and *better*, *harder* for the second slot of *the X-er the Y-er* construction. Fillers are thus variables that appear in open slots in constructions. Fillers often constitute semantic groups of words, as we see in the *VP into the phone* construction, where common fillers are speaking verbs like *yell*, *mutter*, *whine*. In our *najti-Pst NP-Acc!* construction *najti* "find" is an anchor word, and some common fillers for the open slot are illustrated in examples (1)–(3).

Coercion is a phenomenon related to the non-compositional and complex meaning of constructions. Many constructions influence the meanings of the words in the construction, causing them to express meanings that they don't otherwise have[6]. Sometimes coercion has a grammatical focus. The caused-motion construction of English can coerce an intransitive verb to express a transitive meaning, as in *The audience booed the comedian off the stage* (the caused motion construction, cf. Goldberg, 1995, p. 54), and the *NP all over (+ DP)* construction can coerce a count noun to be interpreted as a mass noun, as in *There was cat all over the driveway* (cf. Langacker, 2008, p. 144). More often coercion focuses on the lexical meanings and their pragmatic interpretations, as in *A(n) NP waiting to happen*, where a strong association with negatively evaluated situations causes even a neutral word like *event* to take on an ominous meaning: *an event waiting to happen* suggests danger that needs to be averted (cf. Stefanowitsch and Gries, 2003). Our *najti-Pst NP-Acc!* construction likewise coerces the meaning of its filler nouns, sarcastically forcing them to mean something like "the wrong NP, an NP I disapprove of" rather than just "NP."

To summarize, constructions are the basic unit of language, composed of a form and a meaning and exist at all levels of language. Constructions vary along a scale from idiomatic to schematic. Constructions can invoke meanings that are not derivable from their components and can even coerce their components to express meanings that they are not usually associated with. An entire language can be modeled as a structured system of constructions, linked by meaning, syntax, and anchor words. This article is primarily focused on the last point, namely the way in which constructions constitute a language. We observe two kinds of structure in the system of the constructicon, namely hierarchical and overlapping patterns. These patterns are explored in more detail in sections "The Russian Constructicon" through "Overlap of Assessment and Attitude Networks of Constructions."

THE RUSSIAN CONSTRUCTICON

The Russian Constructicon is a free open-access electronic resource that offers a searchable database of Russian constructions accompanied with descriptions of their properties and illustrated with examples from the Russian National Corpus (www.ruscorpora.ru). The Russian Constructicon is designed for both linguists and second language learners of Russian, focusing on solid analyses of constructions as well as their annotation in terms of semantic types, syntactic patterns, morphological categories, semantic roles, and levels of language proficiency (Janda et al., 2018). Search functions make it possible to filter constructions for all of these features, as well as to access all of these features for each individual construction. The project

[4]In such cases, the name of the construction indicates the anchor verb in the infinitive form and restricts its variation to the past tense: *najti-Pst*. For more details on our system of naming constructions see the Appendix.

[5]This is the reason why the name of this construction does not indicate the standard subject position NP-Nom, as opposed to verb argument constructions with specific anchor verbs like *NP-Nom predstavljat' iz sebja NP-Acc* (illustrated in **Table 1**).

[6]Coercion effects can be observed in morphological constructions. Booij (2016, p. 429) argues that in the English $[un\text{-V}]_V$ construction, the attachment of the prefix *un-* to stative verbs like *see* and *have* coerces these verbs to denote telic achievements, as observed in these examples from Bauer et al., 2013, p. 375, *And once you've seen it, you can never unsee it; The other big difference is once you have AIDS, you can't unhave it*. Booij (2016, p. 429) points out that "it is the construction as a whole that imposes this interpretation of telic achievements on these *un-* verbs," and this comports with his approach to morphemes as constituent parts of constructions.

page is available at https://site.uit.no/russian-constructicon/ (for more information on the analysis of constructions in the Russian Constructicon see Endresen et al., 2020; Janda et al., forthcoming).

Constructicons are being built for a limited number of languages: English, Swedish, German, Spanish, Brazilian Portuguese, and Japanese. The Russian Constructicon joined this movement and is currently a part of the international enterprise termed multilingual constructicography (Lyngfelt et al., 2018).

The Russian Constructicon is a joint project administered over 5 years (2016–2020) as a collaboration between two educational and research institutions: UiT The Arctic University of Norway (CLEAR research group) in Tromsø and the National Research University Higher School of Economics in Moscow (School of Linguistics). The building of this resource has been supported by two grants received from the Norwegian Agency for International Cooperation and Quality Enhancement in Higher Education [Diku, https://diku.no/en: "Constructing a Russian Constructicon" (NCM-RU-2016/10025) in 2016 and "Targeting Wordforms in Russian Language Learning" (CPRU-2017/10027) in 2017-2020].

The team working on this project includes Laura A. Janda, Tore Nesset, Anna Endresen (UiT); Ekaterina Rakhilina, Olga Lyashevskaya, Valentina Zhukova (HSE); Daria Mordashova (Institute of Linguistics, the Russian Academy of Sciences); and Francis M. Tyers (Indiana U). The website is currently under construction by Radovan Bast (Section for Digital Platform and Operation, UiT).

Semantic Annotation of Constructions

Consistent with the assertion of cognitive linguistics that meaning plays a central role in language, we observe that the primary way in which constructions are organized is according to their semantics. With respect to the over 2,200 constructions in our Russian Constructicon resource, we find 53 meanings that yield both hierarchical and lateral (overlapping) groupings. These meanings are represented as semantic tags in the Russian Constructicon.

Semantic tags were assigned by a panel of three native speakers of Russian (including a co-author of this article) who are also linguists actively engaged in development of the content of the Russian Constructicon resource. The three taggers worked together as a panel and discussed each of over 2,200 constructions in weekly digital meetings over a period of several months. As a result, assignment of semantic and syntactic tags for individual constructions has not been a matter of individual decisions but rather an outcome of a panel decision that was often reconsidered and refined with time. As our classification of semantic and syntactic types of constructions evolved, we came back to already analyzed cases and re-analyzed them, taking into account newly gained knowledge and newly added constructions. Although any semantic interpretation of linguistic data might be regarded as subjective to some degree, we believe that using a panel of taggers helped our project to minimize the subjectivity in the analysis and secure the reliability of the outcome. This approach made it possible to control for identical and consistent understanding of the terminology used in tag-assignment and adopted by all three taggers. The terminology evolved together with the classification of constructions and the size of the database. Our system of semantic tags is to a large degree based on the categories and terminology used in typological literature [cf. the "universal grammatical set of meanings" (Plungian, 2011, p. 65) among others].

The taggers took into account corpus data as well as independent previous scholarship on individual constructions and groups of constructions. For example, in distinguishing between apprehensive and preventive constructions we followed Dobrušina (2006), recognized the types and subtypes of concession constructions according to Apresjan (1999), and consulted Rakhilina (2013) while analyzing continuative prohibitive constructions.

Figure 1 displays the twenty most frequent semantic tags and their overall distribution in our database. Each of these tags is assigned to more than fifty individual constructions. The tags are listed on the left, and the bars visualize the raw numbers of constructions they describe. The numbers of constructions are provided for each bar.

The tags represented in **Figure 1** refer to major semantic types of constructions. Most of these major types have an additional level of granularity represented by their subtypes that yield an overall inventory of 173 specific sub-tags. For instance, the general type Comparison has subtypes such as Inequality, Equality, Similarity, Contrast, and Imitation, following the standard typology of comparative constructions (Treis, 2018). Many constructions (over 40%) belong to more than one major semantic type, and therefore carry two or more major tags and corresponding sub-tags. Using our annotation, we can identify those semantic types of constructions that overlap with each other.

We do not exclude the possibility that when more constructions are added to the Russian Constructicon, new tags will have to be used to account for their semantics. However, the amount of data collected so far suggests that most major semantic types are already represented and identified.

Figure 1 shows that the evaluative meanings of Intensity, Assessment, and Attitude constitute the three semantic types most frequently attested in the Russian Constructicon database. They are assigned to 280, 224, and 222 constructions, respectively. Interestingly, the networks of Assessment and Attitude constructions are of approximately the same size. These networks overlap in 58 constructions that express both Assessment and Attitude.

Taking this overlap into account, we can calculate that Assessment and Attitude constructions yield 388 items, or 18% of the entire database (2,210 constructions) and thus represent a group larger than Intensity (280 constructions, 13%). As we show in sections "A Network of Assessment Constructions: 4 Clusters and 25 Families" and "A Network of Attitude Constructions: 4 Clusters and 18 Families," both Assessment and Attitude constructions can be analyzed in terms of semantic subtypes and in terms of positive vs. negative values.

Semantic tags make it possible to subdivide the collected inventory of constructions into meaningful classes and smaller groups of constructions, turning an initial list into a structured

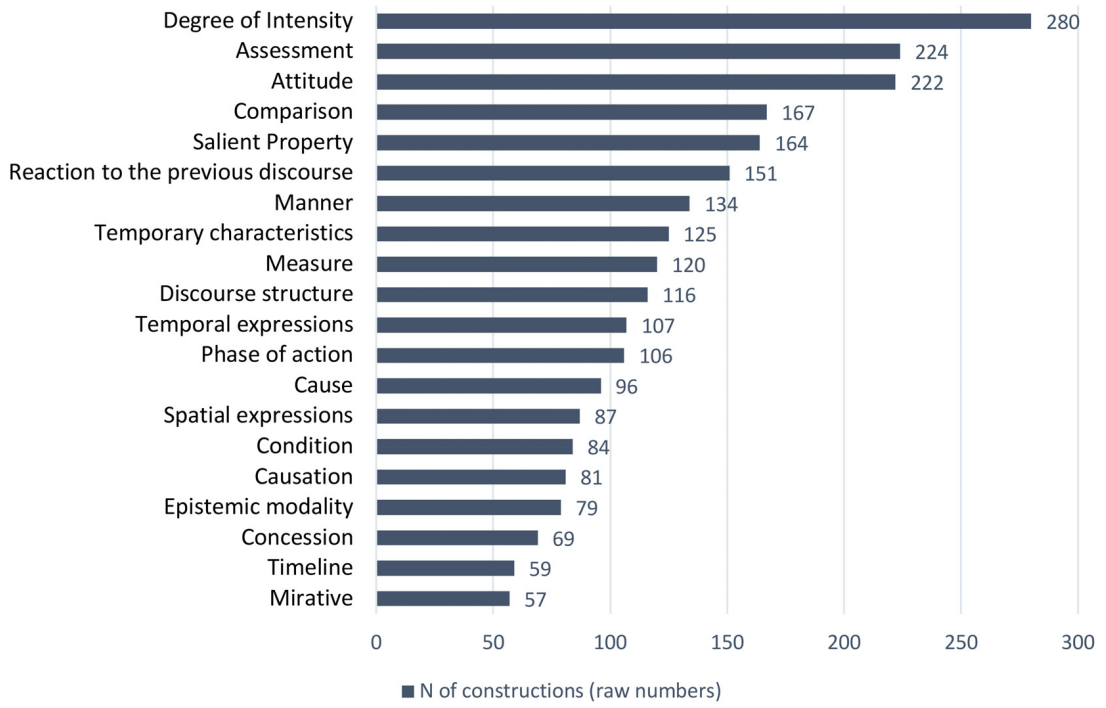

FIGURE 1 | Distribution of constructions across twenty major semantic tags of top frequency.

network. Those constructions that belong to the same semantic subtype often share some syntactic (syntactic function in a clause, the structure of the anchor part) and structural properties (such as negation, inversion, or reduplication). Such groups of constructions form families, and families form clusters, as we detail in the next subsection.

Hierarchical Patterns Within the Constructicon

We find hierarchical patterns within the Russian Constructicon, where we can identify three levels, which we term "Families," "Clusters," and "Networks."

Families are smaller groups, usually of 2–9 constructions. **Table 1** displays three families of constructions used to express evaluation of objects and actions in the cluster *Assessment in relation to norms/expectations* of the Assessment network.

In **Table 1**, notice that the constructions in each family are nearly synonymous, and some of them also share similar syntactic structure and anchor words. The constructions in Family 1 all evaluate an object as important, though this evaluation can be negated as well. In contrast, the constructions in Family 3 necessarily evaluate the object as inadequate. Family 2 is specialized to the evaluation of activities. Syntactically we see some parallels, for example in Family 1 there are two constructions consisting of an NP followed by the preposition *v* and a noun in the Locative case (*NP-Nom Cop v cene* and *NP-Nom Cop v počete*). Also in Family 1 we see five constructions exhibiting the canonical syntax of a transitive clause [*NP-Nom ne igrat' (nikakoj) roli*, *NP-Nom imet' (Adj) značenie*, *NP-Nom ne imet' (Adj) značenija*, *NP-Nom igrat' Adj rol'*, *VP NP-Acc s rukami (i nogami)*]. Both constructions in Family 2 use the Genitive case to signal quantification. Family 3 is syntactically somewhat diverse, but contains three constructions with adverbial phrases modifying NPs (*vsego liš' NP*, *vsego-navsego NP*, *sovsem ešče NP*). In terms of anchor words, the collocations *imet' značenie* "have meaning" and *igrat' rol'* "play role" are important in Family 1; in Family 2 both constructions contain the verb *stoit'* "cost," and in Family 3 we see that forms of the determiner *ves'* "all" recur.

Expansion of the Russian Constructicon

Organization of constructions in terms of families, clusters and networks helped us to expand the scope of the Russian Constructicon by filling out the families of constructions.

Figure 2 visualizes the key stages of database expansion: start of the project, initial inventory, corpus-based expansion, and system-based expansion, showing how many constructions the database contained at each stage.

An initial inventory of 660 constructions was amassed manually from a variety of sources including textbooks for learners of Russian and scholarly literature on Russian constructions, as well as a crowd-sourced Google spreadsheet. We then added 407 constructions using manual text analysis, by culling from running texts of various kinds, particularly those that contain dialogs and spoken discourse, as well as an automatically extracted list of highly frequent collocations attested in the Russian National Corpus. Thus overall, 1,087 constructions were added through corpus-based means. This method does not target semantic or syntactic types, but relies instead on the unpredictable appearance of constructions in running text. Subsequently we worked in a different direction and

TABLE 1 | Three families of Assessment constructions.

Name of construction	Short Illustration	English [+ literal translation]
Family 1: Evaluation of an object as important		
NP-Nom Cop v cene[7]	*Ran'še družba byla v cene*	"Friendship used to be appreciated [lit. earlier friendship was in price]."
NP-Nom Cop v počete	*Fiziki u nas v počete*	"Physicists are highly respected here [lit. physicists by us in honor]."
NP-Nom imet' (Adj) značenie	*A kakoe èto imeet značenije, ždali ètu junuju ledi ili ne ždali?*	"Does it matter [lit. what this has meaning] whether they waited for the young lady or not?"
NP-Nom ne imet' (Adj) značenija	*Den'gi uže ne imejut značenija*	"Money plays no role anymore [lit. already not have meaning]"
NP-Nom igrat' Adj rol'	*Odežda igraet važnuju rol' na sobesedovanii*	"Clothes play an important role at a job interview"
NP-Nom ne igrat' (nikakoj) roli	*Èto obstojatel'stvo ne sygralo v ego sud'be nikakoj roli*	"This circumstance made no difference in his life [lit. did not play in his fate no role]."
VP NP-Acc s rukami (i nogami)	*V sekciju po plavaniju menja brali s rukami i nogami – ja pokazyvala neploxie rezul'taty.*	"I was easily accepted into the swimming sports club [lit. they took me with arms and legs], because I was good at it."
NP s bol'šoj bukvy	*On vrač s bol'šoj bukvy*	"He is a very good doctor [lit. spelled with a capital letter]"
NP-Nom Cop u PronPoss-Gen nog	*Ves' mir u našix nog*	"We have power/control over others [lit. the whole world is at our feet]"
Family 2: Evaluation of an activity as worth doing		
NP-Nom togo stoit'	*Poezdka v Afriku togo stoit*	"The trip to Africa is worth taking [lit. trip that costs]"
NP-Nom stoit' desjati NP-Gen	*Odin čas obščenija s uvlečennym i znajuščim čelovekom stoit desjati pročitannyx knig*	"An hour of talking to an enthusiastic and competent person equals the effect of having read 10 books [lit. costs ten read books]"
Family 3: Evaluation of an object as unimportant		
vsego liš' NP	*Ona vsego liš' medsestra*	"She is just a nurse [lit. all only nurse]"
vsego-navsego NP	*Èto byl vsego-navsego staryj divan*	"This was merely [lit. all on all] an old sofa"
Cl, (a) tak, Cl	*Ona mne ne nravilas', a tak, balovstvo odno*	"I didn't like her, you see [lit. and thus], I was just having fun"
(s)dat'sja-Pst PronPers-Dat ètot NP-Nom!	*Dalsja tebe ètot neudačnik!*	"There's a loser for you! [lit. gave-self to you that loser]"
sovsem ešče NP	*On sovsem ešče mal'čik*	"He is just [lit. entirely yet] a boy"
Cl, čto s NP-Gen Cop vzjat'?	*On daže ne zakončil školu, čto s nego vzjat'?*	"He did not even graduate, what can you expect of him? [lit. what from him take]"
čto/čego s NP-Ins Cop govorit'/sporit', Cl	*čto s nim govorit', on vse ravno sdelaet po-svoemu*	"There's no point talking with him [lit. what with him talk], he will just do what he wants anyway"
NP-Nom predstavljat' iz sebja NP-Acc	*Ty iz sebja voobšče ničego ne predstavljaeš'!*	"You're completely irrelevant! [lit. you from yourself in general nothing not represent]"

applied a method of system-based expansion of the database. This method entailed examining semantic families of constructions already in the database and searching for synonyms, antonyms, and related constructions containing the same or similar anchor words in order to fill gaps in each family (mostly using native intuition). We therefore classified the first 1,087 collected constructions into meaningful families and clusters and added the missing constructions to each family. This process yielded 1,123 new items, and the database reached the current size of 2,210 constructions. Comparing the 407 corpus-based added items vs. 1,123 system-based added items shows that the latter methodology turned out to be almost three times more effective (2.8 times, to be precise). In other words, our efficiency in discovering additional constructions was aided by the classification: once we knew what to look for, constructions became easier to find.

Our work on semantic groups of constructions turned what initially was a list of unrelated items into a structured inventory of constructions, where we have plenty of relevant information on both hierarchical and lateral relations among and across constructions. We can now show how families form clusters and how these groupings overlap with each other by sharing some of the same members. Moreover, we are now in a position to estimate the amount of overlap for various semantic types and syntactic patterns of constructions and to show how semantic types and syntactic patterns of constructions can relate to each other.

[7] See the **Appendix** for the list of abbreviations and explanation of how the names of constructions represent their morphosyntactic structure. Each slot and morphological specifications in the names of constructions are verified by data from the Russian National Corpus, supplemented by internet searches where data is sparse.

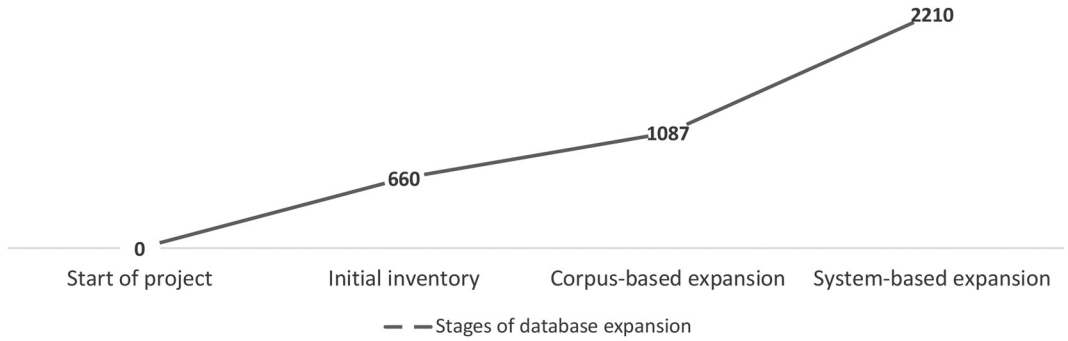

FIGURE 2 | Stages of database expansion and the cumulative size of the database at each stage.

A NETWORK OF ASSESSMENT CONSTRUCTIONS: 4 CLUSTERS AND 25 FAMILIES

Overview

Assessment constructions express evaluation of an item external to the speaker. This item can be understood as an object of Assessment, using the word "object" in a broad sense. An object can be a physical object, or an animate participant in a situation, or a situation itself. For example, Assessment constructions can evaluate someone's appearance or intellectual capacity. We analyze Assessment constructions in terms of semantic types and in terms of the polarity values they carry, that is positive vs. negative Assessment.

Overall, out of 224 (100%) constructions, there are almost twice as many constructions that encode negative Assessment as opposed to those that express positive Assessment (109 vs. 57 items, or 49% vs. 25%). A set of 58 constructions (26%) can express either of the two values depending on the lexical fillers of their slots (as in *na redkost' Adj/Adv* used in both *na redkost' umnyj* "unusually smart" and *na redkost' lenivyj* "unusually lazy [lit. on rareness]") and the possibility of negation (as in *VP (ne) k mestu* "do something (not) to the point [lit. (not) to place]," e.g., *Ty očen' k mestu èto skazala* "You said it very much to the point" vs. *On ljubut ne k mestu pošutit'* "He tends to tell inappropriate jokes").

Arutjunova (1988) provides a detailed overview of several influential theories of Assessment, showing how they matter for understanding linguistic data, summarizing works by Aristotle, Kant, Perry, Hare, Wittgenstein, Vendler, and many others. Value is a complex category that has been discussed broadly in philosophy, ethics, and logic (cf. theory of value, discussion of moral value, the nature of goodness and other issues). Following "The Varieties of Goodness" by von Wright (1963) and applying his taxonomy to data on Russian value predicates (mostly adjectival), Arutjunova (1988, p. 75) suggests that axiological meanings expressed linguistically can be broken down into two major types: General Assessment ("obščaja ocenka") and Specific Assessment ("častnaja ocenka"). General Assessment is an overall, undifferentiated Assessment that evaluates an object holistically, approaching it as a whole. General Assessment is expressed by the adjectives that denote "good" or "bad" and their synonyms that vary in terms of expressivity and stylistics (e.g., *prekrasnyj* "wonderful," *zamečatel'nyj* "excellent," *durnoj* "nasty," etc.). By contrast, Specific Assessment evaluates an object not as a whole but from one of various possible perspectives, focusing on a single property of an object. For example, Specific Assessment can refer to evaluation of physical qualities (like shape or smell) or the usefulness of an object. Having re-classified and somewhat simplified the taxonomy of values described by von Wright (1963), Arutjunova suggests that Specific Assessment can be further subdivided into Sensory, Ethical and Aesthetical, and Rationalistic types.

In our analysis of Assessment constructions attested in Russian, we adopt the distinction of General vs. Specific Assessment discussed in von Wright (1963) and Arutjunova (1988), but we group the specific subtypes of the latter in a different way, as motivated by the data we analyzed[8]. In this section we identify several crucial semantic types of Assessment constructions in Russian and model their relationship as a radial category of families and clusters that form a network of constructions.

A Radial Category Model

Figure 3 presents a radial category model of Assessment constructions, showing how they form families and clusters, and how these units are related to each other within this network. Large boxes visualize clusters of constructions, smaller boxes represent families, and lines between boxes connect clusters and families that are closely related in terms of semantics or/and involve the same individual constructions. Solid lines indicate both conceptual closeness and overlaps between the groups (observed when constructions are associated with more than one family or cluster). Dashed lines link the groups that exhibit conceptual closeness only. The thickness of the box contour and the size of the box represent the type frequency which is likely indicative of relative entrenchment of the cluster in the network. The visualization is determined by these observed relationships.

[8] A detailed comparison of our radial category model of Assessment constructions with types proposed by von Wright (1963) and Arutjunova (1988) goes beyond the scope of this article.

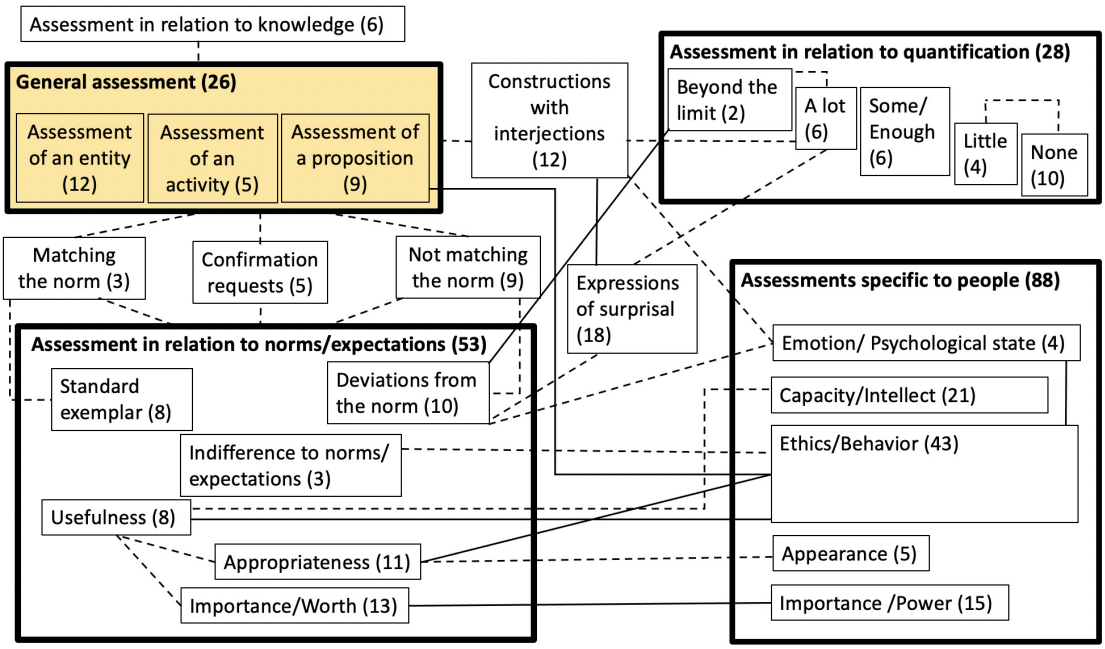

FIGURE 3 | A radial category model of the network of Assessment constructions.

Numbers in parentheses are type frequencies for each family and cluster, that is the number of individual constructions from our dataset that belong to each unit. The classification of constructions across these families and clusters results from our analysis of data and has been verified against the intuitions of two additional taggers.

Figure 3 shows that Assessment has several dimensions. We distinguish between General Assessment, Assessment in relation to quantification, Assessments specific to people, and Assessment in relation to norms/expectations. The two latter clusters are the most prominent in terms of type frequency. Assessment related to knowledge is a distinct type of Assessment that is encoded by a family of six constructions. Because it does not belong to any of the four large clusters, we represent it as a separate structural unit of the network. Many families belong to more than one cluster at the same time: *Matching the norm, Confirmation Requests, Not matching the norm, Constructions with interjections* and *Expressions of surprisal*. We call them "transitional" and represent them by boxes placed outside the clusters. These families are connected by lines to those clusters where they belong.

General assessment is conceptually the most basic and prototypical type of assessment and is most intensively connected with all other clusters, a further indication of its prototypicality (Lewandowska-Tomaszczyk, 2007). In **Figure 3**, the prototypical cluster is shaded.

Figure 3 represents transitional families that belong to two or more clusters. **Table 2** provides type frequencies for each cluster, both without and including transitional families.

The total is larger than 224 constructions because some of these constructions belong to multiple families.

Table 2 makes it possible to estimate the degree of overlap between the four clusters, that is the number of constructions that belong to more than one unit of this network is 71 constructions, yielding 32% of our sample of Assessment constructions (where 224 = 100%)[9].

In what follows we present each cluster and briefly characterize the families it contains.

TABLE 2 | Distributions of Assessment constructions across the four clusters.

Cluster	Number of constructions	Number of constructions including transitional families
General assessment	26	26 + 3 + 5 + 9 + 12 = 55
Assessment in relation to norms/expectations	53	53 + 3 + 5 + 9 + 18 = 88
Assessment specific to people	88	88 + 12 = 100
Assessment in relation to quantification	28	28 + 12 + 18 = 58

General Assessment

General assessment is the most basic type of assessment not restricted to a certain domain and expressed by 26 constructions in our database. General Assessment refers to an overall evaluation of an object (in the broad sense) as a whole. Each construction in this cluster contains evaluative lexemes that

[9]We calculate this by adding the number of constructions from transitional families (3 + 5 + 9 + 12 + 18 = 47) and the number of constructions with multiple motivations inside the four clusters (26 + 53 + 88 + 28 + 6 + 47-224 = 24).

denote "good" or "bad." For example, in the construction *dela (u NP-Gen) Cop ploxi* (as in *Dela u nego ploxi* "Things go wrong for him [lit. affairs by him bad]"), the anchor includes the adjective *ploxoj* "bad" that clearly encodes negative evaluation of a situation.

Russian offers a range of various partially schematic expressions that often carry colloquial flavor and are more or less semantically equivalent to the "neutral" standard lexemes *xorošij* "good" and *ploxoj* "bad." Syntactically, such constructions represent a variety of patterns, mostly populating three syntactic subtypes: (1) constructions with a predicative anchor part, (2) constructions where the anchor functions as an adverbial modifier, and (3) biclausal constructions with matrix predicates in the main clause. Each of these syntactic types is compatible with both positive and negative evaluative semantics, as illustrated in the following three paragraphs. These subtypes form families of constructions that we term *Assessment of an entity, Assessment of an activity,* and *Assessment of a proposition* respectively.

The Family *Assessment of an Entity*

Predicative phrases with positive assessment include constructions like *NP-Nom Cop ničego (takoj-Nom)* (as in *professor on byl ničego* "He was an okay professor [lit. nothing]"). Examples of predicative phrases with negative evaluation come from the constructions *NP-Nom Cop ne očen'* (as in *Dlja stojanki mesto ne očen'* "The place is not so good for parking [lit. not very]"), *NP-Nom Cop tak sebe* (as in *kartina tak sebe* "the painting is so-so [lit. that self]"), and *NP-Nom Cop ne axti (kakoj-Nom/kakoj Adj-Nom/kakoj Noun-Nom)* (as in *Iz-za vetra skorost' byla ne axti* "Because of the wind the speed was not so good [lit. not ah]").

The Family *Assessment of an Activity*

Constructions with the anchor in the role of adverbial modifier include similar expressions encoding positive assessment: *VP na slavu* (as in *Prazdnik udalsja na slavu* "The party was a success [lit. on glory]"), and *VP ničego* (as in *Kormili v našej stolovoj ničego* "The food in our canteen was okay [lit. They fed in our canteen nothing]"). Negative assessment is expressed in adverbial constructions like *VP tak sebe* (as in *Na pianino ja igraju tak sebe* "I play the piano not so well [lit. that self]") and *VP-Ipfv počem zrja* (as in *Paša rugaetsja počem zrja každyj den'* "Paša (diminutive from Pavel) argues indiscriminately [lit. how-much in vain] every day."

The Family *Assessment of a Proposition*

Biclausal constructions of General Assessment contain matrix predicates that are elaborated in a subordinate clause. For example, in the construction *PronPoss sčast'je, čto Cl* (as in *Ego sčast'je, čto rejs zaderžali, inače by ne popal na samolet "He was lucky* [lit. his happiness] that the flight was delayed, otherwise he would not have gotten on the plane"), the matrix is the anchor noun *sčast'je* 'happiness', and it requires a dependent clause that explains the grounds for the evaluation. Another good example of this pattern comes from the construction *NP-Nom Cop, konečno, NP-Nom, čto Cl* (as in *Ja, konečno, durak, čto poslušalsja tebja* "I am, of course, a fool, that I followed your advice"), where the matrix predicate is not the anchor but a slot that can be filled with evaluative nouns of either positive or negative value: *molodec* and *umnica*, both meaning "attaboy," or *durak* and *glupec*, both referring to a "fool."

Previous scholarship suggested that General Assessment predicates tend to be semantically deficient and therefore require context to support the evaluative judgment (Arutjunova, 1988, p. 92–94). Our data support this claim in that the biclausal constructions with evaluative matrix predicates attach a subordinate clause that substantiates and specifies the meaning of the main clause. Another way to compensate for the informative deficiency of evaluative predicates is to describe the domain of goodness/badness of an object via the instrumental case. As an example, consider the construction *NP-Nom Cop xorošij-Short/ploxoj-Short NP-Ins* (as in *èti mesta xoroši svoimi lesami* "These places are good in terms of their forests [lit. by their forests]," where the noun *lesa* "forests" is used in the instrumental case) (cf. Arutjunova, 1988, p. 94 for discussion).

Summing up, General Assessment contains subgroups of constructions that are defined in terms of both semantic and syntactic properties. On the one hand, semantics is expressed in the syntactic structure, and on the other hand, the syntax predetermines nuances of semantics. Thus, we arrive at a more or less homogeneous group of constructions at the intersection of semantics and syntax, taking both of these characteristics into account.

Assessment in Relation to Norms/Expectations

Previous studies of value predicates showed that the concepts of the norm, the standard, and the expectations associated with them play a crucial role in motivating the linguistic expressions of Assessment. In this sense, Assessment constructions serve as a type of reference point constructions, and the latter are considered pervasive in human cognition (cf. Rosch, 1977, 1978; Langacker, 2008, p. 83–85). The concept of the norm refers to cultural and social conventions that constitute an idealized model of the world that people often rely on (cf. Arutjunova, 1988, p. 202). In cognitive linguistics, this idea has been discussed in terms of Idealized Cognitive Models (Lakoff, 1987) that structure our background knowledge, and in terms of "mental spaces" (Fauconnier, 1985) that represent cognitive constructs of potential worlds relevant for human communication. When evaluating, speakers tend to compare the evaluated object to their idealized cognitive model, which functions as a standard. The idea of what is normal suggests to the speaker what to expect. A failure to match the expectations can cause a surprise, often an unpleasant one. Usually, matching the norm yields positive assessment, whereas deviations from the norm motivate negative assessment.

We find that these concepts are crucial for understanding a prominent group of constructions that encode Assessment in terms of what is normal, standard, and/or expected. Here we can observe the association of positive vs. negative values and matching vs. non-matching of the norm in three families of

constructions. These families are transitional in nature and can be best understood as belonging to two clusters: General Assessment and Assessment in relation to norms.

The first family is termed *Matching the norm* and includes three constructions with anchor words that refer to norms and standards: *VP kak nado* (as in *Otec gotovil jaičnicu kak nado* "Father fried the eggs just right [lit. like need]"), *VP kak sleduet* (as in *On rabotal kak sleduet* "He worked properly [lit. like follows]"), and *NP-Nom Cop čto nado* (as in *Prazdnik čto nado* "The party is super-duper [lit. what need]"). All three constructions express positive evaluation motivated by the semantics of fitting into the standard, expected and proper performance.

The other family is termed *Not matching the norm* and includes nine constructions that encode negative evaluation. Constructions of this type formally resemble general holistic positive evaluation, but in fact mean the opposite, ironically pointing to deviations from the standard/norm. Examples include *xorošij-Short NP-Nom!* (as in *Xoroš učenyj!* "The opposite of a good scholar! [lit. Good scholar!]"), *tot ešče NP* (as in *To ešče udovol'stvie!* "A notorious [lit. that yet] pleasure!"), *tože mne NP-Nom!* (as in *Tože mne geroj!* "A false/pseudo- [lit. too to me] hero!"). Most constructions of this semantic type share a certain syntactic pattern: they represent exclamatory clausal statements that assign a name to an object of evaluation that does not deserve this name. The exclamatory intonation emphasizes the speaker's resentment about the mismatch between the evaluated object and the name or status it has been assigned: e.g., [*ešče (i)] NP-Nom nazyvaetsja*, as in *Moloka ne daet. Korova nazyvaetsja!* "It gives no milk. What a bad cow it is! [lit. cow is-called]."

A third transitional family of constructions contains *Confirmation requests* that seek to establish whether an object corresponds to the normal representative of a category X. Syntactically, such constructions share the patterns of rhetorical questions like *razve ne NP-Nom Cop?* (as in *Razve ne krasota?* "Isn't it a beauty? [lit. really not beauty]") and *Cl, čem Cop ne NP-Nom* (as in *Prismotris' k Miše. Čem ne ženix?* "Take a better look at Miša. As good a bridegroom as any/In what respect is he not a bridegroom? [lit. which not bridegroom]"). Although formally the speaker is questioning whether the object matches the norm, the form of these questions indicates that the assumption behind them is that the object clearly does so, and positive evaluation is conveyed by establishing this correspondence between the object and the norm.

Apart from these transitional families, the cluster Assessment in relation to norms/expectations also includes the families *Deviations from the norm* and *Standard exemplar*. Closely related to the concept of the norm and expectedness are the families *Appropriateness, Importance/Worth, Usefulness,* and *Indifference to norms/expectations*.

The family *Deviations from the norm* includes 10 constructions that specify in what respect the norm is not matched. For example, many constructions in this group refer to a large size or a large number of objects, and this relates them to the Quantification cluster: consider the construction *NP-Gen.Pl Cop vyše kryši/golovy* (*Problem vyše kryši* "Problems through the roof [lit. higher roof]"). Some constructions in this family refer to deviations from the norm that come with positive evaluation, like *ničego sebe (takoj) NP* (as in *Ničego sebe mašina!* "Wow, what a car! [lit. nothing itself car!]"). Other constructions specify deviations that are compatible with both positive and negative views of the situation. For instance, the construction *na redkost' Adj/Adv* "unusually [lit. on rareness!]" supports both types of uses: *na redkost' krasiv* "unusually pretty" and *na redkost' glup* "unusually stupid."

The family *Standard exemplar* is a group of eight constructions that evaluate an object as the most prominent of its kind, the best example of a category. Most constructions in this family share a non-trivial structural property: a reduplicative nominal pattern, where the noun is repeated in the same or a different grammatical case. Examples of such constructions are *NP-Nom Cop vsem Noun-Dat.Pl ∼Noun-Nom* (as in *Vsem borščam boršč* "The best vegetable soup of all [lit. to all soups soup]") and *NP-Nom Cop Noun-Nom ∼Noun-Ins* (as in *On takoj glupyj, durak durakom* "He is so stupid, a fool times two [lit. fool by-fool]," cf. a detailed discussion of this construction in Janda et al. (2020) and references therein). A closely related subset of constructions compares the object to the standard and indicates that the object is so standard that this makes it average, unremarkable, ordinary, and unimpressive. The construction *(èto Cop) Noun-Nom kak ∼Noun-Nom* (as in *Xleb kak xleb* "Just normal bread [lit. bread like bread]") evaluates the standard exemplar positively, whereas the construction *(nu) XP i ∼XP* (as in *Byl u teti Maši kot. Nu kot i kot. Ničego osobennogo* "Aunt Maria had a cat. Just an ordinary cat, nothing special [lit. well cat and cat]") suggests that the speaker evaluates the standard-like nature of the cat to be uninteresting and even boring.

The family of constructions termed *Appropriateness* conveys a rationalistic evaluation of whether an object fits the situation. Most of these constructions contain predicative phrases that can alternatively modify verb phrases and can also be negated: compare *NP (ne) v temu* (as in *Tvoi zamečanija sejčas sovsem ne v temu* "Your remarks are now completely out of place [lit. not in topic]") and *VP (ne) v temu* (as in *On skazal èto očen' v temu!* "He said it very much on point [lit. in topic]"). Similarly used prepositional phrases include *(ne) k mestu* [lit. (not) to place], *(ne) po delu* [lit. (not) on business], and *(ne) v kassu* [lit. (not) in cash register] all referring to well-fitting vs. ill-fitting in the conversation, as well as *v točku* [lit. into point] meaning "to the point" and *mimo kassy* [lit. past cash register] meaning "beside the point."

The three families of constructions listed above in **Table 1** refer to the concepts of *Importance/Worth* and *Importance/Power* and evaluate an object as important vs. unimportant and an activity as worth doing. By assessing an object as important, the speaker assigns it a certain value (e.g., *NP-Nom Cop v cene*, as in *Ran'še družba byla v cene* "Friendship used to be appreciated [lit. was in price]"), that can or cannot play a role *(NP-Nom igrat' Adj rol'* "play a role"), matter, and affect the situation (*NP-Nom imet' (Adj) značenie* "matter [lit. have meaning]"). Importance motivates positive evaluation, and lack of value implies negative evaluation of an object. In those constructions that assign value to animate referents, the concept of Importance transforms into Power and Respect: consider the constructions *NP-Nom Cop u*

PronPoss-Gen nog (as in *Ves' mir u našix nog* "We have power over others [lit. the whole world is at our feet]") and *NP-Nom Cop v počete* (as in *Fiziki u nas v počete* "physicists are highly respected here [lit. physicists by us in honor]") that connect the *Importance/Worth* family to the cluster Assessment specific to people (family *Importance/Power*). Note that most constructions in the three *Importance* families (**Table 1**) are specific either to inanimate referents (including abstract notions like factors, properties, relationships) or to animate referents: compare *NP-Nom Cop v cene* "appreciated" (for inanimates) vs. *NP-Nom Cop v počete* "respected" (for animates) accordingly. By contrast, a few constructions allow both types of fillers, like the pattern *NP s bol'šoj bukvy* "very good [lit. with capital letter]" that can be encountered in positive evaluations of persons of certain professions (e.g., *vrač/učitel'/aktrisa s bol'šoj bukvy* "a highly professional and talented doctor/teacher/actress") or evaluations of certain occasions (e.g., *delo/moment/igra s bol'šoj bukvy* "highly important and critical business/moment/game"). Similarly, in the family of Assessment constructions that evaluate an object as unimportant, the first three constructions (*vsego liš' NP; vsego-navsego NP; Cl, (a) tak, Cl*, all meaning "merely") can refer to both animate and inanimate referents, whereas the remaining four constructions (e.g., *sovsem ešče NP* "merely"; *Cl, čto s NP-Gen Cop vzjat'?* "what can you expect of?") encode evaluation of a person and thus rather belong to the cluster Assessment specific to people. In this light, representation of all interrelations between the constructions in a network like Assessment can hardly be adequately depicted in a two-dimensional model like **Figure 3**, which should be treated as an approximation of the real picture[10]. Rather, one should keep in mind that analysis allows for different levels of granularity that account for the fact that certain subsets of constructions within a single family can belong to several clusters at the same time (in this case, the clusters Assessment in relation to norms/expectations and Assessment specific to people). This only proves the point of a radial category model that recognizes the legitimacy of multiple overlaps and the lack of rigid categorical distinctions between the established groups of data.

Another important overlap can be observed between the families encoding *Importance* on the one hand and the *Usefulness* family on the other hand. Both constructions that evaluate activities (e.g., *NP-Nom togo stoit'*, as in *Poezdka v Afriku togo stoit* "The trip to Africa is worth taking [lit. trip that costs]") and constructions that evaluate objects and persons (*VP NP-Acc s rukami (i nogami)* [lit. with arms and legs]) suggest that the value of an object or activity is often established on the basis of the speaker's personal benefit from using this object or performing this activity. One can benefit from something one can effectively use.

The *Usefulness* family of constructions determines the so-called teleological evaluation of an object and defines whether an object can be of any use. The construction *vidavšij vidy NP* (as in *Na vidavšem vidy velosipede ja poexal dal'še* "I went biking on the weather-beaten bicycle [lit. having seen sights bicycle]") can carry either positive or negative assessment depending on the context: it can either refer to an old and well-worn object in case of negative evaluation or, by contrast, to an object that the speaker has confidence in, values and relishes. Another curious construction in this family is *(NP-Dat) NP-Nom (ne) katit'* (as in *Mne takoj argument ne katit* "For me this point does not work [lit. not rolls]"). This construction has a strong colloquial flavor and shows that usefulness can be assessed on the basis of appropriateness, thus conceptually relating the two categories and the two families. Objects that are appraised as appropriate are "supported" by standard expectations, they tend to be useful and positively evaluated. By contrast, constructions like *zrja/naprasno VP* (as in *Zrja staraeš'sja* "You strive in vain") carry negative assessment, suggesting that there is no need in doing X, as this is not useful for the situation.

A separate family of constructions denote *Indifference to norms/expectations*. However, in terms of assessment, such constructions are not neutral but clearly negative, as in the following example: *VP PronInt popalo* (e.g., *Vasja šlet pis'ma komu popalo* "Vasja sends letters to every Tom, Dick or Harry [lit. to-someone it-fell]"). In this example, the first comer, or any random person is evaluated negatively and the whole activity of dealing with people indiscriminately also receives a negative evaluation.

We have seen that the cluster Assessment in relation to norms/expectations is connected not only to General Assessment, but also to Assessment specific to people (*Importance/Worth* and *Importance/Power* families) and to Assessment in relation to quantification (*Deviations from the norm* family). We will now examine each of these clusters in turn.

Assessment Specific to People

Assessment specific to people is a large cluster that contains several families of constructions. The most important groups here involve *Capacity/Intellect* and *Ethics/Behavior*, with smaller groups for *Importance/Power*, *Appearance*, and *Emotion/Psychological state*.

The family *Capacity/Intellect* contains twenty-one constructions that assess someone's ability to perform a certain activity or deal with a certain subject or academic discipline. Most of these constructions refer to intellectual abilities and encode positive evaluation of the capacity itself, and any kind of activity can fill the slot.

Syntactically, we can observe a rich variety of patterns including anchor predicative phrases in *NP-Nom Cop gorazd VP-Inf/na NP-Acc* (as in *On na vydumki gorazd* "He is very inventive [lit. strong on inventions]") and *NP-Nom Cop NP-Nom VP-Inf* (as in *On master gotovit'* "He is good at cooking [lit. expert cook]"); anchor light verbs in *NP-Nom znat' tolk v NP-Loc* (as in *On znaet tolk v nastol'nyx igrax* "He is an expert in board-games [lit. He knows sense in board-games]"); anchor adverbials in *VP na pjaterku/pjat' ballov/otlično* (as in *znat' matematiku na pjaterku* "know math at the highest level [lit. on five]"); and clauses like *NP-Nom VP-Inf Cop ne durak* (as in *On vypit' ne durak* "He can drink well [lit. have-a-drink not fool]").

Semantically, prominent strategies of referring to good intellectual abilities employ conceptual blending (Fauconnier and Turner, 2002) of producing ideas and cooking food that

[10]It seems unnatural to split the three *Importance* families of constructions depending on the animacy of the object they take. We can attribute thirteen constructions to *Importance/Worth* and fifteen constructions to *Importance/Power*, including nine constructions that can encode both.

we see in the metaphorical construction *u NP-Gen golova varit'* (as in *U Peti golova varit – s nim možno imet' delo* "Peter has his head screwed on right [lit. by Peter head stews], so one can do business with him." Other constructions denote measuring intellectual abilities in terms of having enough sense to perform an activity: e.g., *(NP-Dat/u NP-Gen) xvatit' NP-Gen VP-Inf*, as in *U nee xvatilo uma priostanovit' supruga* "She had the wisdom to stop her husband [lit. had enough cleverness]"). An alternative strategy is stating whether one needs to borrow some wisdom (*NP-Gen NP-Dat Cop ne zanimat'*, as in *Xitrosti emu ne zanimat'* "He does not need to borrow any cunning") or whether wisdom is an inalienable possession (*NP-Gen u NP-Gen ne otnimeš'/Cop ne otnjat'*, as in *Talanta u nego ne otnjat'* "One cannot take his talent from him").

Negative evaluation of intellectual abilities is expressed by constructions like *u NP-Gen NP-Nom xromat'* (as in *U brata sil'no xromaet geografija* "The brother does not have a good handle of geography/has problems with geography [lit. by brother strongly limps geography]").

Conceptually, the family *Capacity/Intellect* is related to *Usefulness* since persons with strong intellectual capacity can also be useful.

The largest family in the cluster Assessment specific to people is termed *Ethics/Behavior* and contains constructions that evaluate someone's behavior in terms of general ethical or personal standards. This group of constructions is closely related to *Appropriateness* and mostly contains constructions that carry negative evaluation. Syntactically, constructions in this family are comprised of either mono-clausal or biclausal statements, often flavored with an exclamatory intonation of indignant criticism. The above-mentioned construction *najti-Pst NP-Acc!* "found X!" (as in *Našli razvlečenie!* "What a bad way to amuse yourself! [lit. found amusement!]" belongs here, along with numerous other clausal constructions like *delat' PronPers-Dat Cop nečego!* (as in *Delat' tebe nečego!* "You should not be doing this/Don't you have anything better to do than this!" [lit. do to-you nothing!]"), the construction *nado že Cop (NP-Dat) VP-Inf* (as in *Nado že bylo svjazat'sja s takimi ljud'mi!* "And it had to happen so that you got involved with such (bad) people! [lit. needed well was connect with such people!]"), etc. Biclausal constructions denote not only negative evaluation of someone's activity or behavior, but they also name a positively evaluated alternative behavior that one could have been doing instead: compare the construction *net čtoby/by VP-Inf, Cl* (as in *Net čtoby podoždat', on ušel bez nas!* "Instead of having waited for us, he just left! [lit. no in-order wait]") and the construction *čem by VP, VP (by)* (as in *čem by učit'sja, on guljaet!* "Instead of being busy with his studies, he is outdoors! [lit. than could study, he takes a walk]"). Some constructions in this family convey positive or negative evaluation through evaluative anchor words, and thus relate this family to the General Assessment cluster: e.g., *(NP-Dat) ne grex Cop i VP-Pfv.Inf*, as in *Teper' ne grex nam i otdoxnut'* "Now there is no harm in taking a rest [lit. not sin us and rest]."

Regarding the *Importance/Power* family, see discussion in section "Assessment in Relation to Norms/Expectations."

A family of five constructions expresses aesthetic assessment of someone's *Appearance*. Some constructions evaluate whether a piece of clothing fits the outfit and overall look of a person, and thus conceptually connects the *Appearance* family to the *Appropriateness* family discussed above. We encounter both predicative phrases as anchors of constructions *NP-Nom Cop NP-Dat k licu* (as in *Sinee plat'je bylo ej k licu* "The dark blue dress was becoming to her [lit. to face]") and *NP-Nom Cop (NP-Dat/dlja NP-Gen) v samyj raz* (as in *Dlja kukly èta šapka v samyj raz* "The hat is the right fit for the doll [lit. in same one time]"), and certain anchor verbs of motion like *podxodit'* "approach by walking" and *idti* "walk": e.g., *NP-Dat idti XP* (as in *Ej idet èta pričeska* "This hairdo looks good on her [lit. to her goes hairdo]").

Emotion/Psychological state is a family of constructions that assess psychological properties or an emotional state of a person. Such constructions tend to indicate those properties that stand outside of the norm. This concerns both temporary characteristics like emotional states (e.g., *NP-Nom Cop sam ne svoj* (as in *Papa segodnja sam ne svoj* "Dad is not himself today [lit. oneself not one's own]") and constant characteristics like personality type or temper (e.g., *NP-Nom Cop sebe na ume*, as in *Vasja sebe na ume, nikogda ne govorit vsej pravdy* "Vasya has his own agenda [lit. to oneself on mind], he never tells the whole/full truth").

Assessment in Relation to Quantification

The cluster of Assessment in relation to Quantification constructions serves to relate the Assessment network to other constructions that encode quantification and degree of intensity. This cluster includes several families distinguished on the basis of different degrees, or quantities, of a certain property. The relevant degrees form a scale and include: *None, Little, Some/Enough, A lot,* and *Beyond the limit*. A prominent group of constructions includes various *Expressions of Surprisal*. Overall, constructions in this cluster show that qualitative evaluation (positive vs. negative) is motivated by quantitative assessment.

In the context of the conceptual metaphor MORE IS BETTER (Lakoff and Johnson, 1980), the zero level of a property ("none") is associated with negative evaluation: compare constructions like *NP na nule* (as in *Immunitet na nule* "Immunity is absent/does not function/is at the zero level" [lit. on zero], *NP-Ins (tut/tam) i ne paxnut'* (as in *Naukoj tut i ne paxnet* "Science is nowhere near here" [lit. with science here and not smells], and *nikakoj PronPers Cop ne XP* (as in *Nikakoj on ne genij* "He is not a genius at all" [lit. none he not genius].

A small degree of a property ("little") is encoded in patterns like *ne takoj už i Adj* (as in *ne takoj už i strašnyj* "not so frightening").

A larger amount of a property ("some") is often positively evaluated, if it is enough for performing an activity: *NP-Nom Cop dostatočno Adj, čtoby VP-Inf*, as in *On dostatočno vzroslyj, čtoby ponjat' èto* "He is old enough to understand this."

Denoting a high degree of a property ("a lot") often comes along with positive evaluation: *čertovski Adj/Adv* (as in *On čertovski umen* "He is drop-dead smart [lit. devilishly smart]," *vo vsex otnošenijax XP* (as in *Novyj spektakl' byl vo vsex otnošenijax udačnym* "The new performance was successful in all respects").

However, intensifiers are compatible with both positive and negative evaluations. A highly prominent strategy of encoding high degree of a property in evaluative constructions is to use an interrogative pronoun in exclamative function[11], as in *kakov Cop NP-Nom!* (as in *Kakov podlec!* "What a rascal! [lit. which rascal]"). Often, a pronoun is combined with additional intensifiers: *(možno) s uma sojti kakoj Adj* (as in *Sumka u nee s uma sojti kakaja dorogaja!* "Her bag is crazy expensive! [lit. bag by her from-mind-depart what expensive]"). Such exclamatory clauses with pronouns tend to imply surprisal due to a greater amount of the property than expected, and in this regard such constructions are transitional to the cluster Assessment in relation to norms/expectations. This connection is even more evident in the *Beyond the limit* family, in constructions like *VP/Adj sverx mery* (as in *On odaren sverx mery* "He is talented above measure").

Some evaluative constructions that encode high degree of a property contain both a pronoun and an interjection that accompany the evaluative statement. Whereas the pronoun takes the role of intensifier, the interjection often clearly specifies whether the construction carries positive or negative evaluation. For example, the patterns *iš', kakoj Adj-Nom Cop* (as in *Iš', kakoj veselyj!* "How inappropriately glad he is!") and *fu, kakoj NP-Nom Cop!* (as in *Fu, kakaja gadost'!* "Yuck, what a disgusting thing!") always carry negative assessment, whereas the constructions *ux ty, kakoj/kak XP!* (as in *Ux ty, kakuju rybu pojmali!* "Wow, what a fish we have caught!") and *aj da NP-Nom!* (as in *Aj da geroj!* "What a hero!") obligatorily encode positive evaluation. This family of constructions can be considered transitional between the cluster Assessment in relation to quantification and the cluster of General assessment, as it equally belongs to both clusters. Also, because interjections encode specific emotions (e.g., *ux ty* expresses surprise, *aj da* encodes admiration and praise, *fu* stands for disgust, etc.), one can argue that these constructions are additionally motivated by the cluster Assessment specific to people that contains the family *Emotion/Psychological state*.

Assessment in Relation to Knowledge

A distinct family of six constructions stands outside of the clusters discussed above and encodes *Assessment in relation to knowledge*. These constructions can evaluate an object, a situation participant, time, or space depending on whether it is known or unknown information. All constructions in this family convey negative evaluation arguably motivated by the fact that something is unknown and unspecified. Representative examples come from the constructions like *bog vest' PronInt* (as in *Oni prinesli v pakete bog vest' čto* "They brought who knows what in the bag" [lit. God knows what]), *neznamo PronInt* (as in *Neznamo kak ja vernulsja domoj* "I came home without knowing how" [lit. not-known how]), *ne NP kakoj-nibud'* (as in *My ne bomži kakie-nibud'!* "We are not some homeless people!"), etc.

[11]These are classified as "interrogative/relative pronouns" (Wade, 1992, p. 126–133), the corresponding Russian term is "voprositel'no-otnositel'nye mestoimenija" (Padučeva, 2015, compare also "voprositel'nye/otnositel'nye mestoimenija" in the Russian National Corpus).

Summary of Assessment Constructions

Assessment motivates a highly complex network of constructions in Russian organized both hierarchically and horizontally. Hierarchically we observe over two dozen families of constructions which are internally relatively homogenous, sharing semantics and often syntactic patterns as well. Most of these families can be grouped into clusters which in turn give structure to the overall network. Horizontally we see relationships between families and between clusters motivated both by constructions with allegiances to multiple families, and via conceptual similarity. For example, three families connect these two clusters: General Assessment and Assessment in relation to norms/expectations. Conceptual similarity is observed among constructions that focus on usefulness, importance/worth, intellectual capacity, and appropriateness. Examination of a large number of constructions makes it possible to spot trends and confirm claims of previous scholars, for example about the tendency for General Assessment to be expressed in a biclausal construction, and the skewed polarity of assessment. The latter tendency toward negative polarity is even more pronounced in the network of Attitude constructions which is the topic of the section "A Network of Attitude Constructions: 4 Clusters and 18 Families."

A NETWORK OF ATTITUDE CONSTRUCTIONS: 4 CLUSTERS AND 18 FAMILIES

Overview

Whereas Assessment constructions evaluate an item external to the speaker, Attitude constructions, by contrast, refer to evaluation of the speaker's internal state of mind or internal emotional approach taken toward a situation. In other words, Attitude constructions express how the speaker feels about something, what standpoint he or she takes, what the speaker's personal perspective on a subject or a situation is.

As in the case of Assessment constructions, we analyze Attitude patterns both in terms of semantic types and in terms of polarity values (positive vs. negative Attitude).

In terms of semantic types, we found that Attitude constructions are highly diverse but can still be grouped under general and specific domains. For example, we distinguish between clusters such as Emotional Attitude and Mental Attitude, and at a more granular level we recognize families of constructions encoding Skepticism, Perplexity, Confidence, etc. (see subsection "A Radial Category Model" for details).

In terms of polarity values, we found that the vast majority of Attitude constructions in our dataset carry negative evaluation. Over 72% (159 out of 222 items) of constructions in this network are used to encode negative Attitude, whereas only 18% (40 items) of constructions refer to positive Attitude. The remaining 10% of Attitude constructions are neutral for polarity, which is determined instead by other factors (see below). For example, the construction *Cl, ne vopros* (as in *Ja vse sdelaju, ne vopros* "I will do everything, this is not a problem [lit. not question]") can only

express positive attitude and willingness to perform an activity, whereas the construction *NP-Dat Cop ne do NP-Gen* (as in *Mne ne do uborki* "I am not going to tidy up now (assuming that I have a lot of other things on my plate or I have no time for it right now) [lit. to me not to tidying]") is restricted to imply only negative attitude and lack of willingness to perform an activity.

The observed distribution (72% negative vs. 18% positive) might suggest that a large part of the network of Attitude constructions serves the need to express a range of subtle differences of speaker's attitudes and/or express approximately the same type of attitude in a variety of different ways, ranging in terms of politeness vs. strictness, transparency vs. opacity, etc. Comparing the distribution of positive vs. negative values in Attitude and Assessment networks, we observe that the relative proportion of constructions encoding negative Attitude is higher than that of negative Assessment constructions (compare 72% Attitude vs. 49% Assessment, respectively). However, the difference in positive value rates is not that dramatic: positive Attitude in 18% vs. positive Assessment in 25% of each of the two relevant datasets, respectively. This finding suggests that Attitude constructions as a network are even more negative than Assessment constructions that specify all possible nuances of deviations from the norm, expectations, and standards. Negative attitude constructions clearly predominate in our dataset.

We observe that only 10% (22 items) of Attitude constructions (as opposed to 26% of Assessment constructions yielding 58 individual items) can carry either positive or negative evaluation depending on the fillers, possibility of negation, or a broader context. For example, the same construction *kak NP-Nom Cop Adj-Short, čto Cl!* can be used to express both positive and negative Attitude, depending on the filler of the slot: compare *Kak ja rad, čto ty vernulas'!* "I am so glad that you came back!" vs. *Kak ja zol, čto svjazalsja s ètoj firmoj!* "I am so angry that I got involved with this agency!" In a similar way, a negated version of a construction can express the opposite polarity value, as in *(NP-Dat) oxota/neoxota Cop VP-Inf*: e.g., *Mne spat' oxota* "I want to sleep" vs. *Mne rabotat' neoxota* "I do not want to work." In some cases, interpretation of the attitude value expressed by a construction is only possible in a broader context or might even be not entirely appropriate, as in the case of *kak že NP-Dat Cop ne VP-Inf*? (e.g., *Kak že mne ne pomnit'?* "How could I fail to remember (given this situation) [lit. how well me not remember]?") that refers to the lack of choice and can be seen as a type of attitude associated with neither of the two polarity values.

Attitude constructions are very diverse in terms of semantic and syntactic types and complex in terms of their relationships and multiple overlaps with each other, as we show in the next section.

A Radial Category Model

We model the network of Attitude constructions as a radial category visualized in **Figure 4**. This model accounts for the major semantic types of Attitude constructions as well as minor relevant distinctions and their relations with one another. We adopt the same manner of representation of the radial category structure as in the section "A Radial Category Model."

Figure 4 shows that Attitude constructions form a complex network that consists of four large clusters and eighteen families. Large boxes visualize clusters of constructions termed Acceptance, Dissatisfaction, Emotional Attitude, and Mental Attitude. Smaller boxes represent families inside these clusters as well as one family that does not belong to any of these clusters, namely *Capacity/Preferences*. Solid lines connect those units that overlap (contain constructions that belong to more than one family), and dashed lines indicate conceptual connections. Shading highlights the Acceptance cluster as the most prototypical in this network. We observe that this cluster is conceptually the most general one and it provides motivation links to all remaining clusters. The Dissatisfaction cluster, although more numerous, is a specific case, a "negated" version of Acceptance. Numbers in parentheses indicate type frequencies for each unit of this network. Note that the total is larger than 222 constructions because some constructions belong to more than one family. This concerns only 12 constructions (5% of the Attitude dataset), showing that the amount of overlap between the families of this network is smaller than that of the Assessment network, estimated at 32% (cf. the section "A Radial Category Model").

In the following subsections we present each cluster and characterize each family of the Attitude network.

Acceptance

Constructions of the *Acceptance* cluster convey the meaning that the speaker more or less accepts the situation. This cluster includes the families *Support, Willingness, Concern, Reconciliation,* and *Remorse*. Each of these families suggests additional semantic nuances to the general meaning of *Acceptance* and has certain tendencies in selecting syntactic structures and anchor lexemes.

Constructions that form the *Support* family express whether the speaker takes someone's side, shares someone's opinion, or promotes a certain idea that aligns with his or her own interests or views. For example, the constructions *NP-Nom Cop (ne) protiv NP-Gen* (as in *Ja protiv škol'noj formy!* "I do not support having a school uniform [lit. against uniform]") and *NP-Nom Cop za NP-Acc* (as in *Ja za revoljuciju* "I support the idea of revolution [lit. for revolution]" usually encode the speaker's attitude to abstract concepts, institutions, regulations, and situations. By contrast, the construction *NP-Nom Cop na PronPoss-Loc storone* (as in *V ètom spore ja na vašej storone* "In this argument I am on your side") encodes a positive attitude toward someone's opinion or executed strategy. Syntactically, these constructions usually employ predicative prepositional phrases and nominal patterns.

The *Willingness* family of Attitude constructions carries the meaning that the speaker is willing or unwilling to perform an activity. Some constructions in this group encode this meaning transparently by means of the anchor word *xotet'* "want": e.g., *NP-Nom i slyšat' ne xotet' o NP-Loc* (as in *On i slyšat' ne xočet o poezdke!* "He does not want to even hear about the trip [lit. and hear not want about trip]"). Other constructions employ derivatives of the verb *xotet'* "want," namely the nouns *oxota* "willingness" and *neoxota* "reluctance," as well as a synonymous noun *len'* "laziness." These nouns perform a predicative function

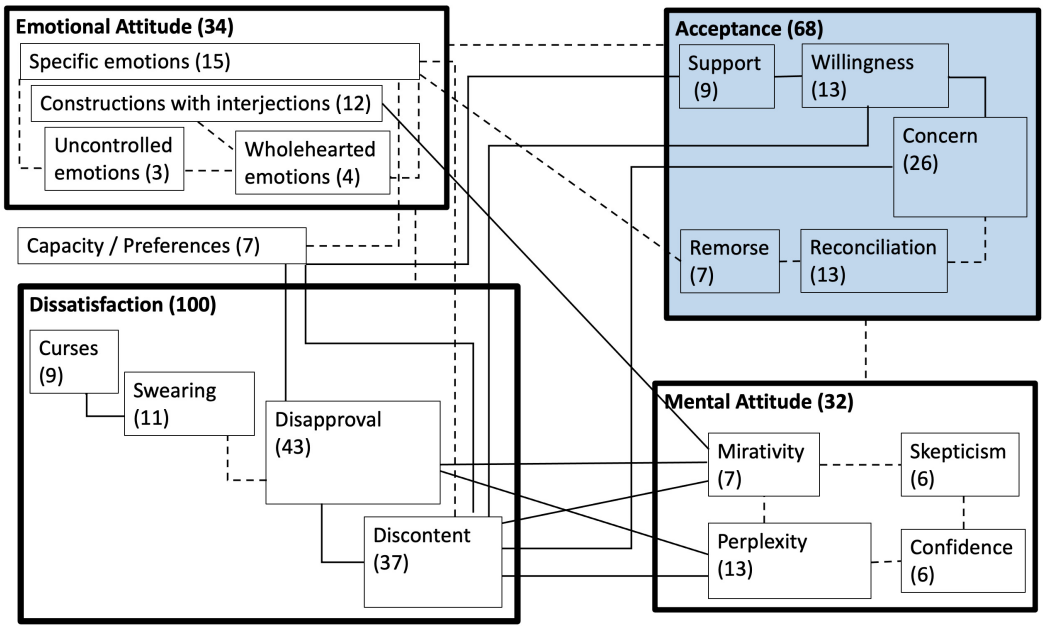

FIGURE 4 | A radial category model of the network of Attitude constructions.

and govern an infinitive denoting an activity in the constructions *(NP-Dat) oxota/neoxota Cop VP-Inf* (as in *Mne spat' oxota* "I want to sleep [lit. to me willingness sleep]") and *(NP-Dat) len' Cop VP-Inf* (as in *Mne len' gotovit'* "I do not want to cook [lit. to me laziness cook]"). Less semantically transparent are the structures that convey the semantics of unwillingness via predicative prepositional phrases like *v lom* "a bummer" (consider the construction *NP-Dat Cop v lom VP-Inf*, as in *Maše idti v magazin bylo v lom* "Maria did not want to go to the store [lit. to Maria walk in store was in bummer]") and *ne do NP-Gen* "not to X" (*NP-Dat Cop ne do NP-Gen*, as in *Mne ne do uborki* "I am not going to tidy up now [lit. to me not to tidying]"). Infinitival constructions encode the (un)willing subject in the dative case, thus morphologically suggesting that an unenthusiastic attitude is rather a state that "happens" to the subject and this lack of agentivity and control arguably implies lack of responsibility that the speaker is willing to take for the attitude in question (see Divjak and Janda, 2015 for detailed discussion). An interesting case in this regard is the construction *(u NP-Gen) ruki ne doxodit' VP-Inf* that does not openly claim the unwillingness to perform an activity and instead transfers the responsibility for the speaker's failure to achieve a result to the lack of the right circumstances: e.g., *Ruki ne doxodjat kryšu počinit'* "I did not get around to fixing the roof [lit. arms not arrive roof fix]."

In contrast to an entire armory of means to express a lack of enthusiasm about an activity, a smaller subgroup of constructions denotes the speaker's readiness for active participation and positive attitude toward it. This type can be illustrated with constructions like *VP-Inf Cop (da/voobšče/da voobšče) ne vopros* (as in *Postroit' dom – ne vopros* "Building a house – sure! [lit. to build house not question]") and *Cl, bez problem/voprosov* (as in *Ja vse sdelaju, bez problem!* "I will do everything, no problem! [lit. without problems]").

Concern is a large family of twenty-six Attitude constructions that encode the speaker's indifference or concern about the situation. Most constructions refer to unconcern and express negative attitude: e.g., *malo (li) PronInt VP* (as in *Malo li čto on poprosit!* "Whatever he asks for, it does not matter [lit. little what he will ask]." Many constructions contain the anchor word *delo* "business" or *vnimanie* "attention": compare *komu kakoe delo Cop do NP-Gen* (as in *Komu kakoe delo do tvoej problemy* "No one cares about your problem [lit. whom what business to your problem]") and *Cl, a NP-Nom ne obraščat' vnimanija* (as in *Oni tam derutsja, a ona ne obraščaet vnimanija* "They are fighting, but she does not pay attention [lit. not turn attention]"). Syntactically, this family is a diverse and non-homogeneous group that includes adverbial patterns like *VP-Imp postol'ku-poskol'ku* (as in *Ego interesuet èto postol'ku-poskol'ku* "He is mostly uninterested in this issue [lit. insomuch in-how-much]"), predicative patterns like *NP-Dat Cop vse ravno* (as in *Mne vse ravno* "It is all the same to me [lit. me everything same]"), with the majority of clausal constructions like *čto PronPers-Dat NP-Nom* (e.g., *čto mne dožd'* "It does not matter to me whether it rains [lit. what to me rain]"), and biclausal syntactic structures like *nu i čto, čto XP* (as in *Nu i čto, čto xolodno* "What's the big deal if it is cold [lit. well and what, that cold]"). Often, constructions of this family blend together, producing structures like *èkzameny ne èkzameny, emu vse ravno* "*Exams or not, it does not matter to him* [lit. exams not exams, to him all same]," where we encounter a combination of the construction *XP ne ∼XP, Cl* and the construction *NP-Dat Cop vse ravno.*

The *Reconciliation* family of constructions suggests that the speaker accepts the situation even though it is not desirable and

often appears to be out of the speaker's control. We observe this semantics in many biclausal constructions, where one clause names the situation, whereas the other clause indicates the speaker's attitude. By means of example consider the construction *Cl (i/no) (tut) (už) ničego (s ètim) (NP-Dat/NP-Nom) ne podelat'* (as in *On uezžaet, i tut ničego ne podelaeš'* "He leaves, there is nothing to do about it [lit. and here nothing not do]") and the construction *čto už tam, Cl* (as in *čto už tam, moja vina* "What shall I say [lit. what there], it is my fault"). By using the former construction, the speaker suggests that nothing can be done to change the situation, whereas the latter construction states that nothing can be said to argue against the truth. Most constructions in the *Reconciliation* family express positive attitude of the speaker (e.g., *čto s PronPers-Ins (budeš') delat'!*[12] (e.g., *Opjat' ty ves' grjaznyj! Čto s toboj delat'!* "You are all dirty again! It can't be helped! [lit. what with you do!]"), or/and lack of choice, as we see in the expressions like *nekuda devat'sja, Cl*[13] (as in *Nekuda devat'sja, nužno emu pomoč'* "There is no way out [lit. nowhere get], we have to help him"). It is implied that, having no choice, the speaker adopts a strategy that is the only one acceptable in the given situation or in the speaker's view, as illustrated with a similar construction *(NP-Dat) nel'zja Cop ne VP-Inf* (as in *Nel'zja bylo ne soglasit'sja s nim togda* "It was impossible to disagree [lit. impossible was not agree] with him in that moment."

Additionally, the *Reconciliation* family includes a notable structural type of various reduplicative patterns, where the same lexeme is repeatedly used in the same or a different morphological form. A good example comes from the construction *XP tak ∼XP* (as in *Sup tak sup* "If I should eat the soup, I will do so [lit. soup then soup]") and a synonymous pattern *XP značit ∼XP* (as in *Dieta – značit dieta!* "If I should go on a diet then I will do so! [lit. diet means diet]"). Even less semantically transparent is a similar reduplicative construction *(nu) XP i ∼XP* (as in *Včera ja poterjal kol'co. Nu poterjal i poterjal, ne nado dumat' o ploxom* "Yesterday I lost a ring. It happened, whatever [lit. well lost and lost], no need to think about bad things").

The *Remorse* family of constructions provides the speaker with various ways to express sadness and regret about what the speaker (or another participant) has done or about the state of affairs in general. An example of the former comes from the construction in *čert (PronPers-Acc) dernul VP-Inf* (as in *čert menja dernul pošutit'* "I don't know what got into me that I made that joke [lit. demon pulled me joke]"), whereas the latter can be illustrated with the construction *žal' Cop, Cl*, as in *Žal', nogi promokli* "It is a pity that [someone's] feet got drenched." Remorse constructions are used in situations when the speaker has to report on something unpleasant or undesired for him- or herself and/or their interlocutor. Therefore the role of such constructions is often to mitigate the negative effect of the upcoming information by expressing the speaker's sympathy and compassion with the interlocutor. Syntactically, many of these constructions contain a parenthetical expression that introduces a clause [e.g., *k (PronPoss/Adj) sožaleniju, Cl*, as in *K sožaleniju, my ne možem vam pomoč'* "Unfortunately [lit. to regret], we cannot help you"] or a matrix predicate (e.g., *beda Cop, čto Cl*, as in *Beda, čto on ne prišel* "It is a disaster that he did not come"), or an interjection (e.g., *uvy, Cl!*, as in *Uvy, koncert otmenili* "Too bad, the concert is canceled"). By expressing regret, the speaker arguably takes partial responsibility for the negative information he/she reports on, and therefore the attitude encoded in these constructions is best captured by the term Remorse.

The Acceptance cluster thus gathers constructions that represent conceptually related nuances. Support is something that is offered when someone is willing to act, and willingness is related to a show of concern. Reconciliation and remorse are two types of acceptance in the face of difficulties.

Dissatisfaction

The largest group of Attitude constructions expresses various kinds of *Dissatisfaction*. All constructions of this cluster carry negative evaluation and constitute four distinct families that form a rising scale of negativity: *Discontent* > *Disapproval* > *Swearing* > *Curse*.

The thirty-seven constructions that form the *Discontent* family share the semantics of relatively mild dissatisfaction on the part of the speaker regarding the entire situation: e.g., *Cl, a NP-Nom VP-Imp!* (as in *On ušel domoj, a ja opjat' peredelyvaj vse posle nego* "He went home, and I again have to redo [lit. I redo] everything after him." By using *Discontent* constructions, the speaker fulfills the need to complain about an unsatisfactory state of affairs, often claiming that there are so many problems that having one more additional problem is even worse. Therefore, many constructions in this family contain anchor words that denote "shortage" or "enough": compare *(NP-Dat) tol'ko NP-Gen (ešče) ne xvatalo!* (as in *Tol'ko doždja ne xvatalo!* "Rain is the last thing I needed! [lit. only rain not was enough]").

The *Disapproval* family comprises 43 constructions that encode both the speaker's strong negative Attitude and negative Assessment of someone's behavior. This group of constructions is the home of the above-mentioned construction *najti-Pst NP-Acc!* "found X!" (as in *Našli razvlečenie!* "What a bad way to amuse yourself! [lit. found amusement!]") and constitutes a large zone of overlap connecting the two networks, as described in section "Assessment Specific to People" (family *Ethics/Behavior* of Assessment constructions).

Swearing constructions form a family of 11 constructions that mark an even more negative Attitude of the speaker toward the situation. Swearing constructions included in the Russian Constructicon contain anchor swear words like *čert* "demon" or its derivatives: e.g., *kakogo čerta Cl!* (as in *Kakogo čerta zdes' tak grjazno!* "Why the devil is it so dirty here?").

Curse constructions form a distinct family of nine constructions that denote the highest degree of negative Attitude. Curse constructions do not necessarily contain swear words but obligatorily carry the intention of harming someone or something: *Cl, buď PronPers-Nom prokljatyj-Short!* (as in *Opjat' èti komary, buď oni prokljaty!* "Again these mosquitos, damn them [lit. be they damned]!").

[12] In this case, we treat *budeš'* not as a form of the auxiliary verb *byt',* which is part of the analytic future tense form *budeš' delat'* "will do," but as an optional "frozen" element of this construction.

[13] We suggest that *nekuda devat'sja* is a periphrastic element that can only be used in the present tense. Adding a copula verb in past or future tense shifts the semantics of this expression to its literal meaning.

Mental Attitude

The Cluster termed *Mental Attitude* is formed by constructions denoting Attitude motivated by the speaker's knowledge or expectations. This cluster comprises four families: *Skepticism, Confidence, Perplexity,* and *Mirativity*.

A *Skeptical* attitude on the part of the speaker is conveyed by constructions that are used in speaker's responses to a statement made by the conversation partner. All of these constructions express different shades of disagreement with the previous discourse. Many of these constructions employ a peculiar syntactic pattern: they repeat the key part of the interlocutor's statement and frame it with an Attitude construction. Consider such an "echo"-pattern in the construction *skažeš'/skažete tože – XP* (as in—*On takoj xorošij! – Skažeš' tože – "xorošij"!* "– He is so nice! – Come on! How can you say that! [lit. you say too – "nice"]." The construction *vot ešče, XP!* (as in – *Da ty vljublena v nego! – Vot ešče, vljublena!* "– You seem to be in love with him! – In love? No way! [lit. here more, enamored]") is organized in a similar way: it repeats the exact quote of the preceding problematic statement made by the interlocutor and argues against it. Another example comes from the construction *rasskazyvaj/rasskazyvajte, Cl* (as in – *U nas ne bylo deneg. – Rasskazyvaj, ne bylo deneg!* "– We had no money. – Tell me another, "had no money"! [lit. tell, not was money]") that expresses the speaker's doubts and distrust.

The *Confidence* family aggregates six constructions that express the speaker's certainty about his or her knowledge. All constructions in this family contain the anchor words *znat'* "know" or *dumat'* "think": *PronPers-Nom PronPers-Acc znat'-Prs, Cl* (as in – *Ja tebja znaju, ty vse razboltaeš'!* "I know you, you are going to blab it all") and *Tak PronPers-Nom i dumat'/znat'-Pst, (čto) Cl* (as in – *Tak ja i dumal, čto ty menja obmaneš'* "I knew [lit. so I and thought] that you were going to deceive me").

The *Perplexity* family is represented by thirteen constructions that encode the speaker's uncertainty about the cause of a situation or the actions of another participant. In terms of syntax, all these constructions are questions: e.g., *da i PronInt VP?* (as in *Da i gde ego sejčas najdeš'?* "And where can one find him now? [lit. and where find]"). Often *Perplexity* constructions can additionally signal the speaker's discontent, and in this regard they are related to the *Discontent* family of the *Dissatisfaction* cluster: *čto že NP-Nom VP?* (as in *čto že on sidit?* "Why is he sitting (and not acting)? [lit. what well he sits]").

The *Mirativity* family of seven Attitude constructions encodes the speaker's surprise caused by new and unexpected information (see DeLancey, 1997; Aikhenvald, 2012 for discussion of the term). The construction *vot tebe i raz/na: Cl* can express both positive and negative attitude of the speaker (as in *Vot tebe i na: u nee tri dočki i dvoe synovej!* "There you are [lit. here to you take]! She has three daughters and two sons!"). Some mirative constructions encode surprise accompanied with frustration: compare negative evaluation in e.g., *(NP-Nom VP, čto/kazalos' by) Cl/XP, an net!* (as in *Ja nadejalas', čto den'gi vernut, an net!* "I hoped that I could get the money back, but nothing came out of it [lit. on the contrary no!]"). These constructions relate the *Mirativity* family to the *Discontent* family in the *Dissatisfaction* cluster. Syntactically, all constructions in this family contain a clause.

We observe that each family in the *Mental Attitude* cluster employs a characteristic syntactic pattern. Conceptually, we can establish connections between these groups: *Skepticism* is related to *Confidence*; *Confidence* is the opposite of *Perplexity*; and *Perplexity* is close to *Mirativity*.

Emotional Attitude

A cluster of constructions denoting Emotional attitude is related to other clusters through their families of *Remorse, Discontent*, and *Mirativity* constructions. The *Emotional attitude* cluster is highly diverse, but we can distinguish three major semantic subtypes that form families: constructions that name specific emotional attitudes, constructions that refer to strong uncontrolled emotions, and constructions that emphasize the depth or scope of the feeling. This cluster also contains a family of *Constructions with interjections* discussed in the section "Assessment in Relation to Quantification."

Constructions expressing specific emotional attitudes (*Specific emotions* family) often include anchor words that name the emotion within a nominal pattern: e.g., *VP na radost' NP-Dat* (as in *Na radost' detjam vypal sneg* "Much to the children's delight [lit. on gladness/joy to children], it snowed") and *k užasu/sčast'ju NP-Gen, Cl* (as in *k užasu mamy, vse moroženoe rastajalo* "Much to mom's horror, all the ice cream melted"). However, there are some constructions that specialize in expressing emotional attitude even without anchor words naming an emotional state. By means of example consider the reduplicative construction *NP-Dat Noun-Nom Cop ne (v) ∼Noun-Acc (bez NP-Gen)* (as in *Devočkam radost' ne v radost'* "For the girls their joy was not real rejoicing [lit. gladness not in gladness]")[14], that indicates impossibility to enjoy a certain emotional state because of some external interference.

Constructions that refer to strong uncontrolled emotions (the *Uncontrolled emotions* family) can be illustrated with such structures with light verbs as *NP-Nom vyjti iz sebja* (as in *Načal'nik vyšel iz sebja* "The boss lost his temper [lit. walked out from self]") and *NP-Nom poterjat' golovu (ot NP-Gen)* (as in *On poterjal golovu ot sčast'ja* "He went crazy for happiness [lit. lost head from happiness]").

Constructions that emphasize the depth or scope of a feeling in the *Wholehearted emotion* family tend to have an adverbial modifier function: compare the synonymous constructions *VP do glubiny duši* (as in *On obidelsja do glubiny duši* "He took offense to the bottom of his heart [lit. to depth of soul]") and *VP vsem serdcem* (as in *Ja vsem serdcem perežival za nee* "I was wholeheartedly [lit. by entire heart] distressed for her"), etc.

The *Emotional attitude* cluster serves to relate the Attitude network of constructions to the Assessment network. This cluster is conceptually similar to the *Emotion/Psychological state* family of the cluster *Assessment specific to people* (recall section "Assessment Specific to People").

[14]This construction can refer to emotional states even without naming them, as supported by corpus examples like *Emu bez morja i žizn' ne v žizn'* "For him there is no joy in life without the sea [lit. life not in life])."

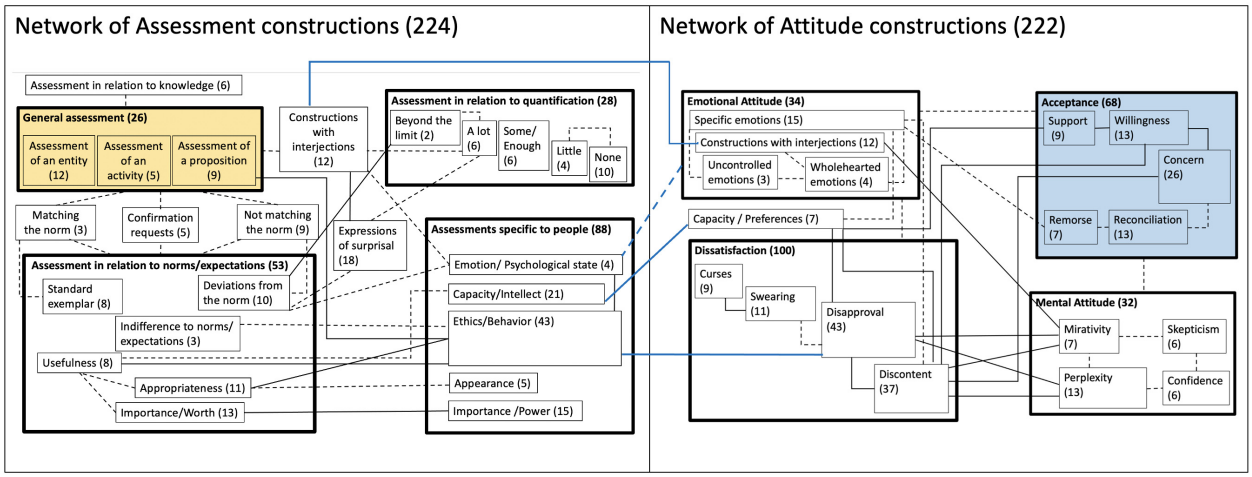

FIGURE 5 | Overlap of Assessment and Attitude networks.

Capacity/Preferences

A family that does not belong to any of the Attitude clusters is formed by constructions that denote *Capacity/Preferences*: e.g., *NP-Nom Cop s NP-Ins na "vy"* (as in *Ja s texnikoj na "vy"* "I am not friends [lit. on 'you'] with technical equipment"). Being capable to deal with something motivates the attitude of feeling comfortable or uncomfortable with a certain activity: *XP èto Cop ne PronPers-Nom* (as in *Xodit' po teatram – èto ne moe* "Going to the theaters is not my strong point").

Summary of Attitude Constructions

While the Attitude network is somewhat less complex than the Assessment network, the overall types of structure are the same. Attitude constructions comprise a multiply interconnected system, with both hierarchical relationships that join families into clusters and clusters into the network, as well as horizontal relations across families and clusters linked via shared constructions and similar concepts. And while both networks are biased toward negative evaluations, the Attitude network is even more strongly skewed in the negative direction.

OVERLAP OF ASSESSMENT AND ATTITUDE NETWORKS OF CONSTRUCTIONS

In addition to the horizontal relationships we have mapped out within both the Assessment and the Attitude networks, we find strong horizontal relationships across the two networks, which is not surprising given that one's assessment of something or someone can influence one's attitude to that something or someone. This conceptual proximity is realized also in a number of constructions that are multiply motivated by both networks. As diagrammed in **Figure 5**, there is overlap across the two networks in three families of constructions, namely constructions signaling assessment of an attitude toward the capacity of people, their negatively evaluated behavior, and emotional attitudes, as detailed below. The families in question are linked with solid blue lines. Conceptual closeness is indicated with the dashed blue line that connects the Emotional Attitude cluster of constructions with the *Emotion/Psychological state* family of Assessment constructions.

The largest portion of this overlap is contributed by forty-three constructions that simultaneously belong to the *Ethics/Behavior* family of Assessment and the *Disapproval* family of the Attitude network. We observe that negative evaluation of someone's behavior mostly supports negative attitude to such behavior, as we observe in the construction *najti-Pst NP-Acc!*, literally "found X!" as in *Našli razvlečenie!* "What a bad way to amuse yourself! [lit. Found amusement!]."

Second, both networks contain a family of 12 constructions with interjections, where the NP conveys the Assessment, whereas the interjection expresses emotional attitude of the speaker: e.g., *fu, kakoj NP-Nom Cop!* (as in *Fu, kakaja gadost'!* "Yuck, what a disgusting thing!").

Finally, three constructions simultaneously belong to *Capacity/Intellect* family of Assessment and *Capacity/Preferences* family of Attitude, including the construction *NP-Nom Cop s NP-Ins na "vy"* (as in *Ja s texnikoj na "vy"* "I am not friends [lit. on 'you'] with technical equipment"). This example illustrates that depending on the filler of the NP-Nom slot the semantics of constructions can shift toward Assessment or Attitude: if the referent is the speaker, then the construction conveys his or her attitude to a certain type of activity (in this case: dealing with technical equipment), whereas, if the referent is another participant, the construction is rather used to encode Assessment of his or her abilities to deal with a certain object named by *NP-Ins*, as in this example from the Russian National Corpus:

(4) *Nepravda, čto vse* ***ženščiny s texnikoj na "vy."***
'It is not true that all **women are unable to deal well with [lit. on "you"] technical equipment**'.

Overall, the overlap of the two networks amounts to 58 constructions (26% of each network).

CONCLUSION

Our case study of Assessment and Attitude constructions in Russian is part of the first large-scale study of the structure of a constructicon of any language and represents an advance in the mapping of semantic fields expressed by grammatical constructions. Whereas the semantics of lexemes that express evaluation has been subjected to classification (cf. Serdobol'skaja and Toldova, 2005 Tixonova, 2016), this is the first study of a large number of constructions that serve this function. And whereas there have been numerous detailed studies of individual constructions and smaller groups of closely related constructions, the Russian Constructicon project reaches a new level by attempting a more comprehensive classification. Classification reveals the intricate structure that binds constructions together in the grammar of a language.

The analysis of large groups of constructions makes it possible to discover overall patterns. Relationships among constructions are observed both hierarchically within the Assessment and Attitude networks as realized by families and clusters, as well as horizontally across all three levels of organization. Families are related to other families motivating clusters, clusters are related to other clusters motivating networks, and networks are also related to each other. Relationships are formed through transitional constructions with multiple allegiances, as well as through near-synonymy of constructions and families.

Within families there is some tendency for syntactic similarities as well. Overall we find a propensity for clausal constructions and constructions with the anchor in the role of adverbial modifier. When semantic and syntactic patterns are recognized, they can serve as the basis for further expansion of the constructicon. In other words, once we know what to look for, it becomes easier to identify additional candidates for inclusion in the constructicon. Thus the process of classification has directly facilitated the process of collection.

The distribution of data can serve to test and flesh out hypotheses made in previous scholarship regarding constructions and semantics. For example, construction grammarians (Goldberg, 1995, 2005; Croft, 2001; Langacker, 2008) have hypothesized that the grammar of an entire language consists of an interconnected system of constructions, hence the term "constructicon." Our study gives detailed concrete evidence of the internal structure of a constructicon. Our study likewise lends support to the hypothesis formulated in previous scholarship (e.g., Arutjunova, 1988) regarding a greater number and diversity of linguistic means employed for encoding negative evaluation, which is what we find in our data.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://site.uit.no/russian-constructicon.

AUTHOR CONTRIBUTIONS

Both authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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APPENDIX

In this study, we follow the representation of constructions in the Russian Constructicon. For each construction, we provide its name and a short illustration: e.g., *najti-Pst NP-Acc! Našli razvlečenie!* "What a bad way to amuse yourself! [lit. found amusement]."

The name of a construction is a short morphosyntactic formula that includes fixed lexical parts as well as grammatical slots indicated by means of common abbreviations: NP – noun phrase; VP – verb phrase; PP – prepositional phrase; XP – any phrasal unit (a slot that can be NP or VP or AP or PP); Adj – adjective; Adv – adverb; PronPers – personal pronoun; PronInt – interrogative/relative pronoun; PronPoss – possessive pronoun; Cl – clause; Short – short form. When necessary, we specify morphological characteristics of the fixed lexeme or a slot, where we use abbreviations according the Leipzig Glossing rules: Nom – Nominative case; Gen – Genitive case; Dat – Dative case; Acc – Accusative case; Loc – Locative case; Ins – Instrumental case; Sg – Singular; Pl – Plural; Pst – Past tense; Inf – Infinitive; Imp – Imperative; Ipfv – Imperfective verb; Pfv – Perfective verb; Cop – Copula; Pred – Predicative; ∼ – Reduplication. We combine these abbreviation systems, as in e.g., NP-Nom – Noun Phrase in the Nominative case. In our system of annotation, the symbol () indicates optional elements of a fixed part, and the symbol "/" is used to list alternative elements of construction. Each slot and morphological specifications are verified by the data from the Russian National Corpus, supplemented by internet searches where data is sparse.

In representing the syntactic structure of constructions, we adopt the following strategies. If a construction contains an NP that can be used not only in the predicative function marked with the nominative case but also in other roles (e.g., object, etc.) encoded with oblique cases, we do not specify the case in the construction name: e.g., *NP na nule* [lit. NP on zero], as in *Immunitet na nule* "Immunity is at the zero level" vs. *Vypisali bol'nogo s immunitetom na nule* "They released a patient with immunity at the zero level."

If a construction contains an NP that is only used in the predicative function, we indicate its form as the default NP-Nom, as it appears with the present tense copula: e.g., *NP-Nom Cop NP-Nom VP-Inf* (as in *On master gotovit'* "He is good at cooking [lit. expert cook]"). We assume that the instrumental case marking of the predicative NP that appears with the past and/or future tense copula is a general rule of Russian grammar and this is mentioned in the commentary field on the Russian Constructicon website: e.g., *On byl masterom gotovit'* "He was good at cooking [lit. expert cook]." Note that we include the copula in the name of a construction only if the copula verb can be used in this construction not only in the present tense but also in other tense(s), as in this example.

Some constructions contain reduplicated nouns rather than NPs, and we represent this accordingly: e.g., *NP-Nom Cop vsem Noun-Dat.Pl ∼Noun-Nom* (as in *Vsem borščam boršč* "The best vegetable soup of all [lit. to all soups soup])."

In verb argument constructions that contain a specific verb lexeme (the anchor verb) and slots for the verb's arguments, we specify the subject slot even if it has a default nominative case marking: e.g., *NP-Nom znat' tolk v NP-Loc* (as in *On znaet tolk v nastol'nyx igrax* "He is an expert in board-games [lit. He knows sense in board-games]"). Normally, the anchor verb is given in the infinitive to represent any inflectional form. For example, in the construction *NP-Nom znat' tolk v NP-Loc*, the infinitive of the anchor verb *znat'* "know" indicates that this verb can be used in this construction in other forms too.

If the anchor verb can be used in a construction only in a specific grammatical form, the construction name indicates this specific form (or forms, if there are very few options): e.g., *s PronPers-Gen xvatit/xvatilo (NP-Gen)*, as in *S menja xvatit* "I'm fed up [lit. from me enough]." If the use of the anchor verb in the construction is restricted to a certain sub-paradigm, this is indicated accordingly. For example, in the construction *najti-Pst NP-Acc!* (as in *Našli razvlečenie!* "What a bad way to amuse yourself! [lit. found amusement]"), the anchor verb *najti* 'find' can appear only in the past tense.

For constructions that contain a VP, we do not include the subject slot NP-Nom in the name of the construction, because the case marking of the arguments (including the logical subject) depends on specific verb lexemes: compare *večno VP* in *Večno mne ne vezet* "I am always short on luck [lit. eternally to me not catch-luck]" (where the logical subject has an experiencer role and is marked with the dative case) vs. *Večno Petr opazdyvaet* "Peter is always late [lit. eternally Peter is late]" (where the logical subject has the agent role and is encoded with the nominative case).

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Developing Abstract Representations of Passives: Evidence From Bilingual Children's Interpretation of Passive Constructions

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According to usage-based theories, children initially acquire surface-level constructions and then abstract representations. If so, bilingual children might show lags relative to monolingual children early in acquisition, but not later on, once they rely on abstract representations. We tested this prediction with comprehension of passives in 3- to 6-year-old children: French–English bilinguals and English monolinguals. As predicted, younger bilingual children tended to be less accurate than monolingual children. In contrast, the older bilingual children scored equivalently to monolinguals, despite less exposure to English. When the children made errors, the bilingual children were more likely to interpret the subject as the agent of the action than the monolingual children. These results are consistent with the argument that children develop increasingly abstract representations of linguistic constructions with usage. They further suggest that bilingual children might catch up with monolingual through use of selective attention and/or a semantic bias.

Keywords: bilingual first language acquisition, cross-linguistic transfer, passive constructions, positive transfer, usage-based theories of language

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INTRODUCTION

According to usage-based accounts of language acquisition (Tomasello, 2000, 2003; Bybee, 2010), children first learn surface forms of language (i.e., as presented in the input) before generalizing to more abstract forms of representation. Abstract representation allows children to generate novel constructions that are nonetheless grammatical (Tomasello, 2000). The process of abstraction is thought to be both gradual and conservative, as well as highly linked to frequency of usage (Marchman and Bates, 1994; Matthews et al., 2005; Ambridge et al., 2015).

Bilingual children use each of their languages less, on average, than same-aged monolinguals (see Unsworth, 2016). Usage-based accounts would therefore predict that bilinguals should lag in language acquisition relative to monolinguals. Indeed, studies have shown that bilinguals often lag behind monolinguals in at least one language in terms of vocabulary (Oller et al., 2007; Bialystok, 2009; Bialystok et al., 2010; Scheele et al., 2010; Hoff et al., 2012) and morphology (Nicoladis and Marchak, 2011; Nicoladis et al., 2012). Even for monolinguals, frequency plays an important role in

the acquisition of vocabulary (Goodman et al., 2008) and morphology (Marchman, 1997), so it is not surprising to see lags among bilinguals in these domains.

Usage-based approaches also predict lags among bilinguals in syntactic acquisition. However, some research shows that young bilingual children do not lag behind monolinguals in syntactic acquisition, including in aspects where the two languages differ structurally, such as in their word order (Paradis and Genesee, 1996; Serratrice et al., 2004; Paradis et al., 2005-2006). However, these studies have often relied on data drawn from children's spontaneous speech. Usage-based approaches could explain bilingual children's high degree of accuracy in terms of learning surface-level representations. If so, then the apparent commensurate performance would not truly reflect bilinguals' syntactic development. Lags in bilinguals' syntactic acquisition might be observable in experimental tasks, tapping children's ability to process novel constructions and therefore a more abstract level of re(presentation). Indeed, bilingual children show some delays in syntax relative to monolingual children on experimental tasks, like elicitation (Pérez-Leroux et al., 2009).

Regardless of the theoretical framework adopted, researchers generally agree that bilingual children can eventually rely on language-independent representations of syntax [e.g., Universal Grammar (Gawlitzek-Maiwald and Tracy, 1996; Kupisch, 2006) and constructivist and usage-based accounts (Tomasello, 2000; Gathercole, 2007), the Competition Model (Döpke, 1998)]. Usage-based approaches predict developmental changes in the degree of abstraction of linguistic representation, from surface-level and language-specific to abstract and language-independent. There is evidence among adult language learners for this change (Bernolet et al., 2013). The purpose of the present study was to test for this developmental change in bilingual children.

One way to detect bilingual children's reliance on abstract shared representation of language is through cross-linguistic influence. Cross-linguistic influence refers to processing language in such a way that shows influence from the other language (Serratrice, 2013). For example, a French–English bilingual child might produce an adjective following a noun in English (like *the hat purple*) because adjectives often follow nouns in French (Nicoladis, 2006). Cross-linguistic influence must reflect an abstract representation of syntax that is at least somewhat shared across languages, such as overlap in word order (Müller and Hulk, 2001). For this reason, usage-based approaches predict that cross-linguistic influence should increase as children age and use the languages more. To date, results have not consistently supported that prediction. Some studies have shown that cross-linguistic influence decreases with increasing proficiency and/or age (Serratrice et al., 2004; Zwanziger et al., 2005; Nicoladis, 2006, 2012; Hacohen and Schaeffer, 2007), while other studies have shown the opposite pattern (Nicoladis and Gavrila, 2015) or that proficiency interacts with other variables to predict cross-linguistic influence (Navés et al., 2005; Kupisch, 2007; Sorace et al., 2009; Mykhaylyk and Ytterstad, 2017). However, these studies have concerned aspects of language in which cross-linguistic influence resulted in errors or infelicitous constructions. As there may be other reasons for children's errors, the present study focused on a linguistic construction for which cross-linguistic influence would increase children's accuracy (also known as positive transfer; see Chan et al., 2017).

The goal of the present study was to test the prediction that bilingual children will show more positive transfer with passive constructions in English and French as they get older. Full passives are constructed in the same way in both English and French and can be word-for-word translations. This quality of passive constructions in these two languages could allow for positive transfer once children represent these constructions in an abstract, language-independent way.

Passive Constructions

In passive constructions, the patient of an action is the subject of the sentence and the agent of the action an optional adjunct. Within languages, there are often several different forms of passives (Creissels, 2001). We focus here on the full passive, with agent and patient supplied, because these constructions are formed identically in both English and French (e.g., *la bouteille était remplie par la fille* translates word for word to *the bottle was filled by the girl*).

The ability to comprehend and produce constructions in the passive voice is difficult for both English-speaking children (Horgan, 1976; Lempert, 1978; Maratsos et al., 1985; Vasilyeva et al., 2006) and children acquiring Romance languages like French (Jakubowicz and Seguí, 1980) and Spanish (Estevan, 1985; Pierce, 1992). In interpreting passive constructions, children often interpret the subject as the agent (Lempert, 1978; Jakubowicz and Seguí, 1980). For example, in the passive construction, *the monkey was seen by Sandra*, young children would interpret *monkey* as the subject and *Sandra* as the object of an active sentence. Their interpretation of the sentence then becomes *the monkey saw Sandra.* Children continue making these errors of transposition through to at least 8 years of age (Horgan, 1976; Estevan, 1985).

Children can start to show evidence of abstract knowledge about passives as young as 3 years of age (Messenger et al., 2011) but continue to get better at abstraction as they get older (Savage et al., 2003; Vasilyeva et al., 2010). One study showed that bilingual children surpassed monolingual children in their ability to interpret passive constructions by the age of 9 years (Filippi et al., 2015). These results are consistent with the argument that older bilingual children can understand passives based on language-independent, abstract representations.

This Study

The purpose of this study is to test the prediction that bilingual children will show greater positive transfer at an older age (5–6 years of age) than at a younger age (3–4 years of age). This prediction was generated from usage-based accounts of language acquisition. According to these accounts, when children are younger, they represent surface-level (and therefore language-specific) knowledge. Therefore, children's experience with a particular language should be highly correlated with their accuracy in interpreting passive constructions. Since bilingual children have had less experience, on average, with each language than monolinguals, the younger children should show delays relative to monolinguals. As children get older, they construct

abstract, language-independent representations. Older bilingual children should show positive transfer from their other language; in other words, they should interpret passive constructions at least as accurately as monolinguals, despite less exposure.

We also tested the kinds of errors made by the children. The children were asked to interpret passive sentences by picking one of three pictures that corresponded to the meaning of the sentences. One of the distractors was always a picture showing the subject of the passive sentence as the agent of the action. The other distractor depicted the same characters engaged in an action that was not named in the sentence. Given that the bilinguals' vocabulary size in one language would likely be lower than that of monolinguals', the monolinguals might be more likely to make transposition errors than bilinguals. That is, since the monolinguals were more likely to be familiar with the words in the sentences, they would be particularly likely to pick a picture corresponding with the subject as the agent. In contrast, because of their lesser familiarity with the words, the bilinguals might pick a picture corresponding to the incorrect activity.

MATERIALS AND METHODS

Participants

All children were between 3 and 6 years of age, living in Canada, recruited through daycares and preschools, and deemed typically developing by their parents and educators. A total of 62 French–English bilingual children participated in this study. Most of the children can be characterized as simultaneous bilinguals, having heard both languages starting at the age of 1 year or younger. There were three children whose age of onset of acquisition of French was between 2 and 3 years and four children whose age of onset of acquisition of English was between 2 and 4 years. The children with later onset were not outliers in any of the measures included in the present study and so were included in all analyses.

A total of 62 age-matched English monolinguals living in Canada also participated in this study. The data were drawn from a database of 79 children. The 62 children were selected as being the closest age match to the bilingual children.

We analyzed the results both with age as a continuous measure and as a categorical variable. To construct the younger and older age groups, we split the groups at the median age of 58 months. **Table 1** summarizes the background characteristics of the age and language groups.

Materials and Procedure

For the bilingual children, there were two language sessions: one in English and the other one in French. The monolingual children did the tasks once, in English. The language sessions for the bilinguals were scheduled on different days, usually about a week apart, with different experimenters. The experimenters were native speakers of the target language of the session and spoke entirely in that language during respective sessions. The order of the language sessions was counterbalanced.

In each session, children were given a battery of language and cognitive tasks. The order of the tasks was determined by the experimenter, depending on the child's level of engagement and willingness to respond. Most often the sessions started off with the more passive tasks, such as receptive vocabulary tests, where children are simply invited to point to a picture corresponding to a word provided by the experimenter. Later in the session, the experimenter would present tasks requiring children's active production, such as storytelling. We present here the results only for the tasks relevant to the research questions: the receptive vocabulary tests and the test of comprehension of passive constructions.

In the present study, we estimated exposure time to a particular language with vocabulary scores because previous studies have shown strong correlations between vocabulary scores and exposure time to each language in bilingual children (Thordardottir, 2011). All children were invited to take the receptive vocabulary test in English, the Peabody Picture Vocabulary Test III (PPVT; Dunn and Dunn, 1997). In the French session, the children took the French version of this test, the *Échelle de vocabulaire en images Peabody* (EVIP; Dunn et al., 1993). Both the PPVT and EVIP are standardized tests and were administered according to the examiner's manual. Both tests are standardized so that a normed score of 100 (with a SD of 15) represents age-typical performance. The scores were also calculated according to the manuals. We present both the raw scores and normed scores for both language groups (in **Table 1**). In order to calculate relative proficiency, we present the ratio of the PPVT normed scores divided by the EVIP normed scores. Thus, a one would represent fairly balanced vocabulary scores. As can be seen in **Table 1**, on average, the bilingual children were fairly balanced in their vocabulary scores in their two languages, with no difference by age group. In the analyses including vocabulary, we used the raw vocabulary scores (rather than the normed scores) because we were interested in the children's total vocabulary, not how their vocabulary compared with that of other children of the same age.

The children's comprehension of passives was measured in English by their performance on passive constructions in Section G (complex sentences) of the Comprehension part of the Reynell Developmental Language Scales III (Edwards et al., 1997). Section

TABLE 1 | Background characteristics of participants.

	Younger		Older	
	Bilinguals	**Monolinguals**	**Bilinguals**	**Monolinguals**
N	33	33	29	29
Age range	46–58	47–58	59–82	59–78
Average (SD) age	53.6 (3.4)	54.0 (3.0)	65.1 (6.0)	65.4 (5.0)
#Girls/boys	20/13	17/16	15/14	15/14
PPVT-raw	54.0 (23.1)	78.6 (19.2)	74.3 (17.9)	90.9 (27.3)
PPVT-norm	96.2 (21.2)	116.9 (13.8)	102.7 (12.8)	116.5 (20.2)
EVIP-raw	39.4 (21.7)	n/a	57.6 (22.0)	n/a
EVIP-norm	94.9 (22.6)	n/a	101.3 (22.6)	n/a
Ratio PPVT/EVIP	1.1 (0.4)	n/a	1.1 (0.4)	n/a

Age is in months. PPVT, Peabody Picture Vocabulary Test; EVIP, Échelle de Vocabulaire en Images Peabody; Ratio PPVT/EVIP, the normed PPVT score divided by the normed EVIP score.

G is composed of 10 complex sentences, six of which are in passive voice, such as *The mother is fed by the baby* (see the **Appendix** for complete list). All of the passive constructions had animate agents and patients so should be challenging for children within this age range (Horgan, 1976). To demonstrate their comprehension of a passive construction, children were presented with three pictures and asked which one corresponded to the sentence. One picture depicted the target (e.g., the baby feeding the mother), another the situation if the agent and the patient were reversed (e.g., the mother feeding the baby), and the third with the agent and patient performing some other action (e.g., the mother hugging the baby). To measure the bilingual children's comprehension of passives in French, a translated version of the Reynell constructions was presented to them. The exact wording of the passives in French can be found in the **Appendix**.

Coding and Analysis

All monolingual children performed all the tasks. Five bilingual children declined our invitation to take the PPVT, two the EVIP, and one the passive task in French. We include these children in the analyses whenever the analyses do not critically involve these measures.

For each child, we calculated the ratio correct in each language out of the total number of items that each of the children answered. For each language, chance was 0.33 (the children had three options, so random choosing should result in one-third correct).

To test for the children's errors, we calculated the percentage of their errors that were transposition errors (rather than a picture of an irrelevant activity). Not all the children made errors, so we report the exact number of participants included in the analyses below. All statistical analyses were carried out in SPSS.

RESULTS

The average vocabulary scores for the bilinguals and monolinguals are summarized in **Table 1**. On a 2 × 2 (Age Group × Language Group) ANOVA on the raw scores of the PPVT, the younger children scored 16.34 lower than the older children, $F(1,115) = 15.85$, $p < 0.001$, $\eta^2_p = 0.121$ (95%CI of this difference [8.17, 24.36]). The bilinguals scored significantly lower (by 21.09) than monolinguals on the English vocabulary test, $F(1,115) = 25.40$, $p < 0.001$, $\eta^2_p = 0.181$ (95%CI of this difference [12.50, 28.69]), but there was no interaction between language group and age group, $F(1,115) = 0.45$, $p = 0.33$, $\eta^2_p = 0.008$. The main effect for Language Group supports our assumption that the bilinguals had less exposure to English than the monolinguals.

Passives: Accuracy

Figure 1 summarizes the average ratio correct on passives for younger and older monolingual and bilingual children. The younger monolingual children averaged 0.66 (SD = 0.23; 95%CIs [0.58, 0.74]) correct, while the younger bilingual children averaged 0.55 (SD = 0.32; 95%CIs [0.42, 0.63]) correct. The older monolingual children averaged 0.75 (SD = 0.20; 95%CIs [0.68, 0.83]) correct and the older bilingual children 0.79 (SD = 0.19; 95%CIs [0.72, 0.86]). A 2 × 2 (Age Group × Language Group) ANOVA revealed a significant effect for age, $F(1,120) = 15.92$, $p < 0.001$, $\eta^2_p = 0.117$. The older children's accuracy was 0.18 higher than the younger children's (95%CI of this difference [0.09, 0.27]). There was no significant main effect for Language Group, $F(1,120) = 0.81$, $p = 0.37$, $\eta^2_p = 0.007$ (95%CI of this difference [−0.05, 0.13]).

Usage-based approaches predict an interaction between Language Group and Age Group. In fact, the interaction effect neared significance, $F(1,120) = 3.25$, $p = 0.07$, $\eta^2_p = 0.026$. To better understand this interaction, we compared the two age groups and the two language groups with independent-samples *t*-tests. In both language groups, the younger children tended to be less accurate than the older children, although this difference approached significance for the monolingual children, $t(60) = -1.75$, $p = 0.09$ (95%CI of this difference [−0.21, 0.01]) and was significant for the bilingual children, $t(60) = -3.71$, $p < 0.0001$ (95%CI of this difference [−0.40, −0.12]). There was a near-significant difference for the younger groups, $t(64) = 1.72$, $p = 0.09$ (95%CI of this difference [−0.02, 0.26]), but not the older groups, $t(56) = 0.78$, $p = 0.44$ (95%CI of this difference [−0.14, 0.06]).

In French, the younger bilingual children scored an average ratio correct of 0.51 (SD = 0.33; 95%CIs [0.40, 0.62]) and the older children 0.68 (SD = 0.31; 95%CIs [0.57, 0.79]). For the younger children, there was no significant difference between languages on a paired *t*-test, $t(32) = 0.57$, $p = 0.58$ (95%CI of this difference [−0.19, 0.11]). In contrast, the older children were significantly more accurate in English than in French, $t(28) = 2.25$, $p = 0.03$ (95%CI of this difference [−0.01, 0.22]).

To see how age and vocabulary were related to children's performance, we correlated age (in months) and raw vocabulary scores with their ratio correct of passives (see **Figure 2**). For the monolingual children, age showed a trend for being more highly correlated with accuracy, $r(60) = 0.304$, $p = 0.02$, 95%CI [0.059, 0.515], than vocabulary, $r(60) = 0.043$, $p = 0.74$, 95%CI [−0.209, 0.290] ($z = 1.47$, $p = 0.07$). For the bilingual children in English, accuracy was highly correlated with both vocabulary, $r(55) = 0.500$, $p < 0.0001$, 95%CI [0.275-0.673], and age, $r(60) = 0.377$, $p = 0.003$, 95%CI [0.140, 0.573], with no difference between the two correlations ($z = 0.81$, $p = 0.21$). For the bilinguals in French, vocabulary was more highly correlated with accuracy, $r(58) = 0.685$, $p < 0.00001$, 95%CI [0.522, 0.800], than age, $r(60) = 0.402$, $p = 0.001$, 95%CI [0.169, 0.592] ($z = 2.22$, $p = 0.01$). In sum, these correlations revealed that age was an important correlate of accuracy for the monolingual children, while within-language vocabulary scores were an important predictor for the bilingual children.

Passives: Transposition Errors

We predicted that the monolingual children would make more transposition errors than bilinguals due to their greater vocabulary. Among the monolingual children, 29 of the younger children and 22 of the older children made at least one error. Among the bilingual children, 28 of the younger

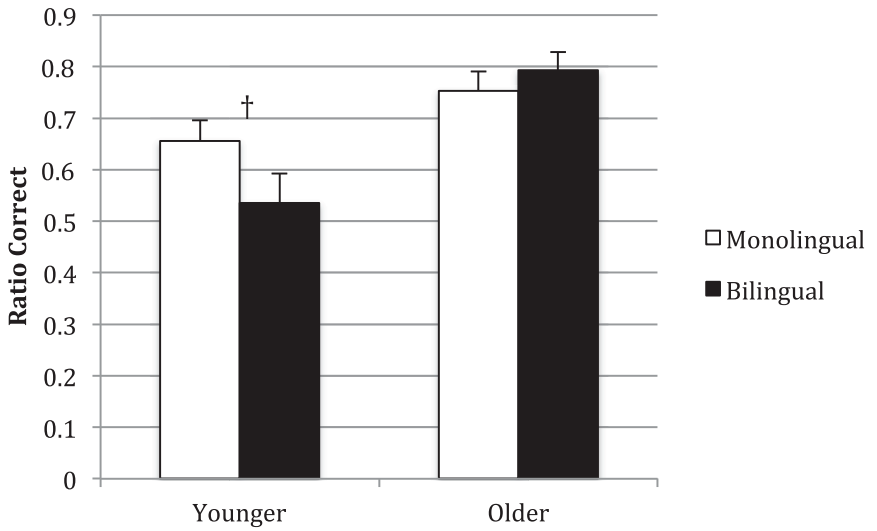

FIGURE 1 | Average ratio correct in English. †$p = 0.09$. Error bars show standard error around the mean.

children and 21 of the older children made at least one error. **Figure 3** summarizes the average ratio of errors that were transposition errors (rather than choosing an irrelevant action). The younger monolingual children averaged 0.55 (SD = 0.45; 95%CIs = 0.39, 0.71) transposition errors, while the younger bilingual children averaged 0.83 (SD = 0.24; 95%CIs = 0.75, 0.92). The older monolingual children averaged 0.63 (SD = 0.42; 95%CIs = 0.46, 0.81) transposition errors, while the older bilingual children averaged 0.86 (SD = 0.26; 95%CIs = 0.75, 0.97). A 2 × 2 (Age Group × Language Group) ANOVA showed no effect for Age Group, $F(1,96) = 0.58$, $p = 0.45$, $\eta^2_p = 0.006$ (95%CI of this difference [−0.09, 0.20]). The main effect for Language Group was significant, $F(1,96) = 12.56$, $p = 0.001$, $\eta^2_p = 0.116$ (95%CI of this difference [0.11, 0.40]). The interaction effect was not significant, $F(1,96) = 0.14$, $p = 0.71$, $\eta^2_p = 0.001$. As can be seen in **Figure 3**, the main effect of Language Group showed that, contrary to predictions, the bilinguals made 0.26 more transposition errors than the monolinguals.

In French, 27 of the younger children and 19 of the older children made at least one error. The younger bilingual children averaged 0.74 transposition errors (SD = 0.28; 95%CIs = 0.62, 0.83) and the older bilingual children 0.87 (SD = 0.25; 95%CIs = 0.76, 0.98). There was no significant difference between languages on paired *t*-tests for either the younger, $t(26) = 1.14$, $p = 0.25$ (95%CI of this difference [−0.08, 0.28]), or the older children, $t(18) = 1.05$, $p = 0.31$ (95%CI of this difference [−0.07, 0.23]).

Further Tests for Positive Transfer Among the Bilinguals

High positive correlations between languages on accuracy of the interpretation could be evidence for positive transfer. For the younger bilingual children, the correlation between ratio correct in the two languages did not attain significance, $r(30) = 0.210$, $p = 0.25$, 95%CI [−0.150, −0.521]. In contrast, this correlation was positive and significant for the older children $r(27) = 0.476$, $p = 0.009$, 95%CI [0.133, −0.717].

One alternative interpretation to these correlations is that the older bilingual children were simply better at remembering which picture they had chosen in the other language session than the younger bilingual children. To test this possibility, we compared the age groups on the percentage of items for which the children chose the same picture in both languages. The younger children chose the same picture on average 56.6% of the time (SD = 25.7%) and the older children 67.2% (SD = 28.0%). This difference did not reach significance, $t(60) = 1.57$, $p = 0.12$. Thus, it seems unlikely that the older children were simply remembering which picture they had chosen.

DISCUSSION

Drawing on usage-based approaches, we predicted that younger bilingual children would show no positive transfer in passive constructions in French and English, since they might still be representing only the surface structure of these constructions. In contrast, older children would have an abstract representation of passive constructions and therefore show positive transfer across languages. The results upheld those predictions. We found that the younger bilingual children tended to be less accurate than monolingual children in English and that there was no correlation between languages for the younger bilingual children. In contrast, we found that the 5- to 6-year-old bilingual children tended to be just as accurate in interpreting passive constructions as English monolinguals, even though they had less exposure to English. Furthermore, there were high positive correlations across languages for the older bilingual children.

These results are consistent with usage-based accounts of acquisition proceeding from surface-level to abstract

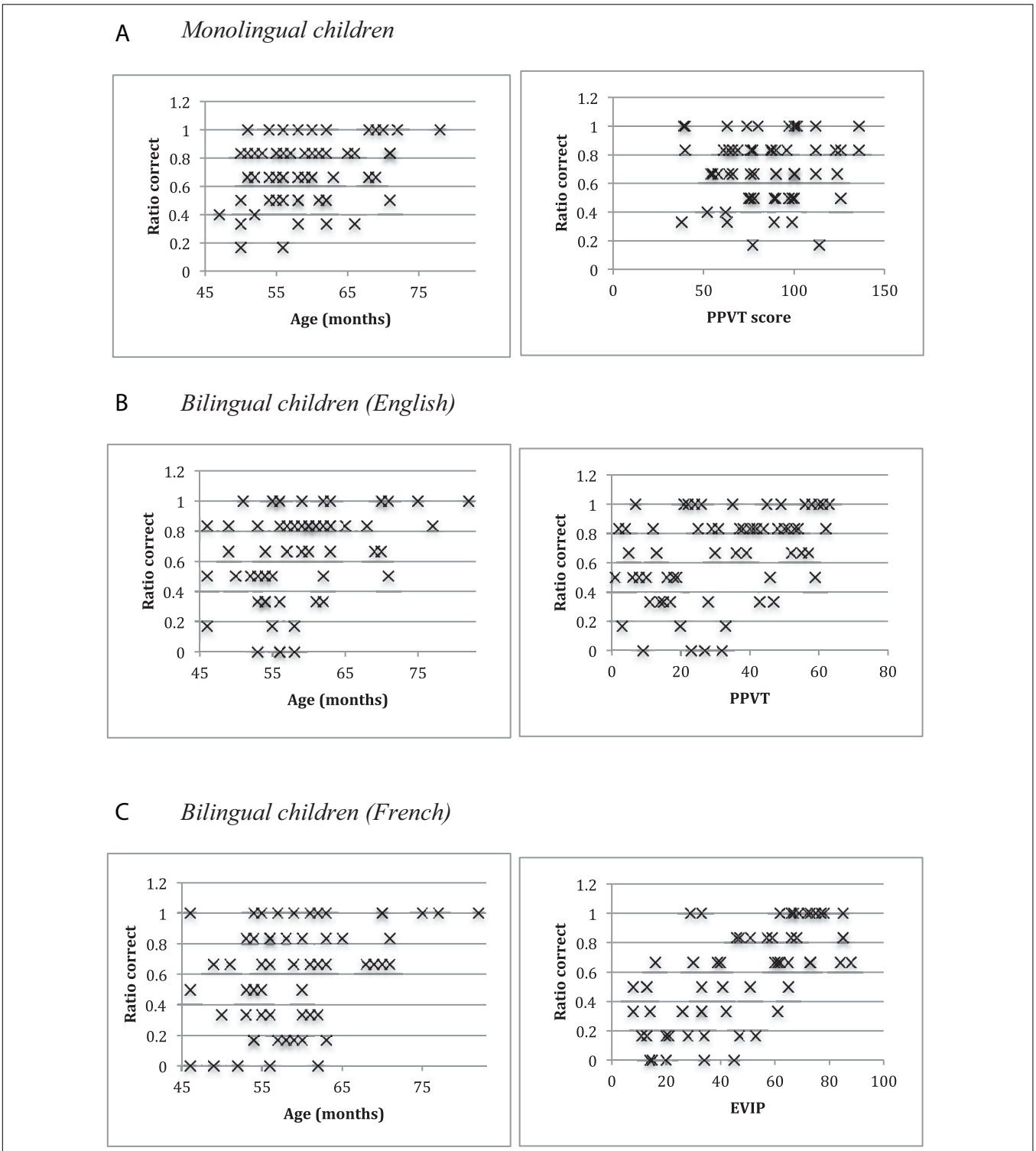

FIGURE 2 | Scatterplots for ratio correct and age **(left)** and vocabulary **(right)**. **(A)** Monolingual children. **(B)** Bilingual children (English). **(C)** Bilingual children (French).

representation. At the age of 3–4 years, the children could be representing passive constructions at the level of words (including the auxiliary and the word "by" or "par"). By the age of 5–6 years, children could be representing at an abstract level, perhaps something like PATIENT-AUXILIARY-PAST PARTICIPLE-"BY/PAR"-AGENT.

According to this interpretation, the way that bilingual children can catch up with monolingual children is through

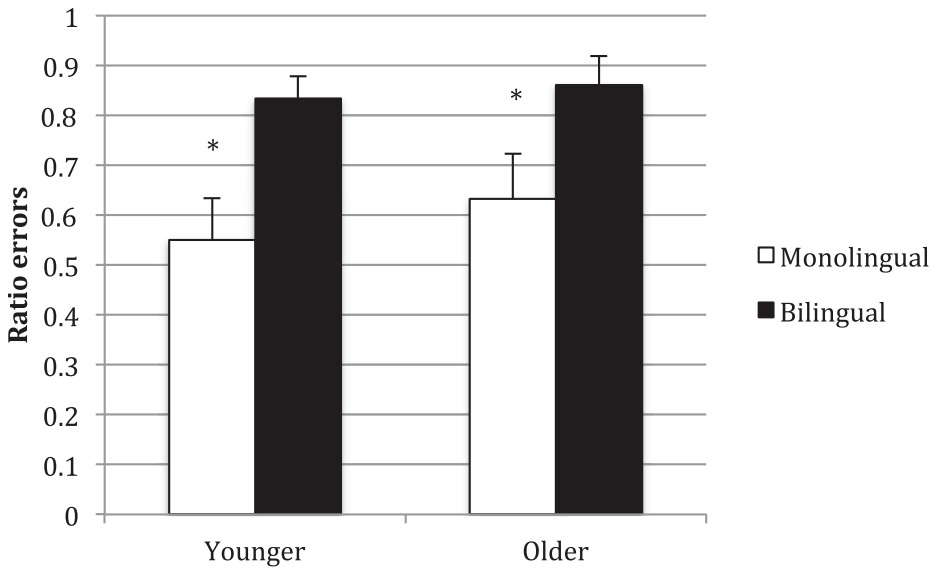

FIGURE 3 | Average ratio transposition errors in English. *$p < 0.05$. Error bars show standard error around the mean.

increasing abstraction of syntactic constructions, through exposure to both of their languages. However, our results suggest that there may also be at least two other possible mechanisms (entirely compatible with increasing abstraction) by which bilingual children can catch up with their monolingual counterparts: a semantic bias and selective attention. We consider each of these mechanisms in turn.

One possible mechanism that could allow bilingual children to catch up with monolinguals is that they rely heavily on semantics to interpret language until they acquire the relevant syntactic constructions. In the present study, the finding that even the younger bilinguals were more likely to make transposition errors than the same-aged monolinguals suggests that the bilinguals were taking the meaning of the presented words into account when interpreting the sentences. Some previous research on other linguistic aspects has suggested that young bilingual children can show this sort of semantic bias. For example, one recent study showed that preschool bilingual children interpreted the English past tense morpheme –ed as meaning completion rather than marking for tense (Nicoladis et al., 2020). Future studies can test for this possibility by including irrelevant words in passive sentences to see if bilingual children attempt to find a referent for all the words in their interpretation.

Another possible mechanism (one that is entirely compatible with the semantic bias) is selective attention. The greater rate of transposition errors among bilinguals could mean that the younger monolingual children were not paying as much attention to the words used by the experimenter to select a corresponding picture as the younger bilingual children. Selective attention refers to the ability to pay attention to the relevant aspects of the environment to achieve a goal or solve a problem (Blom et al., 2017). It is possible that even from a young age, bilingual children are selectively attending to the aspects of language that allow them to interpret the meaning. For example, for passives, if they selectively attend to the words contributing to the meaning of the sentence, then, with exposure to more passive sentences in context, they can correct transposition errors quickly. This argument does not necessarily mean that bilinguals would be better than monolinguals at selective attention (although some studies have found this; Blom et al., 2017) but rather that they are relying more on their selective attention in the task of language learning than monolingual children. Analogous results have been reported in other linguistic domains. For example, one study showed that bilingual children relied more on cognitive flexibility when accessing words to tell a story than monolingual children even though they showed no advantage over the monolinguals in cognitive flexibility (Nicoladis and Jiang, 2018). In order to test this interpretation, future studies can include measures of selective attention. If studies show that bilingual children rely more on selective attention in syntactic acquisition than monolinguals, this finding alone would not challenge usage-based approaches. Instead, it would suggest that these approaches need to be supplemented.

One curious finding in the present study was that age was a strong predictor for accuracy for monolingual children, while within-language vocabulary was a strong predictor for accuracy for bilingual children. It is not entirely clear to us why these predictors differ for the two language groups. That within-language vocabulary predicts accuracy fits well with usage-based approaches. That age predicts accuracy for monolingual children suggests that cognitive development may play an important role in monolingual children's development of passives. If so, it is unclear what aspects of cognitive development would be important and how those aspects of cognitive development would play a role. Again, this finding could be indicative that usage-based approaches may need to be supplemented with the inclusion of some cognitive constructs. In any case, for the moment, we can conclude that vocabulary was not a

good measure of the development of passives in monolingual children in this study.

Our characterization of children's abstract representation (i.e., PATIENT-AUXILIARY-PAST PARTICIPLE-"BY/PAR"-AGENT) is highly speculative; the exact nature of abstract representation in usage-based approaches is rarely spelled out (Tomasello, 2000; Goldberg, 2013). In the present study, we included constructions that are word-for-word translations of each other, meaning that the word order is exactly the same in French and English. It is not clear that this perfect transliteration is necessary for bilinguals to show positive transfer. In fact, the weight of evidence to date suggests that adult bilinguals can show positive transfer even when word order varies across languages (Hatzidaki et al., 2011; Hwang et al., 2018). One case study of a bilingual child also suggested that positive transfer could occur, despite a lack of similarities in the constructions in the two languages (Babatsouli and Nicoladis, 2019). If positive transfer can occur even in the absence of similar word orders, then the form of abstract representation might be primarily in terms of function. Tomasello (2000) argued that the abstract representation would critically be based on constructions that serve highly similar communicative functions. Future research could therefore focus on how passives are used in communication, as well as focusing on linguistic constructions that differ across languages.

There were a number of limitations to the present study. First, only six passives sentences were included. Second, to test for the effects of age, we did a median split with children aged 3–6 years, rather than recruit participants with a greater difference in age groups. Both of these choices may have reduced the statistical power, and we may therefore be underestimating the true difference. Another limitation is that, in French, we used a translated version of the passive sentences. The bilingual children in the present study tended to do worse on the French version than the English version, particularly the older children. As we had no French monolingual comparison group, we do not know if this tendency is due to the bilingual children's poorer French (than English) performance or whether there were some weaknesses to our translated version. Future research can be designed with greater statistical power and include comparison groups of monolinguals in both languages.

In conclusion, we have shown here that there are developmental changes in bilingual children's positive transfer across languages in passive constructions. These results are consistent with the argument that children's representation of linguistic constructions becomes increasingly abstract as they learn to use their language(s). We have also found suggestive evidence that bilinguals may better employ selective attention to the task of learning passives than monolinguals. With increasingly abstract representation and skillful employment of selective attention, the bilingual children in this study performed better in a language than expected from their exposure time.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University of Alberta Research Ethics Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

EN spearheaded the data collection, analyzed the data, and wrote the manuscript. SS reviewed the literature, coded the data, and edited the manuscript. Both authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.545360/full#supplementary-material

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APPENDIX

TABLE A1 | Passive sentences used in English and French.

English	French
The boy is chased by the dog.	*Le garçon est chassé par le chien.*
The mother is fed by the baby.	*La maman est nourrie par le bébé.*
The cat is bitten by the dog.	*Le chat est mordu par le chien.*
The girl is hugged by the monkey.	*La fille est câlinée par le singe.*
The elephant is carried by the boy.	*L'éléphant est porté par le garçon.*
The baby is pushed by the mother.	*Le bébé est poussé par la maman.*

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What Are Constructions, and What Else Is Out There? An Associationist Perspective

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Constructionist approaches to language propose that the language system is a network of constructions, defined as bidirectional mappings between a complex form and a meaning. This paper critically evaluates the evidence for and against two possible construals of this proposal as a psycholinguistic theory: that direct, bidirectional form-meaning associations play a central role in language comprehension and production, and the stronger claim that they are the only type of association at play. Bidirectional form-meaning associations are argued to be plausible, despite some apparent evidence against bidirectionality. However, form-meaning associations are insufficient to account for some morphological patterns. In particular, there is convincing evidence for productive paradigmatic mappings that are phonologically arbitrary, which cannot be captured by form-meaning mappings alone, without associations between paradigmatically related forms or constructions. Paradigmatic associations are argued to be unidirectional. In addition, subtraction and backformation at first glance require augmenting the associative networks with conditioned operations (rules). However, it is argued that allowing for negative form-meaning associations accommodates subtraction and backformation within the constructionist approach without introducing any additional mechanisms. The interplay of positive and negative form-meaning associations and paradigmatic mappings is exemplified using a previously undescribed morphological construction in Russian, the *bez*-Adjective construction.

Keywords: construction grammar, usage-based linguistics, associative learning, morphology, morphological paradigms, second-order schemas, Russian

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INTRODUCTION

In constructionist approaches to language, the grammar and the lexicon are unified into the constructicon, a single network of constructions, defined as form-meaning pairings (e.g., Bybee, 1985; Langacker, 1987; Goldberg, 1995, 2006; Kapatsinski, 2013, 2014; Diessel, 2015). All languages have constructica, and the ability to acquire a large constructicon is the crucial pre-requisite to acquiring a human language (Deacon, 1997). Constructions are agreed to be probabilistic, multiply determined and learned by generalization over experienced utterances.

However, two issues remain unresolved. First, an important issue involves directionality: are constructions really bidirectional form-meaning mappings, Saussurean signs, or are there separate sets of form→meaning and meaning→form mappings? While the former has been the default assumption in the literature, there are also strong arguments for assuming otherwise (e.g., Ramscar et al., 2010). Second, there is disagreement on whether form-meaning mappings are sufficient

to explain utterance comprehension and production, or if the mental grammar also contains other types of generalizations. One such generalization type is represented by second-order, paradigmatic generalizations mapping one construction onto another. Paradigmatic or "second-order" generalizations can be of two kinds. Within the constructionist framework, the grammar is a network of mappings, and second-order generalizations are paradigmatic mappings between constructions (Ford et al., 1997; Cappelle, 2006; Nesset, 2008; Booij, 2010; Kapatsinski, 2013, 2017b, 2018; Booij and Audring, 2017a,b; Audring, 2019). In the generative framework, second order generalizations are rules (context-specific operations) that transform a base construction into another one, in a certain context (Albright and Hayes, 2003; Kapatsinski, 2010a). As pointed out by Pinker and Prince (1988), operations are not consistent with an associationist approach to the mind and require an additional mechanism.

Paradigmatic generalizations of both kinds have been explicitly questioned in the constructionist literature (e.g., Bybee, 2001; Goldberg, 2002) because there is less need for them than in a framework that does not posit constructions. Indeed, I will argue below that we do not have evidence that they are necessary above the word level (i.e., in syntax). However, morphology provides crucial evidence for the existence of paradigmatic mappings and/or rules (Nesset, 2008; Booij, 2010; Becker and Gouskova, 2016; Booij and Audring, 2017a,b). I argue that rules may not be necessary if paradigmatic mappings are allowed and associations can be inhibitory.

The workings of an associative network are illustrated using a previously undescribed construction in Russian, the *bez* Adjective construction. A full description of the construction requires us to make use of all types of associations: *schematic* associations between meanings and forms, as well as syntagmatic[1] and paradigmatic associations between forms, and requires both excitatory and inhibitory schematic associations. It also illustrates two fundamental but less controversial properties of an associative network: that multiple bases are used to produce a novel wordform via a multitude of parallel routes.

ARE BIDIRECTIONAL FORM-MEANING ASSOCIATIONS (CONSTRUCTIONS) POSSIBLE?

Constructions are typically defined as pairings between form and meaning, a definition that brings with it at least an implicit assumption of bidirectionality. In an associative network, bidirectional mappings[2] mean that activation of a form changes activation of a meaning as much as activation of the meaning changes activation of the form. One worries about at least two ways in which this assumption may not hold water. First, the connection from a form to a meaning might have a different strength than the connection from the meaning to the form. Second, there may not even be a single form level used for production and comprehension: if we take the constructionist assumption of there being no levels of abstraction between meaning and form to its logical extreme, then the forms in comprehension of a spoken language would be auditory or audiovisual in nature while the forms in production would be articulatory. In contrast, bidirectionality requires a form level that mediates the mapping from audition to semantics in comprehension and from semantics to articulation in production (Kapatsinski, 2018, pp.59-62).

Production-Comprehension Dissociations Are Predicted by Bidirectional Associations

The existence of bidirectional form-meaning associations can be questioned on the ground that there exist production/comprehension dissociations. In particular, when multiple forms are competing to express a meaning, the form most likely to be chosen to express the meaning in production may not be the form that would best transmit the meaning to the listener, i.e., the form that is the best cue to that meaning in comprehension (Kapatsinski, 2012; Harmon and Kapatsinski, 2017; Koranda et al., 2018). Production-comprehension dissociations of this type can even be observed within the same individual. However, the existence of such dissociations does not necessarily imply that the connections between form and meaning are unidirectional.

The basic reason that production-comprehension dissociations are not probative regarding directionality of form-meaning connections is that there is always a reason for choosing a form i.e., not the best cue to the meaning to be expressed. Often, this reason can be incorporated into the network as an additional cue to the form, which contributes to form choice independently of the bidirectional form-meaning connection. To take an extreme example, a bilingual chooses among cognate constructions in part based on how strongly they are activated by the meaning to be expressed, but also based on the language that the listener is likely to understand.

An additional reason for dissociations is the role of form accessibility in production choice. Frequent, more accessible words can be chosen for production over less frequent alternatives even when those infrequent alternatives would be better cues to the meaning for the listener. As discussed by Harmon and Kapatsinski (2017), Harmon (2019), and Smolek (2019), this mechanism can explain regularization and paradigm leveling in language change. Harmon and Kapatsinski (2017) show experimentally that increasing the frequency of a construction in a learner's experience makes the construction's form more likely to be used to express *related* meanings, and yet makes the same speaker more confident that it does not map onto these meanings in comprehension. For example, learners who experience the constructions N-*dan* and N-*sil* paired with multiple large creatures a few times are equally likely to pick multiple small creatures and multiple large creatures in response

[1]Syntagmatic generalizations could be used to predict upcoming forms and retrodict the forms one has missed (Lieberman, 1963; Osgood, 1963). An alternative is posed by interactive activation flow between parts and wholes (McClelland and Elman, 1986). Because of space restrictions, I will simply assume syntagmatic associations here.

[2]*Mappings* may be implemented by multiple *associations* in the mind, or by multiple *connections* in a neural network.

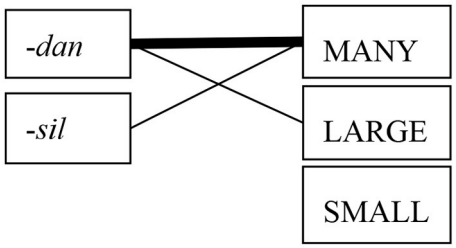

FIGURE 1 | A network with bidirectional connections modeling a production-comprehension dissociation after exposure to nouns suffixed with *-dan* and *-sil* paired with multiple large creatures, with *-dan* being more frequent than *-sil* (after Kapatsinski and Harmon, 2017).

to either form. However, as they keep encountering N-*dan* with multiple large creatures they stop selecting multiple small creatures in response to examples of N-*dan*. They become more confident that "large" is a necessary part of the meaning of *-dan* (see also Xu and Tenenbaum, 2007). However, they also become more likely to choose *-dan* to name multiple small creatures. Koranda et al. (2018) also demonstrate this effect in a continuous semantic domain of angles: learners use frequent terms to refer to a broader range of angles although they are more confident about what angle a frequent term actually refers to.

Accessibility-driven dissociations are easily modeled with bidirectional form-meaning connections, as shown in **Figure 1**. We assume that connections between forms and meanings strengthen when the form is paired with the meaning, that MANY (i.e., PLURAL) is a more salient meaning for an English speaker than LARGE, and that connections between salient cues and outcomes develop faster than connections between less salient ones. When the listener is presented with *-dan*, s/he knows that it means LARGE rather than SMALL: *-dan* activates LARGE more than SMALL because it has grown an association with the (initially low-salience LARGE feature). When presented with *-sil*, the listener activates MANY but has no way to pick between LARGE and SMALL. Because of the initially low salience of LARGE as a feature to an English speaker, the small number of exposures to *-sil* paired with LARGE has not allowed that connection to develop. As a speaker, the same participant will choose *-dan* over *-sil* when presented with MANY SMALL because there is no connection from SMALL to either form, while the MANY-*dan* connection is stronger than the MANY-*sil* connection. Thus, production-perception dissociations of this kind are actually predicted by bidirectional form-meaning associations.

Bidirectional Associations Can Be Learned With Unidirectional Mechanisms

A different kind of argument against bidirectionality was presented by Ramscar et al. (2010). Ramscar et al. presented participants with training trials featuring form-meaning pairings, with meanings being visual depictions of novel 3D objects. The crucial manipulation was whether the form preceded the meaning or the meaning preceded the form. The meanings were clustered into six categories, with two categories paired with each of the words *wug*, *tob* or *dep*. There were salient non-discriminative visual features that distinguished subcategories paired with the same form, but were shared between forms, and therefore would not allow the learner to predict the form from the object. There were also non-salient discriminative visual features that defined only one of the subcategories paired with a form but were not shared between forms, and would therefore allow the learner to predict forms. Learners in the meaning-before-form condition picked up on these low-salience discriminative features, while those in the form-before-meaning condition did not.

Ramscar et al. (2010) argue that learners acquire meaning-to-form connections following the classic Rescorla-Wagner learning rule, which uses sets of cues to predict upcoming outcomes. The Rescorla-Wagner rule updates cue-to-outcome connection weights in proportion to the unexpectedness of the outcome's occurrence, or absence (Rescorla and Wagner, 1972), as well as cue and outcome salience. The rule is unidirectional in two senses: it does not learn outcome-to-cue associations, and the roles of cues and outcomes during learning are different. The rule assumes that the learner predicts whether the outcome will occur based on the present cues. Thus, the learner has expectations about which outcomes would occur in various contexts and can learn when those outcomes are *unexpectedly* absent. The learner does not form expectations about the contexts in which cues will occur, and therefore learns nothing from absent cues, and cue salience is due solely to its inherent perceptual properties. Because of these asymmetries in the rule, Ramscar et al. conclude that "the relationship between symbols and the things they represent is not bidirectional" (p.912).

The results of Ramscar et al. provide an important illustration of the importance of prediction in language learning, and document the existence of cue competition between semantic cues. The results are indeed consistent with the predictions of the Rescorla-Wagner rule, and support a different role for cues and outcomes during learning. Nonetheless, learning may result in associations being formed in both directions, allowing the learner to predict an outcome based on a cue and to infer that a missed cue must have occurred based on an outcome. Bidirectionality would imply that the associations in both directions should be equal in strength. Ramscar et al.'s results are consistent with this prediction. In their experiment, participants are tested both on choosing forms given a meaning and on choosing a meaning given a form (p.930). Participants who experienced the meaning-before-form condition appear to have performed better on both tasks (accuracy within task is not reported, and no task differences are reported). It therefore appears that form-to-meaning connections benefit from the meaning-before-form order as much as meaning-to-form connections do. This result is prima facie inconsistent with participants learning meaning-to-form connections in one condition and form-to-meaning connections in the other; strong correlations between the strengths of A→B and B→A are a classic argument for bidirectionality (Kahana, 2002). Rather, the results are consistent with the alternative hypothesis that participants in the meaning-before-form condition are learning bidirectional or reciprocal

associations between discriminative semantic features and the forms they predict. That is, cues that are predictive of outcomes acquire salience and are associated with those outcomes more strongly than cues that are not predictive, but the associations themselves appear to form in both directions.

Second, Ramscar et al. (2010, p.918) assume that forms do not have identifiable subparts that can compete to predict meanings (though cf. Blevins et al., 2016):

> "verbal labels are relatively discrete and possess little cue structure [. . .] consider the label *pan*. A native English speaker can parse it into a sequence of phonemes [p^{h}an] but will be largely unable to discriminate further cues within these sounds [. . . B]ecause phonemes are perceived sequentially rather than simultaneously [. . .] phonemes cannot compete directly as cues. Moreover, the other discriminable cues present in speech—such as emphasis, volume, and pitch contour—do not covary systematically with phonemes."

This paragraph above denies both the existence of subphonemic cues, including phonetic cues and phonological features, and the pervasiveness of coarticulation. Phonemes do of course covary with loudness or pitch; for example, pitch at the beginning of a vowel is a secondary cue to the voicing of the preceding stop, distinguishing [p] from [b], and listeners are exquisitely sensitive to such patterns of covariation (e.g., Idemaru and Holt, 2011). Likewise, it is not the case that the cues to phonemes are strictly sequential. For example, the place cues to the [p] are in the formants also identifying the height and frontness of the following vowel. Given these considerations, we should expect that phonetic cues compete with each other for predicting meanings, and indeed this effect has recently been documented by Nixon (2020).

Third, the way that children experience forms and objects is often very different from the experimental setup in Ramscar et al. (2010), where the object was presented very briefly (for 150 ms) either a second after or a second before the spoken word. Head camera data indicate that most efficacious word learning episodes involve parents naming objects that the child is already looking at, and the child continuing to look at the object during the label and for some time afterwards (Pereira et al., 2014). These experiences allow the child to both predict the form from the meaning, and to predict meaning from the form, potentially forming a connection or connections in both directions.

Finally, in conditioning experiments that have provided the motivation for the Rescorla-Wagner model, cues are predictive but devoid of inherent value whereas the outcomes are biologically relevant events like the dispensation of food or electric shock. Because of this inherent asymmetry, it is plausible that cues are used to predict outcomes and not vice versa (although research in animal learning has argued for models incorporating reciprocal cue-outcome connections; Matzel et al., 1988; Honey et al., 2020). Because wordforms and other speech sounds are not themselves biologically relevant, while the events they predict often are—especially in the early experience of an infant—it appears implausible to restrict learners to predicting forms from meanings.

In conclusion, there is no current empirical evidence against bidirectionality of form-meaning mappings. Dissociations between production and comprehension can be observed, but are predicted from simple models with bidirectional associations. There is evidence that such associations can be learned by predicting forms from meanings, but the learned associations can then be used to select meanings given forms as well as to select forms given meanings.

What Are "Form" Representations?

While bidirectionality is consistent with the behavioral evidence, it does raise questions about how it could be implemented in the brain. On the one hand, many brain areas are connected bidirectionally: there is just as much top-down activation flow (from meanings to forms) as bottom-up activation flow (see O'Reilly and Munakata, 2000, for an excellent review), a fact that has provided a motivation for interactive activation models of language processing (Dell, 1986; McClelland and Elman, 1986; O'Reilly and Munakata, 2000) and Grossberg's Adaptive Resonance Theory (Grossberg, 1987, 2013). While the top-down and bottom-up connections largely involve separate neurons, it is not impossible to imagine bidirectionality at the level of forms and meanings of constructions, which correspond to activation patterns distributed over large populations of neurons (see Allen et al., 2012, for an attempt to identify such patterns in fMRI). For example, in Grossberg's theory, constructions would be resonant brain states in which the form level and the meaning level feed activation to each other, helping maintain a construction in an activated state for the significant period of time likely necessary for constructions to guide utterance planning. Based on Pereira et al. (2014) head camera data, efficacious naming episodes tend to provide children with the opportunity to establish such a resonance as an object persists in the child's view before, during and after the referring form is heard.

The bidirectional top-down and bottom-up activation flows connect semantic representations to perceptual and (pre)motor processing areas of the brain. However, to say that the same form-meaning mappings are active in comprehension and production requires the two processing directions to share a form level. The need for a form level appears to preclude a radical exemplar account of language (e.g., Ambridge, 2019) in which there is no significant abstraction, and therefore constructions map perceptual representations onto meanings in comprehension and meanings onto motor representations in production. The question of whether there is a level of form representations shared between perception and production has been a long-standing area of debate in phonetics. A promising direction for unifying the two is represented by Bayesian analysis-by-synthesis models, in which the listener evaluates hypotheses about possible production representations that could have generated the perceived auditory signal (e.g., Bever and Poeppel, 2010). If these accounts are on the right track, then production representations could serve as the form level mediating between audition and semantics in speech perception, and bidirectional form-meaning connections could connect these production representations to meanings. Literal bidirectionality could also

be maintained by models in which the production targets the speaker aims to achieve are perceptual in nature.

But what if there is no form level? What if listeners map perceptual representations directly onto meanings, while speakers map meanings directly onto articulatory representations? In this case, the mappings would not be constrained to be bidirectional by the architecture of the language system. However, I would argue, learning would nonetheless modify the weights of the unidirectional mappings to bring them in close alignment, allowing for bidirectionality in activation flow. Models that posit separate form levels for production and perception also posit mechanisms for bringing those form levels into alignment during early development (Guenther and Perkell, 2004; Davis and Redford, 2019). Through these mechanisms, which likely include both reinforcement learning and imitation, production and comprehension representations appear to be linked so closely that activating one appears to of necessity activate the other. Although there is debate regarding whether the motor cortex plays a *mediating* role in speech perception, there is consensus that it is *activated* by speech sounds. Likewise, there is recent evidence that silent speech produces activation in the auditory cortex (Okada et al., 2018). If the two form levels necessarily activate and resonate with each other in both production and comprehension, the linked representations function as a single form level i.e., both activated by and activates semantics. That is, if articulatory and perceptual representations necessarily activate each other, it is possible for a meaning to always increase activation of an articulatory representation to the same extent that the corresponding perceptual representation increases activation of the meaning, allowing for bidirectionality.

WHEN ARE SECOND-ORDER GENERALIZATIONS NEEDED?

Usage-based constructionist approaches to grammar are skeptical of transformations, and question the need to derive constructions from either other constructions or underlying forms (e.g., Bybee, 1985, 2001; Langacker, 1987; Goldberg, 2002; Diessel, 2015). However, it has been argued that there are second-order schemas relating "allostructions" (Cappelle, 2006) or, more generally, constructions that share parts (Ford et al., 1997; Nesset, 2008; Booij, 2010; Kapatsinski, 2013, 2017b, 2018; Jackendoff and Audring, 2016; Booij and Audring, 2017b; Audring, 2019). In syntax, for example, Cappelle (2006) has argued that there is a need to relate the English verb-particle-NP construction to the verb-NP-particle construction, as in *When did you give it up* vs. *When did you give up drinking*. In morphology, there is apparent need to relate words that share a stem. For example, *ambition* and *ambitious, caution* and *cautious* can be related together by a schema linking together the $[\ldots ous]_{\mathrm{A}}$ and $[\ldots ion]_{\mathrm{N}}$ constructions, which would encode the fact that an adjective ending in *-ous* usually corresponds to a noun ending in *-ion* and not some other nominal suffix (Audring, 2019). Another well-known example is the [… *ist*]∼[… ism] schema as in *pacifist*∼*pacifism*, which allows one to explain how one would derive an *-ist* adjective from a new *-ism* noun or vice versa (Booij, 2010). As Booij pointed out, these kinds of direct mappings capture the fact that the semantic relationship between the *-ist* and *-ism* forms is regular whereas this cannot be said of each form's relation to its stem. An X-ist can have many semantic relationships to X, but necessarily believes in X-ism.

Second-Order Schemas Are Rare but Necessary for Morphology

Jackendoff and Audring (2016) have argued that second-order schemas are ubiquitous, and that any two constructions that share some aspect of form or meaning are linked by a second-order schema. Furthermore, second order schemas can be posited even if they are not productive. However, from a usage-based perspective, a generalization plays a role in the grammar if it is *used* to understand or produce language, thus unproductive schemas are rather suspect. Dabrowska and Szczerbiński (2006) and Engelmann et al. (2019), among others, show that many speakers of highly inflected languages may not use many of the second-order schemas of their language productively, with productivity of a schema being a gradient function of its type frequency and reliability. Second-order schemas are also notoriously difficult for learners to acquire (e.g., Braine et al., 1990, cf. Audring, 2019, p.14). Learning productive second-order schemas appears to require either encountering the corresponding schemas in the same context, where one form is expected but the other occurs instead (e.g., Onnis et al., 2008), or encountering them in close temporal proximity, so that the form of one can be used to predict the form of the other (Smolek, 2019). Constructions, as form-meaning mappings appear to be easier to acquire (e.g., Braine et al., 1990; Kapatsinski, 2013).

Given the existence and easy learnability of constructions, it is reasonable to assume that second-order generalizations are learned and used only for patterns that cannot be captured with direct form-meaning mappings (Bybee, 2001; but cf. Booij and Audring, 2017a). Therefore, in order to convincingly argue for the necessity of a second-order schema, we need to show that one could not have understood or generated each of the constructions it links without reference to the other construction. This is a high bar to clear in syntax. For example, hearing *The dax fribbles a wug to the frumbly swuppet*, the listener does not need to activate the alternative double-object formulation to understand the sentence (Goldberg, 2002). S/he also does not need to use this specific formulation in generating the double-object alternative. Hearing the sentence, the listener could categorize the *swuppet* as an animal or human and perhaps assign it a gender, necessary for choosing the pronoun. When producing the sentence, the speaker would then be influenced by the inferred characteristics of the swuppet, the wug, and the action of fribbling, which do not require reference to the prepositional dative formulation—they are inherent to the inferred semantics. Choosing to use a pronoun requires knowing that the wug and/or the swuppet was mentioned, but also does not require reference to the prepositional dative formulation. The choice of the construction depends on this choice—the double object construction is strongly favored by selecting a pronoun to refer

to the swuppet (Bresnan et al., 2007) and disfavored by a long noun phrase—but does not depend on anything about the double object formulation. In other words, the two constructions are not in a feeding relationship—generating one of these constructions does not require reference to anything that one could find only in a construct of the other. The closest one comes to such a relationship is when the other construction would sound awkward given a certain filler for the first NP because of that filler's phonology (?*I gave the highly agitated swuppet that was zwigging all over the room a wug*; see Shih, 2017, for a recent review). However, even such cases do not require the use of a second-order schema. For example, the speaker could begin to generate both formulations in parallel, and the awkward-sounding construction would simply lose the race because it is harder to formulate.

In contrast to syntax, paradigmatic morphology presents numerous examples where one does need to reference the form of one construction to generate a related one. For example, Becker and Gouskova (2016) documented the productivity of the generalization that…oCC#$_{\text{Nom.Sg}}$∼…eCCa#$_{\text{Gen.Sg}}$ but…CoC#$_{\text{Nom.Sg}}$∼…CCa#$_{\text{Gen.Sg}}$ in Russian. Here, the same form would result from vowel deletion in the Genitive in both cases (…CC#), but it is avoided when *another* form of the word ends in a single consonant (…oC#). Thus, generating the Genitive Singular seems to require reference to the Nominative Singular construction. It is difficult to find any comparable examples of syntactic constructions; that is, constructions whose use or form depends in an arbitrary fashion on the form of another construction.

Second-Order Schemas Help Enact Large Changes to the Base

Second-order schemas allow the speaker to enact arbitrary changes to an activated form when constructing a production plan. Evidence for this claim comes from a recent dissertation by Smolek (2019), who exposed participants to a language with second-order schemas and manipulated how easy they were to extract from the input. She then tested speakers' knowledge of the language using both judgment and production. She found that participants would produce large changes to the base only if second-order schemas were easy to notice in training. Acceptability judgments were unaffected, as was production of smaller, and more a priori likely changes.

In Smolek (2019), a subset of singulars mapped onto plurals ending in [t∫a], undergoing a stem change either when they ended in [k] or when they ended in [p], as shown in (1), where the consonants in curly brackets were presented to different participants:

(1) … *blu{k;p}*$_{\text{SG}}$ *blut∫a*$_{\text{PL}}$ *smi{p;k}*$_{\text{SG}}$ *smi{p;k}a*$_{\text{PL}}$ *klat*$_{\text{SG}}$ *klata*$_{\text{PL}}$…

Learners produced the p→t∫ change only if exemplifying singular-plural pairs were kept intact during training as in (1-2). When only faithful pairs were kept intact (3) or all words were presented in random order (4), participants did not learn to produce the stem change, retaining the [p] of the singular.

(2) … *smik*$_{\text{SG}}$ *blup*$_{\text{SG}}$ *blut∫a*$_{\text{PL}}$ *klata*$_{\text{PL}}$ *smika*$_{\text{PL}}$ *klat*$_{\text{SG}}$…
(3) … *blup*$_{\text{SG}}$ *klat*$_{\text{SG}}$ *klata*$_{\text{PL}}$ *smik*$_{\text{SG}}$ *smika*$_{\text{PL}}$ *blut∫a*$_{\text{PL}}$…
(4) …*smik*$_{\text{SG}}$ *blup*$_{\text{SG}}$ *klata*$_{\text{PL}}$ *smika*$_{\text{PL}}$ *klat*$_{\text{SG}}$ *blut∫a*$_{\text{PL}}$…

When exposed to p→t∫ using the random order in (4), participants judged singular-plural pairs exemplifying the stem change as being more acceptable than those without the change. In both judgment and production, they also did not know what stems should change and what stems should not, indicating that they had not learned paradigmatic, second-order mappings. However, they would not change any stems while judging that all stems *should* change. Because this was not true of the smaller change k→t∫, where judgments and production probabilities aligned, Smolek argued that second-order schemas are particularly important for making large changes. Without a second-order schema, one can still judge unexpectedly frequent constructions like t∫a∼PL as being particularly characteristic of the experienced language but would not produce such outcomes from inputs that are either very different or a priori unlikely to map onto them.

Smolek's results are partially consistent with Booij and Audring's (2017a) proposal that "output-oriented, constructional schemas [i.e., form-meaning mappings that do not make reference to other forms] should be used for stating regularities that are not productive" because "these schemas have a motivational function only" (p.59). However, I would not go that far, as there is evidence that constructional schemas can be productive and can even be used in preference to second-order schemas with which they conflict (e.g., Wang and Derwing, 1994; Kapatsinski, 2013). Furthermore, in Smolek's (2019) experiments, constructional schemas could support productive generation of plurals, except when singular-plural mappings in the input involved large unexpected changes to the base.

Second-Order Schemas vs. Rules

Second-order schemas are typically depicted as bidirectional (e.g., Booij, 2010; Jackendoff and Audring, 2016), like first-order schemas/constructions mapping form and meaning. However, this appears to be a false analogy. Unlike forms and meanings, paradigmatically-linked words do not occur at the same exact time in one's experience—one or the other word occurs first and can then be used to predict the other. Being able to produce plurals from singulars also does not guarantee being able to produce singulars from plurals, and depends on the reliability of the mappings *in that particular direction* (e.g., Engelmann et al., 2019). Thus, paradigmatic mappings linking two forms often have different strengths in different directions.

As directed paradigmatic mappings, second-order schemas resemble rules that map surface forms onto other surface forms (as proposed by Albright and Hayes, 2003). They differ from such rules because they do not involve a split into a change and a context in which that change occurs (Kapatsinski, 2012, 2013; Jackendoff and Audring, 2016). A rule is an operation that occurs in a certain context; a second-order schema is a mapping between two constructions (or their forms). I have argued for schemas over rules by observing that mappings that involve different changes but the same output can "conspire": as evidence for

one increases the other becomes more productive alongside it, and participants who like or frequently produce one mapping also tend to like and frequently produce the other. In particular, adding pairs of words exemplifying $[\ldots t\int]_{SG}\sim[\ldots t\int i]_{PL}$ to a language in which $[\ldots k]_{SG}\sim[\ldots t\int i]_{PL}$ but $[\ldots t]_{SG}\sim[\ldots ti]_{PL}$ led participants to overgeneralize the $k\rightarrow t\int i$ change to [t] (Kapatsinski, 2012, 2013). These results suggest that learners are treating $[\ldots t\int]_{SG}\sim[\ldots t\int i]_{PL}$ and $[\ldots t]_{SG}\sim[\ldots t\int i]_{PL}$ as exemplifying the same schema even though they involve different changes ($0\rightarrow i$ vs. $t\rightarrow t\int i$). This result rules out models such as Albright and Hayes (2003) or Becker and Gouskova (2016) that split words into changes and contexts, the ingredients of a rule, and then generalize only over the contexts in which a particular change occurs.

However, rules can be rescued if we assume that zero is not a possible (or likely) input to the change, so any change must involve at least one overt segment as the input. That is, learners presented with examples like $blut\int_{SG}\sim blut\int i_{PL}$ are experiencing the change $t\int\rightarrow t\int i$ rather than $0\rightarrow i$. The results of Kapatsinski (2012, 2013) are then captured by assuming that learners do generalize over changes, and that they generalize over inputs more than over outputs so that all kinds of inputs initially map onto $[t\int i]$. Assuming that outputs are action plans to be performed, greater generalization over inputs than over outputs may be a general property of learning in a world where cues calling for a certain action can vary but actions need to be performed with some precision to be efficacious (Kapatsinski, 2018, pp.64-66).

Another way to test the difference between mappings and operations is afforded by subtraction. Pure subtraction involves removing a fixed unit regardless of what remains, in contrast with truncation, which refers to removing as much material as necessary to fit a fixed prosodic template. Truncation is easily captured by a construction in which the form has certain prosodic characteristics. Inkelas (2015) identifies a diachronic pathway from subtraction to truncation, which suggests that speakers often extract a construction from the truncated forms produced by subtraction. However, subtraction does appear to be learnable, and is not easily captured by constructions.

Learnability of subtraction was examined in Kapatsinski (2017a; 2018, pp.186-192). Native English speakers were exposed to artificial languages that could be interpreted as exemplifying either truncation or subtraction. In these languages, the final vowel of the singular was deleted to form the plural always resulting in CVCVC. These languages then could be interpreted either as using the construction $[CVCVC]_{PL}$ or the rule / operation $V\rightarrow 0/\_]_{PL}$. At test, participants were then presented with CVCV singulars, for which the two generalizations predict different choices: satisfying the construction would involve the operation of consonant addition (unattested in training), but result in an attested product (CVCVC), while following the rule would involve using the attested operation of vowel deletion to produce an unattested product, CVC. Participant choices depended on whether one of the consonants was over-represented at the ends of singulars. Participants were more likely to add a consonant if they knew which consonant to add (the overrepresented one). However, both strategies were attested, sometimes within the same individual. These results therefore seem to provide support for both constructions and rules. In the next section, I explore two ways of capturing subtraction within a constructionist framework, without the use of rules.

Subtraction Without Rules: Conditioned Copying or Negative Associations

Subtraction is difficult to capture with a second-order schema because it involves mapping something onto nothing, and null elements are not part of the constructionist framework. How then can subtraction be incorporated into the constructionist worldview? In Kapatsinski (2017b; 2018, pp.193-199), I argue that constructions must be supplemented by an operation that there I called *copying*, on analogy with the copy connections of recurrent networks (Elman, 1990). To produce anything, the speaker needs to construct and execute a production plan, and constructions stored in long-term memory compete for being incorporated ("copied") into the plan.

Subtraction involves learning *not* to copy a certain element of an activated form when expressing a certain meaning. Thus, it may be captured by making copying conditional on various aspects of the input (Kapatsinski, 2017b). Thus, if we assume that copy connections are gated, these gates may be closed by certain meanings and input forms. If production plans for wordforms are filled out left-to-right (Roelofs, 1999), then it may be sufficient for alternative segments to be competing for a "future" slot in the plan. Preventing copying of a final vowel into plurals would then involve learning a negative weight for a connection from the semantics of plurality to a gate on the copy connection that would make the final vowel the future: $w(PL\rightarrow[V\#\rightarrow\_\_{future}])<0$.

Because copying of activation patterns from one brain area to another is biologically implausible (Grossberg, 1987), the construction of a production plan is likely implemented as establishing a resonance between parts of a control structure (e.g., "future") and activated form units. However, it is not clear how the formation of a resonance can be conditioned, thus it is worth considering alternatives to conditioned copying. A possible avenue to accounting for both changes to the base and subtraction is to incorporate negative meaning-form associations. In current constructionist frameworks, construction forms are templates that are filled out by material from long-term memory (see Jackendoff and Audring, 2016). As such, they can only be positively associated with the meaning they express and lack a mechanism for capturing subtraction when it is independent of the resulting shape of the product. However, any computational model that learns associations between meanings and the forms that cue them also learns negative associations between forms and meanings (as stressed by Ramscar et al., 2014, and Roembke et al., 2016).

Negative form-meaning associations can account for subtraction. For example, the final vowel deletion pattern in Kapatsinski (2017a) could be described as a negative association between PL and V#. They can also account for stem changes, the meaning to be expressed inhibiting elements of the base that are dissociated from it. For example, to produce a singular from a

known plural, an English speaker would inhibit the *-s* suffix via a negative SG→*s#* association. The existence of such an association receives independent support from the fact that the singular form *lens* is often misspelled as *lense*, often enough for both to be entered in dictionaries. This misspelling is motivated by the fact that an s#, and especially a C*s#* indicates plurality. The intention to produce an adjective may inhibit nominalizers that distinguish adjectives from nouns (see the next section for an example). If negative associations are particularly strong for unexpectedly absent elements of form, this account may also account for stem change examples like k→s in English *-ity* nouns. A learner of English would expect a [k] after *electri…* Not hearing it would provide evidence that it is suppressed by the meaning the speaker was expressing. The element of the meaning that discriminates *electricity* from *electric* is whatever distinguishes nouns from adjectives. That element of meaning would then activate *-city* and suppress [k]. Similarly, it is possible that the Genitive Singular in Russian inhibits oC# as well as activating CC#, resulting in greater deletion of vowels from…oC# singulars than from…oCC# singulars in Becker and Gouskova (2016). Having heard the frequent Nominative/Accusative *puʃok* "little furball," the speaker would expect the same form in a subsequent production of the rarer Genitive; hearing *puʃka*, s/he would then learn that the Genitive Singular disfavors the oC# as well as favoring the *-a#*.

Cases that would still require second-order schemas involve patterns in which the same structure can be either favored or disfavored in a certain paradigm cell depending on the corresponding form in some other cell. For example, in deriving a Russian Genitive Plural from a known Nominative Singular, /o/ can be both deleted and inserted, depending on whether the noun is Masculine or Feminine, a difference that can be predicted from Nominative Singular forms: *mis-k-a→mis-ok* "bowl" but *kus-ok→kus-k-ov* "piece." Here,…ok# appears to be both eliminated by the Genitive Plural (for Masculines) and imposed by it (for Feminines). Unless these types of choices can be attributed entirely to semantic differences between the word classes (in this case Masculines and Feminines), they require productive second-order schemas. Interestingly, the Genitive Plural is exactly the paradigm cell that Russian speakers have a difficult time filling; with great uncertainty regarding the correct form. For example, dictionaries record both *portkov* and *portok* as the Genitive of the pluralia tantum *portki* "pants," which could be either Masculine or Feminine as unambiguous forms are missing. Paradigm gaps abound, and are spreading (Daland et al., 2007). For example, there is no Genitive Plural for *metʃta* "dream" even though there is one for *matʃta* "mast." The difficulties make sense if the production of this form relies on second-order generalizations, since such generalizations are difficult to acquire.

WHAT GOES INTO ONE MORPHOLOGICAL CONSTRUCTION

From this perspective, a production plan for a novel word is a blend of a number of units stored in long-term memory and activated in parallel by the intended meaning. This results in forms being multiply motivated (Taylor, 2012; Kapatsinski, 2013; see also Burzio, 1998; Booij and Audring, 2017b). As an example, consider the $[bez\ldots]_A$ construction in Russian, exemplified below. This construction carries the same meaning as the $[\ldots less]_A$ construction in English (*groundless*, *priceless*). In Russian, the prefix is the same form as the preposition *bez*, "without" and has grammaticalized out of it. I have collected all 341 examples of this construction from the 125,000-word reverse dictionary of Russian (Zaliznjak, 1974).

I will argue that this construction represents a blend of prepositional phrases of the type [*bez* N.GEN] and adjectives, as well as properties associated with the to-be-expressed meaning. For example, in (5)-(6), the adjective "costless" (i.e., free) is motivated by both the prepositional phrase "without cost," which shares *bez* with the adjective, and the adjective "costful" (i.e., not free). In particular, it contains the adjectival suffix *-n*, which is shared with the *bez*-less adjective. Whenever a *bez* adjective has a *bez*less counterpart, the two share the adjectivizing suffix. However, 31% of *bez* Adjectives lack a counterpart without *bez*, exemplified in (7) and (8). For these adjectives, the only possible base is the corresponding prepositional phrase. However, there are also (less numerous) examples in which the *bez* adjective has no corresponding prepositional phrase, shown below in (18)-(21).

(5) [bez-plat]-n-yj — bez plat-y
without-cost-A-MASC.SG.NOM — without cost-SG.NOM.

(6) bez-[plat-n-yj] — plat-n-yj
without-cost-A-MASC.SG.NOM[3] — cost-A-MASC.SG.NOM

(7) *bez-kryl-yj* "wingless" — *bez kryl-jev* "without wings" — *kryl-at-yj* "winged"

(8) *bez-lik-yj*[4] "faceless" — *bez lik-a* "without face" — ??

Choosing the Suffixes: Schematic and Syntagmatic Conditioning

The final suffix is the case-gender-number agreement marker and is almost regularly *-yj* in the dictionary (Masculine Singular Nominative) form, with the exception of *bez-mater-n-ij* "motherless," which likely avoids homophony with *bez-mater-n-yj* "lacking taboo words," *bez-mu3-n-ij* "husbandless," which follows the same pattern, and *bez-trud-ov-oj* "laborless," which shares the *-ov-oj* with its much more frequent *bez*-less pair *trud-ov-oj* "labor-A." With the exception of *trud-ov-oj*, *bez*-less adjectives ending in *-oj* correspond to *bez-* adjectives ending in *-yj* (e.g., *vyezd-n-oj* "able to leave" but *bez-vyezd-n-yj* "unable to leave," *tsvet-n-oj* "colorful" but *bez-tsvet-n-yj* "colorless"). The

[3]The Masculine Singular Nominative is the one form in which more than one inflectional suffix is possible in adjectives. In all other forms, adjectives inflect regularly.

[4]Phonetically, this word ends in is [kʲij] or [kʃj] depending on dialect but this is due to language-wide phonotactic constraints and is not conditioned by anything specific to the construction thus I am abstracting away from it here. This choice should not be taken as an endorsement of phonemes or underlying forms as a psycholinguistic construct.

choice of suffix also comes with a choice of stress location, as *-yj* is unstressed, while *-oj* is stressed. While the number of such pairs is low ($n = 4$), they suggest that *-yj* must be activated by the meaning of the construction.

At the same time, *-yj* must also be strongly associated syntagmatically with the preceding adjectivizing suffix *-n*, as 95.5% of *-n* adjectives take *-yj*, with only 3.5% taking *-oj* and 1% *-ij*. Compare the very low rate of *-oj* use after *-n* to its rate of use after another adjectivizing suffix, *-ov*. While *-yj* is still dominant with this suffix, accounting for 74% of the adjectives, *-oj* accounts for 26%, which is significantly higher than the 3.5% seen with *-n* ($p < 0.00001$ by Fisher exact test). As noted earlier, the only instance of *-oj* use with *bez-* occurs after the suffix *-ov*. These results suggest that there are syntagmatic associations between *-ov* and *-oj*, and between *-n* and *-yj*, even though the "A" meaning generally is associated with *-yj* more strongly than with *-oj*.

The adjectivizing suffix is not fully predictable. However, 79% of *bez-* adjectives bear *-n*, and *-n* also accounts for the majority of *bez* adjectives that lack *bez*less counterparts (67%), i.e., pairless adjectives. This is a significantly higher percentage than for adjectives generally, where *-n* accounts for ∼52% of types ($p < 0.00001$ by Fisher exact test). Therefore, *-n* may be considered to be part of the construction, activated by its meaning ("WITHOUT N")[5].

There are also many pairless adjectives without an adjectivizing suffix, as in (10)-(11). These form 23% of pairless *bez-*adjectives while only one suffixless *bez* adjective, *bez-pal-yj* "fingerless" has a *bez-*less pair in the dictionary ($p < 0.00001$), and that pair is now obsolete. Suffixless formations are semantically conditioned: all adjectives referring to lack of expected body parts are formed this way; animal body parts account for 20/25 such adjectives. The remaining adjectives refer to parts of non-animal "bodies," formed from the roots *verx* "top," *list* "leaf," *os'* "axle," and metonymic extensions, *pol* ("sex/gender") and *styd* ("shame"). Interestingly, the body part semantics cause a suffixless formation only if the body part is in some notable state: thus, *bez-kryl-yj* "wingless" and *ʃirok-o-kryl-yj* "wide-winged" but *kryl-at-yj* "winged"; *bez-puz-yj* "belly-less," *tolst-o-puz-yj* "fat-bellied" but *puz-at-yj* "bellied"; *bez-golos-yj* "having no voice" and *gromk-o-golos-yj* "having a loud voice," but *golos-ist-yj* "having a [good] voice." The adjectivizing suffixes that are removed from such adjectives in forming the *bez-* form are *-at*, *-ist* and *-ast*. They must be suppressed by the "remarkable state of a body part" semantics.

The suffix *-(l)iv* is always shared with the *bez-*less adjective and thus not associated with "without." Its selection is independently semantically conditioned, in that it refers to characteristic behaviors/character traits. Thus, an *o-pas-liv-yj* "cautious" person operates with caution (*opas-k-a*), and a *za-stentʃ-iv-yj* "shy" person lives behind a self-imposed wall (*stenka*), having the quality of with *za-stentʃ-iv-ostʲ* ("shyness"). A *zabot-liv-yj* "caring" person performs *zabot-a* "care" for other people. The choice of variant is syntagmatically-conditioned: *-liv* after coronals, /s/ and /t/, and *-iv* after /tʃ/.

Copying From the Prepositional Phrase

The suffix *-ov* is less common in *bez-* adjectives than in other adjectives and must therefore be inhibited by the construction's meaning: only 5 (1%) of *bez-* adjectives have the suffix compared to 14% of all adjectives ($p < 0.00001$). Interestingly, this suffix is of the same shape as the Genitive Plural Masculine inflectional suffix on nouns (*kot* "tomcat," *kot-ov* "tomcats-GEN.PL.MASC"). The preposition *bez* requires a Genitive noun, but does not place requirements on number or gender. Thirty-one percentage of the nouns in PP's corresponding to *bez-*Adjectives take *-ov* in the Genitive Plural. However, all nouns corresponding to *bez-* Adjectives taking the suffix *-ov* bear the Genitive Plural suffix *-ov*. While there are only five such adjectives, the pattern is suggestive of *-ov* being copied from the noun in the corresponding prepositional phrase. The pattern is statistically robust across the class of *-ov* adjectives in the dictionary where 74% (1022/1373) have a corresponding noun ending in *-ov*, a proportion statistically greater than the 39% observed with-*n* adjectives ($p < 0.0001$). Thus, it appears that the adjectival suffix *-ov* often results from a genitive plural noun inflection copied into the adjective when the adjective is formed. Copying of inflectional suffixes into adjectives, where they look like derivational, adjectivizing suffixes suggests that copying operates on a fully inflected wordform rather than a stem, and that what is being copied are surface chunks from that form. At the same time *-ov* cannot *always* result from nominal inflection because not all such adjectives have nominal bases ending in *-ov*. In 26% of the cases, it is imposed directly by the A meaning.

Copying from the prepositional phrase is also supported by another aspect of the forms of *bez-* adjectives, the spelling of *bez-* (Kapatsinski, 2010b). Both the prefix and the preposition undergo voicing assimilation, so that *bez* is pronounced [bes] before voiceless obstruents. However, the spelling rules for the prefixes differ from those for prepositions: the preposition must always be spelled *bez*, whereas the prefix must be spelled they way it sounds, with <s> before voiceless obstruents. Kapatsinski (2010b) shows that Russian college students spell the prefix [bes] <bez> ∼50% of the time in low-frequency *bez-* adjectives they do not know, even in a graded dictation test. The error rate is two orders of magnitude higher than the error rate for other comparable prefixes (*iz-* and *raz-*), which also end in /z/ and obey the same spelling rules. Like *bez-*, the errorless prefixes have homophonous free morphemes that are always spelled with <z>. In the case of *iz-*, as in the case of the error-prone *bez-*, the free morpheme is a preposition i.e., near-synonymous with the prefix and is the diachronic source of it. However, neither *iz-* or *raz-*verbs have *bases* that contain free morphemes that correspond to the prefix and from which its spelling can be copied. Both prefixes derive perfective verbs from imperfective ones as in (9)-(10). The low rate of spelling errors on *iz-* and *raz-* suggests that the spelling errors on *bez-* are due to writers copying the orthographic <z> of the base prepositional phrase into the production plan for the adjective. Frequent *bez-* adjectives are spelled correctly because their orthographic forms can be retrieved from the lexicon.

[5]The suffix has a relatively rare allomorph, *-enn*, that attaches to stems ending in certain consonant clusters (stv, {d;t}r, zn) but not {z; 3}d, {s;k;r;n}t, ltʃ, or lk. Thus *-enn* occurs where there would be a sonority sequencing violation if *-n* were attached. Because apparent allomorphs often have additional semantic conditioning (Endresen, 2015), *-enn* tokens are not included in the *-n* counts above.

(9) *raz*$_{<s>}$*-kop-a-t*^{j} *kop-a-t*^{j}
apart-dig-V-INF dig-V-INF
raz$_{<z>}$ *kop-a-t*^{j}*, to…*
since [we are to] dig-V-INF, then

(10) *iz*$_{<s>}$*-kop-a-t*^{j} *kop-a-t*^{j} *iz*$_{<z>}$ *korobk-i*
out-dig-V-INF dig-V-INF out-of box-GEN.SG

No Single Base Is Necessary

A parallel, associationist constructicon predicts that there should be no single base from which *bez* adjectives are derived (see also Burzio, 1998; Booij and Audring, 2017b). The forms blended into the plan need to meet only one criterion: they need to be associated with, and therefore recurrently activated by the intended semantics. The more strongly a form is activated, the more it is predicted to affect the blend. This hypotheses is strongly motivated by results on the diachronic phenomenon of paradigm leveling, which happens between forms that are strongly related semantically (Bybee and Brewer, 1980), and changes less frequent forms by blending in elements of more frequent ones (Tiersma, 1982). For example, Bybee and Brewer (1980) show that paradigm leveling in Provencal verbal paradigms happened between forms of the verb that share all inherent semantics, differing only in agreement. Tiersma (1982) provided evidence that Frisian nouns have leveled mostly in favor of singular forms, except for those for which the plural form is more frequent.

Note that, in any case of paradigm leveling, there is a form that would fully express the intended semantics. This form would receive more activation from the semantics if frequency were controlled, and therefore can often prevent other forms from affecting the blend, blocking/pre-empting the formation of synonyms. Leveling occurs when the form fails to block the formation of a synonym because it is not accessible enough from the intended meaning, and is replaced by something else. That something else is, furthermore, not another existing form, but a new formation that incorporates elements of the more frequent semantically similar form into the form that matched the intended semantics fully. The existence of this process strongly implicates parallel activation of competing forms and a blending process that can combine them into a novel production plan. In the case of *bez-* adjectives, semantic similarity explains copying from the corresponding prepositional phrases that can express most of the meaning of the *bez-* adjective. Because these phrases contain Genitive nouns, this also explains why it is the Genitive i.e., copied.

The proposal that words are formed by blending forms activated in parallel by the intended meaning contrasts with the hypothesis that there is a single base for any particular type of morphologically complex word (Albright, 2002). We have already seen evidence that *bez* adjectives are motivated by both bez-less adjectives and prepositional phrases, contradicting the single base hypothesis. However, until now we could maintain that there is always a prepositional phrase base, suggesting that we could claim that there is one particular base i.e., necessary for deriving a *bez* adjective. However, the problems go deeper: first, it is not possible to claim that the forms of the nouns in the base prepositional phrases always come from the same paradigm cell; second, there are *bez* adjectives that do not have corresponding prepositional phrases.

Some Russian nouns have different stem forms in Singular and Plural Genitives. The examples in (11)-(13) show that it is not: some adjectives copy the plural form (11) while others copy the singular (12). Sometimes, different *bez* adjectives can even be derived from the forms in different paradigm cells, as in (12)-(13). Thus, a single base paradigm cell cannot be identified: whatever forms match the intended semantics best are the ones copied.

	Singular	Plural
(11) *bez-det-n-yj*	*bez dit*^{j}*-a/reb*^{j}*onk-a*	*bez det-ej*
childless	without child-GEN.SG	without children-GEN.PL
(12) *bez-t∫elovet∫-n-yj*	*bez t∫elovek-a*	
inhumane	without person-GEN.SG	
(13) *bez-l*^{j}*ud-n-yj*	?*bez l*^{j}*ud-a*[6]	*bez l*^{j}*ud-ej*
empty of people	without folk-GEN.SG	without people-GEN.PL

A single base is also ruled out by the fact that the base noun can lack an acceptable Genitive Plural form (the Genitive Plural is the nominal form in which paradigm gaps are common in Russian), be uncountable and thus lack plural forms altogether or, conversely, be a pluralia tantum that lacks singular forms. In such cases, the available form of the noun must be used to produce the adjective. For example, *bez-vred-n-yj* "harmless" cannot be formed from a plural form of *vred* "harm" because it is not countable and lacks plural forms. Conversely, *bez-∫tan-n-yj* "pants-less" must be formed from the plural (*∫tan-ov*) because it lacks a singular form.

There are also cases of variation, as in (14). Note that retention of the Vn is consistent with the adjectives being motivated by prepositional phrases, as it is not present in the singular Nominative or Accusative forms but is present in the Genitives requires by *bez*:

(14) *bez-sem{e;ja}n-n-yj bez semen-i*
seedless without seed-GEN.SG
bez semjan
without seeds-GEN.PL

While the vast majority of *bez-* adjectives have a corresponding prepositional phrase, some do not, indicating that *bez-* adjectives cannot always be derived from prepositional phrase bases. Thus, the adjective in (15) appears to be formed directly from a verb.

(15) *bez-voz-bran-n-yj* **voz-bran-ije voz-bran-it*^{j}
"unchallenged" "prohibit"

Other adjectives formed from verbs can often be identified because they retain the infinitival inflection from the base verb, and add the sequence *-el*^{j}*-n-yj* (16-18). The *-el*^{j} is the agentive marker (cognate with English *-er*), as in *stroit*^{j} "to build" ∼

[6]This is a collective noun referring to a "type" of people and is awkward without an adjective defining the type, such as "city" or "working." The plural of this example is the only plural for *t∫elovek*.

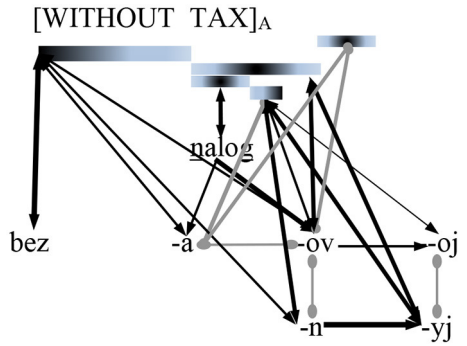

FIGURE 2 | Part of an associative network representing the planning of a novel *bez-* Adjective meaning "without tax(es)" without using complete words or phrases. Excitatory connections are black arrows; inhibitory ones are gray and end in circles. Gradients symbolize activation patterns over a distributed representation. Mutual inhibition and all schematic associations are shown by bidirectional connectors while syntagmatic associations are unidirectional arrows.

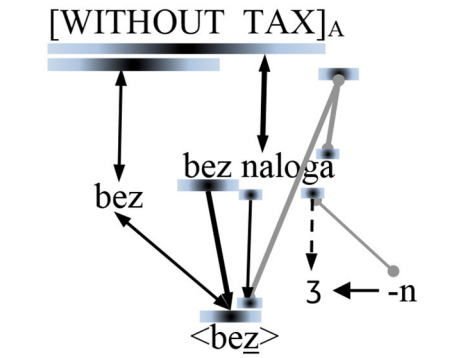

FIGURE 3 | Phonological and orthographic aspects of producing *beznalo3nyj*. Paradigmatic association in dashed line.

stroitʲelʲ "builder." However, these adjectives are not derived from such nouns: the nouns are often missing, and retaining the semantics of the *-er* would require adding a different adjectivizing suffix, thus *stroitʲelʲ-n-yj musor* "building garbage" (i.e., garbage associated with building something), vs. *stroitʲelʲ-sk-yj musor* "builder garbage" (garbage associated with a builder or builders generally). The adjectives can usually be related to "deadjectival" nouns ending in *-stv-o* or *-ostʲ* (*stroitʲelʲstvo* "the process of building"). The examples in (16) and (17) are difficult to explain without reference to such a noun. However, the example in (18) is difficult to relate to the corresponding noun: the corresponding PP is awkward and not interpretable as synonymous with the adjective. Once again, *bez-* adjective forms are produced using whatever semantically close words are available, as one would expect from a lexicon i.e., structured as a parallel, associative network.

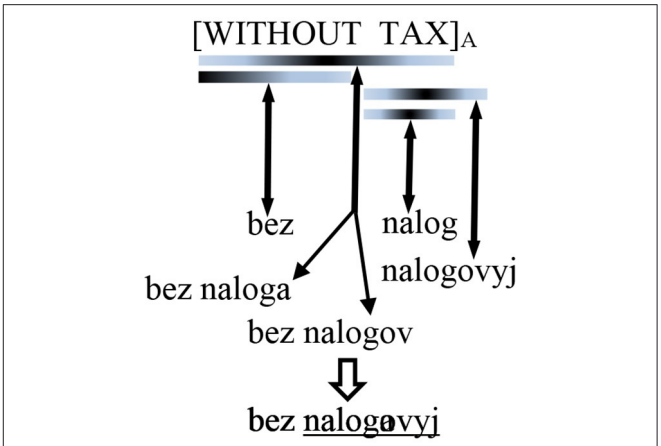

FIGURE 4 | Larger units being blended together to produce *nalogovyj* "tax-free".

(16) *bez-nrav-stv-enn-yj* **nrav-stv-o* *nrav-itʲ-sa*
"moral" "to be liked"
bez nrav-stv-enn-ostʲ-i
"without morality"

(17) *bez-ot-lag-at-elʲ-n-yj* **ot-lag-atʲ-elʲ* *ot-lag-atʲ*
"urgent" "to delay"
bez ot-lag-atʲ-elʲ-stv-a
"without (purposeful) delay"

(18) *bez-ot-nos-itʲ-elʲ-n-yj* **ot-nos-itʲ-elʲ* *ot-nos-itʲ-sa*
"unrelated" "to relate"
??*bez ot-nos-itʲ-elʲ-n-ostʲ-i*
"without relativity"

Producing a *bez*-Adjective

This section provides an informal illustration of what production looks like in this framework[7]. The example shows the process of generating a novel adjective the meaning "tax-free," an adjectival equivalent of "without tax(es)." This adjective is not in the dictionary but can be found on the web, with the two possible forms *beznalogovyj* and *beznalo3nyj*. The former is much more common, with 418 vs. 56 Google hits, and intuitively appears more acceptable. I take the grammar to be responsible for generating both forms and explaining why the former is more common. **Figure 2** shows some of the schematic and syntagmatic associations involved in producing a novel *bez* adjective, including only morphemic chunks. **Figure 3** illustrates the role of paradigmatic associations in enacting changes to the base, and the role of the base in the orthography, showing that chunks larger than the morpheme also play a role in production. **Figure 4** illustrates how blending of these larger forms would result in the most common form produced. Note that **Figures 2**, **4** should not be seen as two different "routes" for producing the new adjective: there is instead a near-infinite number of

[7]A formal treatment would spell out associations as weighted constraints (e.g., Boersma, 1998; Burzio, 1998; Kapatsinski, 2013) but this is beyond the scope of this paper.

routes because all meaning-to-form associations activated by as semantic feature are activated in parallel.

The top of the diagram in **Figure 2**, [WITHOUT TAX]$_A$ represent the intended meaning, which I assume to be a distributed representation, as symbolized by the gradients below it. The top gradient represents the unique aspects of the meaning of the *bez*-A construction, which distinguish that construction from all other constructions and make its representation more than the sum of its parts. The next gradient down is the meaning "without," which strongly cues and is cued by *bez*, as shown by the thick bidirectional arrow. The next one down is the meaning of "relating to taxes," or [tax]$_A$, for which there is an established adjective, *nalogovyj*. The gradients for "tax" and the Adjective category follow.

The meaning "without" is consistent with both adjectives and prepositional phrases and therefore activates both Genitive case markers appropriate for the prepositional phrase and the adjectivizing suffix *-n* i.e., favored over others by this construction. The Genitive suffixes activated include *-a* and *-ov* appropriate for a noun like *nalog* and suffixes from other declension classes (not shown here). The activation of *nalog* from the meaning "tax" boosts the Genitive suffixes appropriate to its over their competitors from other declensions. This is shown by the arrows from *nalog* to the two suffixes *-a* and *-ov*. Because the two suffixes are incompatible with each other, I assume an inhibitory connection between them.

We have seen evidence that the suffix *-ov* occurs in *bez* Adjectives primarily when the corresponding noun selects it as a Genitive Plural suffix. Thus, *-ov* in prepositional phrases and adjectives with *bez* appears to be the same form, associated with the meaning "without," which is the meaning of *bez* and one meaning of the Genitive. Because *-ov* can serve as an adjectivizing suffix, it must also be activated by the Adjective category. Interestingly, however, *-ov* is disfavored by *bez*-Adjectives compared to other adjectives. It must therefore be inhibited by the meaning of the construction as a whole even though it is favored by all of the parts of that meaning ("without," "tax," and "A"). **Figure 2** therefore includes an inhibitory connection from the top gradient (unique features of the construction) to *-ov*.

The adjectivizing suffixes are syntagmatically associated with the case-number suffixes that follow them. As shown above, *-yj* is more common than *-oj* across the board but is particularly rare after *-n*. For this reason, the top-down connection from A to *-yj* is stronger than the one to *-oj* and *-oj* is syntagmatically boosted by *-ov while -yj* is boosted by *-n*. In addition, *-ov* and *-yj* are both activated by the "[tax]$_A$" meaning because *nalogovyj* is an existing adjective.

Figure 2 predicts rapid activation of *bez-* and *nalog*, which are not inhibited by anything. At this point, the speaker's intended production is the same whether or not it resolves into a prepositional phrase or an adjective, because both constructions are compatible with most of the meaning intended. This partial overlap results in competition between the two constructions in usage. According to **Figure 2**, which construction ends up being produced depends on resolution of two competitions: between *-a*, *-ov*, and *-n* and between *-oj* and *-yj*. The first competition will resolve mostly in favor of *-n* because the intended meaning inhibits the other competitors. The second competition will be resolved in favor of *-yj*, which receives more activation from the intended meaning and from the preceding element, and is also favored by the more likely preceding element. Because all processing happens in parallel, it is possible for the competition between *-yj* and *-oj* to resolve before the competition between *-ov* and *-n*, in which case *-yj* is expected to help select *-n* using a backward syntagmatic association (not shown), rather than *-n* helping select *-yj*.

Figure 3 shows additional aspects of form generation, specifying phonology and orthography. Because the suffix *-n* does not allow a velar to precede it, it inhibits the final [g] of *naloga* and *nalogov* if selected, and activates [3], alongside other consonants. The specific consonant, [3], however, is selected because it is also activated paradigmatically by the [g] of *nalog* (dashed arrow). Finally, the orthographic form activated most strongly by *bez* is <bez>, its most common spelling and the only one allowed in prepositional phrases. The strength of this connection could explain why Russian speakers would often spell *bez* with an <s> even when it is a prefix and pronounced with an [s]. However, it does not explain why these errors do not similarly afflict *iz-*, for whom the prepositional spelling is even more common relatively to the prefixal spelling. Thus, the errors must be boosted by the fact that the intended semantics for a *bez* Adjective activate prepositional phrases, while the intended semantics for an *iz* verb do not. This is shown by the connection between *bez* in the prepositional phrase and <bez > in the orthography. Accurate spelling requires the A category to weaken the activation of <z>, allowing the phonological context (here, the [n] of *nalog*) to select the right spelling syntagmatically.

The representation in **Figure 2** therefore oversimplifies the network structure because it omits the larger units like *bez naloga* that are also activated by the intended semantics. Indeed, these units may well be activated by the semantics more strongly than their smaller or less context-bound counterparts: even though smaller units are favored by their greater frequency, larger units match the intended semantics better. This is what allows established forms to outcompete synonymous innovations most of the time. For example, irregular forms like *went* can block/pre-empt the creation of synonymous regulars because *went* is activated by both GO and PAST, whereas each part of *goed* is activated by only one of these cues (Kapatsinski, 2018, p.278). Of course, because frequency also plays a role, blocking can fail, allowing regularization and paradigm leveling to occur.

Figure 4 shows the larger units for the case of *beznalogovyj*. Only units activated by the intended meaning are shown. The block arrow shows that the activated forms are blended into the production plan, by copying and aligning them to maximize overlap. The most likely production, *beznalogovyj*, is predicted. However, blending these larger units will not produce any other variant: the *nalo3nyj* part of *beznalo3nyj* is blocked by the existence of *nalogovyj*. Thus, generating *beznalo3nyj* is possible only using smaller, sublexical units, explaining its lower frequency. Its existence therefore also provides support for the existence of the sublexical route.

DISCUSSION

In this paper, I have argued that constructions are not unitary entities. They emerge from the interaction of schematic (form-meaning), paradigmatic and syntagmatic associations in a parallel, associative network that includes both forms and meanings. Here, I have focused on the role and directionality of schematic and paradigmatic associations and on the proposal that forms are activated in parallel by the intended meaning and blended into a production plan.

I take centrality of symmetrical schematic associations to language production to be a core claim of constructionist approaches (e.g., Bybee, 1985; Goldberg, 2002). There is abundant evidence for the existence of schematic associations and substantial evidence for the assumption that such associations are largely if not always symmetrical. In contrast, paradigmatic associations are likely unidirectional and are of more limited use (cf., Booij and Audring, 2017a). In fact, many isolating languages may get along just fine without paradigmatic mappings. Many native speakers of languages whose description requires arbitrary paradigmatic mappings also do not learn them (Dabrowska and Szczerbiński, 2006; Engelmann et al., 2019). Here, I showed how allowing for negative form-meaning associations further limits the need for paradigmatic mappings. Nonetheless, it is clear that many speakers of languages that require arbitrary phonological mappings between paradigm cells do acquire second-order generalizations, indicating that theories of grammar must allow for their acquisition.

Constructing a new form is a gradual settling process (see Cleeremans, 2004, for a useful simulation), as a "pandemonium" of voices clamoring for or against including various pieces of form into the product being constructed (Kapatsinski, 2013). The resulting form is often a blend of many existing forms. Despite the clamor, the network usually settles on an agreeable solution, although paradigm gaps can emerge when it does not (Albright, 2003)[8]. Generation of new words is a messy and slow process, often taking more than a second, which necessitates the storage of the products for reuse on future occasions, it is also highly flexible, capable of generating an acceptable product by an almost limitless patchwork of routes.

The example of the *bez-* construction illustrates this messy but highly flexible process. Speakers of Russian do generate new *bez-* adjectives as needed—for example, producing *bez-finans-ov-yj* "financing-free" to characterize certain business transactions—by activating a number of forms that partially fit the meaning to be expressed and blending them together by copying bits and pieces into the production plan. These forms are not always the same forms: whatever forms are available are used. Properties of the construction and the activated chunks of existing forms "clamor" for being copied into the plan. What does get copied depends on how compatible the various chunks are with the meaning to be expressed, on how activated the various base forms are, and perhaps on the speaker's knowledge of what should and should not be copied.

Some chunks activated as part of existing forms (*-ost^j* and, less so, *-stv* and *-ov*) will be suppressed by the construction's meaning, while other chunks may be activated by it directly (chunks like *bez-*, *-n, -enn,* and *-yj*, as well as a characteristic pattern of stressing the penultimate vowel). However, the construction's influence is not absolute. Only some of the meaning to be expressed is part of the "construction". Semantic features outside of the construction proper such as the fact that the referent lacks a body part may suppress an otherwise dominant *-n* suffix. Frequent forms compatible with the meaning will exert a greater influence than those less frequent and less compatible and may surface in the produced form even if not fully compatible with the construction's meaning (Bybee and Brewer, 1980; Tiersma, 1982; Harmon and Kapatsinski, 2017).

Often after substantial deliberation, the speaker will settle on a new adjective form with enough confidence to produce it. At that point, the result will be evaluated by the speaker and the interlocutor (e.g., "what a cool way to express that meaning," "that was hard to pronounce," or "that was not understood"), stored in their memories (possibly linked to different meanings and divergent evaluations), and will begin its journey through the social and semantic space. As it is reused under circumstances only partially matching the circumstances of its creation, it will be extended to new uses, diffusing away from the speaker and the meaning responsible for its creation (Harmon and Kapatsinski, 2017; Kapatsinski, 2018). Morphology is a mess, and constructions are only a big part of it.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://osf.io/5er92/.

AUTHOR CONTRIBUTIONS

VK is responsible for all aspects of this manuscript.

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[8]An important direction for future work is to explain the difference between variation and gaps. That is, why sometimes multiple alternative forms are acceptable, and sometimes none are. Accounting for such cases appears to require distinguishing generation of alternative forms (the focus of this paper) and their evaluation. That is, gaps may arise when all generated forms are subject to a negative evaluation, for whatever reason (social stigma, phonotactics, undesired homonymy, or even aesthetics). Speakers of languages with gaps usually know how the gap could be filled, even though they cringe at the possible fillers.

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How Wide the Divide? – Theorizing 'Constructions' in Generative and Usage-Based Frameworks

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What is the nature and function of mental representations in cognitive science, and in human language in particular? How do they come into existence and interact, and how is the information attributed to them stored in and retrieved from the human mind? Some theories treat constructions as primitive entities used for structure-building, central in both production and comprehension, while other theories only admit construction-like entities as devices to map the structure into semantics or to relate them to specific morphophonological exponents. In this positional piece, we seek to elucidate areas of commonality across what have traditionally been divergent approaches to the role of constructions in language. Here we outline a robust specification of the differences in how chunks of structure containing information are treated in the two main approaches, and we seek to offer a path toward a more unified theoretical stance.

Keywords: constructions, Minimalism, emergence, exoskeletal, Nanosyntax, Construction Grammar

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INTRODUCTION

Irrespective of the various traditions scholars primarily associate themselves with (e.g., cognitive science, linguistics, psychology, etc.), as researchers interested in cognition and the study of the structural properties of human language, we are forced to come to terms with defining the frequent and systematic properties that constitute its fundamental building blocks. To put it bluntly, we are still collectively searching for and theorizing about the most appropriate, economical, and effective ways to describe these mental representations, be they single items or objects that are themselves non-trivially composed (let's call these elements constructions), or atomic units and the primitive operations by which they give rise to composed units.

We begin by opposing theories in which mental representations are built, by hypothesis, from single units and the notion of construction is rejected as an ontological component, with theories that take constructions to be fundamental, eschewing the idea of smaller basic units except insofar as these emerge from correspondences among the constructions themselves. The mission of identifying these internally composed building blocks is far bolder than achieving mere descriptive adequacy in identifying the levels of representation of the human mind and their properties. The bigger challenge, as expressed by Chomsky (2005); Christiansen and Chater (2016), and others, is to extend beyond mere descriptive adequacy and explore how our ideas about constructions connect with other aspects of our biological endowment, the ontogenetic and phylogenetic development of language, and the socio-cultural environment that also have made lasting marks on the structural design of language in our species. We are thus called to advance a theory of constructions and the human language faculty (whether or not this is held to include domain-specific properties of the mind-brain) that seeks to achieve explanatory adequacy. This positional essay is an attempt

to draw light on the common properties and existing fundamental differences of two competing theoretical models and their treatment of constructions; namely, (1) Construction Grammar (CxG, which in turn stands for a family of theories that have been developed in different versions by Kay and Fillmore (1999), Goldberg (1995; 2006; 2019), and Michaelis (2012); cf. also Fillmore and Kay (1993); Croft (2001) radical construction grammar, Boas and Sag (2012) sign-based construction grammar and some versions of cognitive grammar, such as Langacker (1987) and (2) Exoskeletal variants of the Minimalist Program [developed also in different versions by Halle and Marantz (1993), Hale and Keyser (2002), Borer (2005a,b, 2013), Ramchand (2008, 2018), and Londahl (2014)], for the sake of exposition here, Nanosyntax (Caha, 2009; Starke, 2009).

Our choice for selecting exoskeletal variants of Minimalist grammars, Nanosyntax in particular, boils down to the interesting contrast they provide when stacked up against CxG. With regards to their architectural similarities, both adopt the position that the internal composition of larger elements are determined by the structural conditions (or "frames") they appear in. In both cases, the claim is that the lexicon contains information about structure, in some sense, either as templates or as configurations. In contrast, these two are diametrically opposed to one another in two fundamental ways: first, exoskeletal grammars – and Nanosyntax in particular – adopt the stance that all complex mental representations must (always) be built, and that the computational system should proceed "with as small as possible a repository of idiosyncratic information appended to it" (Borer, 2005a:15). Second, whereas most versions of CxG are declarative and model-theoretic, exoskeletal grammars adhere to a derivational, proof-theoretical system. As we demonstrate throughout the remainder of this essay, the desiderata employed by these two frameworks highlight and contribute to a host of other related and important issues closely connected to debates circling around the nature of the human mind.

One well-known, traditional way of making a distinction between these two frameworks depends on whether any sort of domain-specific properties of language exist and are drawn upon to aid language development and language processing (often referred to as Universal Grammar; UG), or whether domain-general mechanisms are solely responsible for the creating of linguistic constructions [often referred to as a usage-based approach; see e.g., Bybee (2010); see Adger (2019) for an excellent discussion and overview of this debate]. Although our treatment of the definition of constructions from these two perspectives below certainly touch upon this critical divide, diving too deep into this immediate debate would detract from our discussion of the structural properties of constructions, and so we acknowledge the secondary role this ongoing debate plays here. That point notwithstanding; however, it behooves us to point out that although domain-general cognitive properties undeniably do effect outcomes in language acquisition and development across the lifespan, a direct association between linguistic outcomes and psychological embodiment is highly controversial with regards to phonetics and phonology[1] (Berent, 2013; Berent et al., 2020), syntax (Tettamanti and Moro, 2012), and semantics (Meteyard et al., 2012). The cumulative sum of this research is echoed in Arntz (2020) plea for more attention and focus on the notion of mental representations, which also supports Jackendoff (2017) reminder of the central theoretical importance of theories of mental (linguistic) representations. Thus, irrespective of one's position on the existence and role of domain-specificity in the generation of linguistic structure, the very nature of mental representations is of vital importance.

The position set forth in this paper is the following: even within frameworks whose main tenet is that the primitive units of analysis lack any degree of internal composition, there are non-trivial notions of 'composed unit' that could be characterized as constructions, as they have some of the crucial properties of these types of elements. This article, then, argues that constructions and construction-like units are identified at multiple scales from the very beginning. Thus, even if it turns out that the smaller units are not unanalyzable primitives, some kind of bottom-up structure building is required from the start. Ultimately, therefore, understanding the nature and properties of the building blocks of language is a common enterprise unites us across cognitive disciplines and frameworks. The structure of this essay is as following: In see section "Constructions: Decomposition and Composition" we establish the fundamental established criteria of the notion of construction, primarily from the perspective of a domain-general tradition (as opposed to a domain-specific one). In see sections "Constructions in Minimalist Grammar: Semantic Interpretation and The Role of Constructions in the (Morpho)Phonological Interpretation of Objects," we discuss the role of Constructions according to Nanosyntax (and Minimalist parlance more generally). Adopting an exoskeletal approach to grammar which espouses with the notion of a pre-syntactic lexicon, we maintain that the notion of construction proper is best understood as a second order units that appear at the interface of syntax and its interface with Phonological Form (PF) – the modular domain of grammar responsible for morphophonology. Section "Conclusion" concludes this essay.

CONSTRUCTIONS: DECOMPOSITION AND COMPOSITION

Constructions are defined as form-meaning mappings, potentially containing combinations of independent units, whose meanings and grammatical properties are not predictable from any identifiable internal composition (Goldberg, 2006). One of the more salient consequences of this idea is the possibility of representing (storing and processing) unanalyzed chunks at a fairly large scale, e.g., that of an entire sentence. However, this doesn't imply that constructions are always large, nor that they cannot be decomposed into smaller units. Rather, it emphasizes that the meaning of a complex linguistic unit is, or at least can be, more than the sum of whatever smaller units and structure can be identified therein. This view also does not deny that meaning can be compositional. The meaning of an utterance may involve combining the meaning of a construction with that of lexical items or phrases occupying variable slots, or with other constructions, for example. Thus, meaning maps onto linguistic

[1]The zero-sum of the Berent et al. (2020) work shows that phonetics could easily be associated with embodiment but this is certainly not the case for phonology.

form at multiple scales simultaneously, and meaning is partly compositional, and partly not.

As we will argue below, this picture shares much with more traditionally generative approaches, which, despite their strong tendency to view meaning as derived from structural organization, must nonetheless acknowledge the existence of units with discernible internal structure whose meanings are not reducible to the sum of their parts (in ways that go beyond mere lexical idiosyncrasies, e.g., idioms). Where these approaches diverge is in the theoretical handling of units at different scales. CxG is an example of an emergentist approach to grammar, where units and their combination are defined on the basis of salience to the user given their prior experience, learning and processing mechanisms, and current conditions.

This can be understood at both the developmental and the historical scale (e.g., Tomasello, 2003; Bybee, 2010; Christiansen and Chater, 2016). Developmentally, children identify, create, and store chunks that are discernable in their experience, which may be reused whole, and gradually learn to decompose and compose them, based on the recurrence of similar material in different contexts. Parallels among larger chunks allow children to discern abstract structure that permits chunks to be decomposed into smaller units and recombined productively, and the frequent co-occurrence of smaller chunks leads to the identification of larger functional units, including not only collocations but also syntactic phrases (Hopper, 1998; Langacker, 2000; Bybee, 2001). Note that this does not imply that children begin by memorizing larger (e.g., utterance- or intonation unit-sized) chunks, nor that the emergence of structure always moves from larger-scale units to smaller component units. Whatever units the learner can initially identify from experience, be they syllables, morphemes, words, or larger constructions, are subject to processes that both permit them to be analyzed into smaller units or unitized into larger ones (for a computational implementation of this bidirectional process see McCauley et al., 2015). Historically, language change occurs in a similar way as shifts in the ever-present variability of usage patterns either obscure old patterns or allow new ones to be identified (Bybee, 2010), and as these changes in usage are filtered through the learning and processing mechanisms of succeeding generations (Fedzechkina et al., 2012; Culbertson and Newport, 2015). Change may also occur as individual users age, because the accumulation of experience can lead to changes in the demands that language places on cognitive processes (Ramscar et al., 2013).

Perhaps the most important consequence of this emergentist view of structure is that the units into which constructions may be decomposed are not defined *a priori*, at least not from the perspective of the individual learner. Instead, they are identified gradually and piecemeal as the learner's experience permits, eventually approximating the grammatical system of other individuals with comparable language experience. In this sense, individual learners are not credited with possessing *a priori* units or structures, but we may nonetheless speak of *potential* units and structures, inherent in the usage patterns of the community and learnable through the operation of general cognitive mechanisms on patterns available to the learner through experience. This does not, in principle, exclude the existence of some innate knowledge of the kinds of structures children are looking for, although the usual approach is to avoid assuming it, and as we stated above, we consider this question to be a secondary issue. This approach to an "open UG" has also gained traction in generative approaches to acquisition and language change (Lightfoot, 2020).

The main question from a CxG-perspective is not, therefore, whether constructions possess internal structure. They do, in the sense that members of the community produce language instantiating patterns describable in terms of smaller-scale units and patterns (rules, constraints, or whatever) for combining them, and in the sense that the presence of non-compositionality does not preclude a role for subunits in the real-time processing of language. Rather, CxG, and emergentist approaches in general, focus on when those patterns play a role for the learner or speech community, and when they do not.

This can be thought of as akin to Yang's Tolerance Principle, where the balance of regular and irregular structures in the learner's repertoire determines whether or not the regular rule is operative, or whether items containing potentially regular structures are represented and processed as unanalyzed wholes (Yang, 2016). Thus, for example, Yang proposes that children may represent regular English past tense verbs either as a *stem* + *ed* combination, or as an unanalyzed word, depending on how many regular and irregular past tense wordforms the child has learned. This offers an explanation for U-shaped development: at first, children produce few over-regularizations, because they are producing both regular and irregular verbs as memorized wholes. Then as the rule/pattern strengthens, they produce overregularization errors (e.g., *eated*), and finally they sort out the regulars and irregulars, processing the irregulars as unanalyzed wholes, and the regulars as *stem* + *ed* combinations (Tomasello, 2003). The Tolerance Principle, based on psycholinguistic understanding of lexical processing, helps explain when the rule becomes available. A similar phenomenon can be identified in the ways that type and token frequencies shape language change (Bybee, 2010). Forms and patterns that are frequent enough to be memorized tend to be stable, but infrequent forms may be adapted to fit robust patterns (e.g., paradigm leveling), and patterns with low type frequency may lose their productivity.

A second major consequence of emergentism is to further develop the character of what it means to learn or know a grammar. Language acquisition is not conceived as a search for the right set of units, and the rules or constraints that govern how they are used in a particular language, either in the sense of discovering them from experience or of narrowing down a set of innate structures. Rather, to learn a language/grammar is to learn to *process* language (Chater et al., 2015; Christiansen and Chater, 2016). It may be that, from the standpoint of a speech community, where individuals' experience of language can be expected to be relatively consistent, we could (in the limit) identify an exhaustive set of potential units and patterns that are *available* to be learned, but from the point of view of the individual user in the moment of producing or perceiving language, there could be many ways in which a piece of language (say, an utterance) may be represented for processing. Put differently, what's important is not the maximally articulated structure that *could* in principle

be used to represent the utterance. The important question is what representations and structure the individual user has at her disposal, and which ones, from that repertoire, she *does* use on a particular occasion of language use, from a single undecomposed unit, to a detailed, hierarchically organized set of smaller units. The way this shakes out on any given occasion is determined in large part by the cumulative prior experience of the learner, and the specific abstractions that this experience permits to emerge given the operative learning mechanisms, and it is also subject to real-time conditions, including properties of the preceding discourse, prosody, familiarity with the topic or interlocutor, or cognitive load.

As a useful illustration of this state of affairs, consider the last several decades of psycholinguistic research on morphological processing. To sketch this history only very briefly, an early debate centered on the decomposition of complex words into stems and affixes. Evidence that non-words like *juvenate* and *dejuvenate*, which contain stems that occur in prefixed words like *rejuvenate*, are harder to classify than non-words like *pertoire* and *depertoire*, which do not (the *re-* in *repertoire* is not a prefix) was taken to indicate obligatory decomposition in the processing of complex words (Taft and Forster, 1975). Later work interpreted effects of the whole-form frequency of complex words as evidence that at least some complex words are stored as unanalyzed wholes, but not necessarily precluding decomposition as well (Schreuder and Baayen, 1995; Baayen and Schreuder, 2000), with evidence that a whole-form representation might be formed on the very first encounter with a new complex word (de Vaan et al., 2007). Still more recently, the observation of whole-form frequency effects even in very low frequency complex words (Baayen et al., 2007), and interactions among whole-form and constituent frequencies (Moscoso et al., 2004; Kuperman et al., 2010) have been interpreted as indicating the simultaneous and integrated processing of both holistic and compositional structure.

It would be tempting now to propose a rapprochement, by pointing out that CxG no more denies the presence of smaller units than exoskeletal approaches do the existence of larger units. That compositionality is required even in a Construction-theoretic paradigm has never really been in question, and we will argue shortly that something like constructions are not only possible, but required in a more traditionally generative view as well. With this agreement, we can perhaps work out what all of this means for why human language has developed ontologically and phylogenetically the way that it has.

But this seems a bit glib, and obscures the point where things actually get interesting. Namely, how are we to explain why humans consistently come up with extremely similar ways of representing language? This is true not only of the members of specific speech communities, where statistical distributions over a relatively common corpus of linguistic experience can go impressively far in identifying the units that members are sensitive to, or will become sensitive to given sufficient experience. It is also true of the major commonalities observed across languages around the whole world, and those from the past that have left a written record. That is, humans across time and space appear to have much in common, including what appear to be common categories of representations that are used in similar ways, with an apparently limited range of variability. Explaining this can be thought of as the overarching goal of any scientific approach to human language, and we return to this below as the really exciting way to explore a synthesis of emergentist (represented by CxG) and generativist (represented by exoskeletal) approaches. At this point, however, we turn to the question of constructions in Minimalist Grammar.

CONSTRUCTIONS IN MINIMALIST GRAMMAR: SEMANTIC INTERPRETATION

The title of this section is intentionally provocative. Our goal here is to argue that, implicitly, even Minimalist accounts (Chomsky, 1995) have an implicit notion of construction that is assumed in most linguistic analyses, at least in a weaker sense. This happens in two situations, (1) one affecting the semantic properties and (2) another affecting Spell-Out: whenever the semantic properties of a syntactic object are not interpreted as soon as possible, that is, as soon as structure-building operations such as Merge create a new structural layer, or when the exponent corresponds to a complex constituent rather than to one single terminal. In this section we will concentrate on the first situation, and we will discuss the second in the following one.

Minimalism proposes that the computational system builds up complex structures by adding one unit at a time, so in this sense there is no notion of construction. However, construction-like objects emerge when one considers the interpretation of those structures in semantics. If the set formed when X and Y are merged is fully interpreted as soon as Merge happens, no chunk of structure, i.e., "construction," is needed for interpretation; however, if the combination of X and Y is not semantically interpretable, and must be postponed until a second layer is built, then we must conclude that interpretation applied to a chunk without applying to each one of its internal constituents. This is clearly reminiscent of the CxG tenet that the notion of construction is the domain where meaning is defined, even if, to be fair, Minimalism treats the satisfaction of meaning compositionally, while CxG is not necessarily committed to a notion of compositionality. For this reason, this implicit notion of construction is weak in Minimalism; however, constructions are properly understood as derived objects rather than theoretical primitives. That is to say, Minimalism does not allow constructions as primitives of structure building, but rather they emerge, similar to what is claimed in CxG, when structure is built.

To illustrate what we mean, consider (1) and (2), which are different types of structures that require assigning interpretation to chunks. They both violate in different ways the principle of "assigning interpretation to each unit locally." In (1), the violation is weaker, because it could be avoided if we assumed that "local" means "within its own XP projection." If within XP the meaning of X is satisfied, one can assume that there is a particular complete semantic object {S} that at LF would stand for XP [see Chomsky, 2013, where it is argued that labeling

is required only at the interfaces, i.e., at the juncture when structural objects are "interpreted" for semantic compositionality (LF) and for the realization of morphophonology (PF)]. That is: one single element, XP, corresponds to a particular semantic object, for instance a particular predicate with its arguments satisfied. Assume, for the sake of the argument, that X equals V and (1) represents a (rudimentary) VP. X is a predicate that would select two arguments – whose place-holders are *a* and *b*–. (1a) represents this in semantic notation, using lambda abstraction that expresses the two open variables; (1b) represents the same in syntax, with the two placeholders corresponding to two structural positions.

(1) a. λbλa[X(b,a)]
b. [$_{XP}$ [a] X [b]]

Importantly, even in (1) there would be an intermediate structure-building operation where the head X is still not semantically satisfied, so in the strict sense one would have to consider that there is a local step that does not get interpretation.

The derivations in (2) represents a stronger violation of the principle that interpretation should be as local as possible. Imagine that the satisfaction of the two variables related to X takes place within a bigger chunk of structure, one that goes beyond XP, as in (2b) or even (2c).

(2) a. λbλa[X(b,a)]
b. [$_{YP}$ [a] Y [$_{XP}$ X [b]]
c. [$_{YP}$ [a] Y [$_{ZP}$ [b] Z [X]]]

Now, from the perspective of semantic interpretation (LF), the well-formed semantic object will not be X, but rather YP, which contains XP and possibly ZP. The semantic interpretation of X – in our example, a predicate – would correspond to YP, a bigger structural constituent that contains X and additional heads and members.

Semantic interpretation is compositional and local if, and only if, any combination of two items in syntax is interpreted semantically at LF. Any node of information organized hierarchically in the tree, then, would have to get an interpretation assigned. Postponing interpretation to a further syntactic structure-building operation automatically implies that a chunk of structure containing two or more layers is, in that context, the smallest object that can be assigned an interpretation. Any such case would be a "construction," again in the weak sense.

The ultimate motivation for this idea that requires every operation which builds a new structural layer should be interpreted is the so-called Frege's conjecture. The conjecture is, in essence, that natural language builds complex meaning always through the same procedure: function application. Syntactic combinations such as (3), where a head takes a complement and labels the resulting set, must be invariably translated into semantics as the head being a function that takes the complement as its argument.

(3) [XP X [Y(P)]]

If function application is the only available operation; the following iteration of the structure-building operation should mean that now XP is the argument of a function introduced by Z. Thus, the properties of X must have already been satisfied within XP, as there is no possibility that X still is a function that takes Z as an argument, for instance.

(4) [Z [XP X [Y(P)]]]

Minimalist grammars do not shy aware from this problem, and in fact its existence guides some explicit proposals about how syntactic structure should be mapped into semantics, precisely to guarantee as much as possible that the interpretation of a head X is satisfied within its own projection. Pietroski (2018) monograph is an attempt to set the basis for a purely conjunctional approach to complex meaning which satisfies this no-chunk requisite. Londahl (2014) applies this type of analysis to the building of verbal eventualities in an explicit and convincing way, dividing what we take, at least on the surface, to be one single predicate into an n-number of heads each one devoted only to one particular semantic layer.

To be clear, not even (1) complies to Frege's conjecture if every step of the syntactic-building operations must be interpreted: in (1), the intermediate step where X has combined with b and a has not been merged yet would not correspond to a semantically well-formed object yet, so interpretation would have to skip this step and be postponed until the whole XP is closed – therefore, the interpretation would apply to a chunk of sorts, in this strict interpretation of compositionality.

Complying to Frege's Conjecture has been viewed as a desideratum of syntactic analyses, and in particular within Minimalism. Proposals such as Pietroski (2018) and Londahl (2014), therefore, make sense as explicit attempts to avoid the chunk-problem that we just mentioned, even in the form that (1) presents. This, of course, amounts to admitting that the problem is real, and that if minimalist syntactic analyses allow for correlations between syntax and semantics of the type of (2) they must make room for a weak notion of construction that is undesirable in the strictest sense of establishing a heuristic of "locality." Analyses along the lines of (4) are, thus, to be preferred all things being equal, and we believe that it is fair to say that any minimalist approach would attempt to come at least as close as possible to (4).

However, and as usual, reality is stubborn and it is unclear how, or even whether, every single structure in syntax can be codified in structures that satisfies Frege's Conjecture. One possible objection that comes to mind in this respect is idioms, which require at least parts of their meaning to be built syntactically [see McGinnis (2002) for similar arguments]. However, in the case of idioms one could argue that what makes them special with respect to meaning should be located at the lexical level, the domain of conceptual and world knowledge meaning, in a way that their idiosyncrasies would not directly interfere with how syntax is mapped to LF. There are, however, many other syntactic structures that are problematic from this respect.

One empirical domain where the mapping between syntax and semantics has been particularly problematic form the perspective of Frege's Conjecture is the analysis of comparative structures. Take an example like (5).

(5) Covid-19 is more dangerous than the regular flu.

The very abundant literature on the semantics of these constructions (see Klein, 1991; Schwarzschild, 2008; Beck, 2011 for distinct overviews) agrees on two facts, beyond many controversies. The first fact is that the adjective, here *dangerous*, must contain some type of open variable corresponding to degree – the extent to which an entity exhibits the property denoted by it. The second is that the adverb *more* is somehow assigning a value to that open degree variable by identifying it with those values higher than the degree of dangerous exhibited by the regular flu. Semantically, this corresponds to (6) for the semantics of the degree adverb, and to (7) for the semantics of the gradable predicate.

(6) λyλPλx∃d,d′. max[λd.P(d,x)] > max[λd′.P(d′,y)]
(there are two degrees d and d′ such as that for a property P, the maximal degree d of P that x has is higher than the maximal degree d′ of P that y has)

(7) λdλx[x is d-property]
(the subject x has the property to a certain degree)

The question is how this semantic denotation is represented in a syntactic structure. Note that according to (6), the degree adverb takes three arguments: a property (that is, a predicate) and two entities that display that property to different degrees. Larson (2014): 471), being completely aware of the compositionality problem, proposes that the degree adverb is in fact the head of the structure, taking as complement the second member of the comparison and as its specifier the property. The semantic properties of the comparative are almost completely satisfied within one single XP, except that Larson (2014) proposes that degree should be divided in two related heads, using the highest one to introduce the subject of predication of the adjective (see also Bowers, 1993; Baker, 2003 for the problem of where the subjects of adjectives are introduced). In any instance, if the *v*P-shell structure is actually viewed as the projection of two essentially identical categorial heads, this type of structure would satisfy Frege's Conjecture: the head is a function that takes other items as its arguments.

(8) [$_{\text{DegP}}$ [pro] Deg [$_{\text{DegP}}$ [$_{AP}$ dangerous] Deg < more > [$_{\text{PP}}$ than the flu]]]

The lower Deg head would head-move (Travis, 1984) to the higher one, producing (9).

(9) [$_{\text{DegP}}$ [pro] Deg < more > [$_{\text{DegP}}$ [$_{AP}$ dangerous] Deg ~~<more>~~ [$_{\text{PP}}$ than the flu]]]

At LF, the head DegP would be translated as a saturated predicate where the subject *pro* would exhibit a property to a particular degree. The problem of this structure, from the syntactic point of view, is that it is not compatible with the standard assumptions about head movement. Consider the cases in which degree is not expressed through the morphologically free adverb *more*, but through the semantically identical suffix *-er*.

(10) Covid-19 is deadli-er than the regular flu.

In Larson's structure, the head of the AP must rise from a specifier position to the higher head, in order to get combined with the suffix. This movement operation is illegitimate given standard assumptions. For this reason, an alternative account that is more popular among syntacticians less concerned with semantic compositionality is (11), where degree is a functional head that projects above the lexical layer AP (see for instance Corver, 1997).

(11) [$_{\text{DegP}}$ Deg < more/-er > [$_{\text{AP}}$ dangerous/deadly]]

Independently of the position of the subject of predication, this structure now faces a problem in terms of semantic compositionality. There are two options with respect to where the comparative coda *than the regular flu* is introduced, and both force the conclusion that the semantics is satisfied within a chunk of structure that exceeds the domain of the head that defines the function. The first option is to introduce the PP coda as the specifier of DegP (12).

(12) [$_{\text{DegP}}$ [$_{\text{PP}}$ than the regular flu] Deg < more/-er > [$_{\text{AP}}$ dangerous/deadly]]

The fundamental problem with this structure is that it implies an intermediate step where the degree that *more* identifies is defined as higher without specifying what reference value is used to define what counts as higher. Specifically, that would be the Deg projection before merging the specifier, whose denotation would be (13).

(13) λyλPλx∃d,d'. max[λd.P(d,x)] > ?
[Deg [AP]]

Interpretation would then have to be postponed until the following layer of structure is built, just as we said was the case with (1), with the result that there would be a structure-building operation that does not get interpreted: interpretation would have to be postponed until the second structure-building operation involving Deg. The second option is even more clearly against Frege's desideratum: it would imply merging the PP coda within the AP.

(14) [$_{\text{AP}}$ dangerous [$_{\text{PP}}$ than the regular flu]]

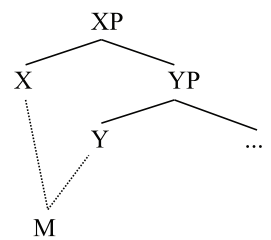
However, this goes against the interpretation of a gradable adjective as presented in (7). Specifically, licensing the comparative coda would have to wait until the specific degree element is introduced in the following layer. Either way, the interpretation would not be satisfied until additional layers of structure are built, and cannot happen at each step in the derivation, as Frege's conjecture would require.

The conclusion is that, in the current state of knowledge, the syntactic structures required to capture some of our standard assumptions force us to accept a weak notion of construction where we have to admit that there are intermediate steps of the structures that cannot receive an interpretation, and complex chunks receive the interpretation instead.

THE ROLE OF CONSTRUCTIONS IN THE (MORPHO)PHONOLOGICAL INTERPRETATION OF OBJECTS

In the same way that it is not always the case that the semantic structure can be read at each single step of a hierarchical syntactic tree created by iterative applications of Merge, standard Generative Syntax also accepts that in some circumstances the PF materialization of syntactic elements also has to apply necessarily to chunks of structure. This is, after all, what underlies the empirical phenomenon known as cumulative exponence (Spencer, 1991; Stump, 1998, 2001). Cumulative exponence is the situation where one single morph, sometimes called a "portmanteau morph" (Hockett, 1958), materializes information that has been independently diagnosed to be contained within two or more syntactic unit, standardly understood as heads according to Minimalist parlance. In this section we approach the syntax-morphophonology interface from the perspective of Nanosyntax (to be discussed below).

(15)



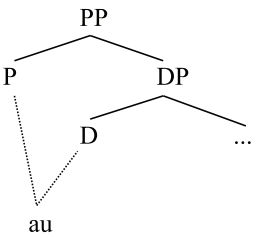
Irrespective of how this phenomenon is analyzed, cumulative exponence implies that at some level the morphophonological information that is associated with the morphosyntactic features must be taken into account not at each separate layer of structure, but rather as representing a combination of at least a minimum of two layers. Portmanteau morphs are uncontroversially illustrated by the case of exponents that materialize the set formed by some prepositions with certain determiners, as in French (Haugen and Siddiqi, 2016; Svenonius, 2016).

(16) a. *à le vin
to the.sg wine
b. au vin
to.the.sg wine
"to the wine"

(17) a. *à les voyageurs
to the.pl travelers
b. aux voyageurs
to.the.pl travelers
"to the travelers"

It is uncontroversial that the preposition and the determiner must constitute distinct structural layers in syntax (18) – perhaps intermediated by additional heads beyond those expressed in the tree.

(18)



Therefore, the exponents *au* and *aux* illustrate a situation where PF must consider a structural chunk bigger than one single unit to introduce the right exponent. Crucially, only some prepositions will require this cumulative exponence; example (19a) and only some combinations of gender and number in the determiner would trigger it (19b vs. 16a), which shows that PF must be sensitive both to the individual exponents that could have been used in each separate head and the syntactic information contained in them.

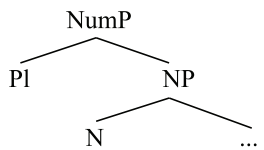
(19) a. avec les voyageurs
with the travelers
"with the travelers"
b. à la mode
to the.f fashion

Current theories have a variety of technical procedures, dependent on their broader theoretical tenets, to address these cases. Word-and-Paradigm morphological theories (Robins, 1959; Matthews, 1991; Stump, 2001; Spencer, 2013) propose that morphemes are not proper units of analysis and the materialization of morphosyntactic features takes place at the word level, intermediated by rules that associate specific word forms with specific sets of features that, syntactically, can be dispersed among several heads. Distributed Morphology (Halle and Marantz, 1993; Siddiqi, 2018) proposes several procedures to account for portmanteau morphemes, including PF-rules that map distinct layers of structure in one single position of exponence and readjustment rules that reorganize the information contained in distinct syntactic positions in the presence of specific exponents. Ramchand (2008, 2018) and Svenonius (2016) propose a spanning procedure that spells out a sequence of distinct heads into one single exponent, with a non-trivial notion of "word" also defined in the second case through diacritics that impose that all heads contained within a chunk of structure are spelled out as part of the same morphological unit. Nanosyntax (Caha, 2009; Starke, 2009) adopts a phrasal spell-out procedure whereby exponents do not need to be introduced in terminal nodes, but can actually substitute XP constituents, including specifiers and complements; see also Fábregas and Putnam (2020), who uses phrasal Spell-Out but allow exponency to be defined at a level distinct from both syntax and PF. Leaving the technical distinctions aside, the fact is that in all these theories the materialization of a portmanteau morpheme necessarily must take into account the information provided by a complex chunk of structure. The procedure that maps the information contained in a single syntactic node to an exponent cannot function simply by looking at the information contained in that node: it needs to consider (depending on the theory) the whole set of features

spelled out in the paradigm, the syntactic heads above or below it or the XP configuration where a single head is located. The result of this is that in the generative tradition – but not in CxG – the relevant notion of "construction" is a second order unit used to associate additional information to the abstract syntactic structure, which is in turn derived principally from a limited set of universal operations that insure the well-formedness of linguistic structure.

As in the case of the mapping between semantics and syntax, this problem has been noted, although it has not been considered as serious as the previous one – perhaps because current generative theories interpret PF as a highly idiosyncratic level of representation that might not be subject to the minimalist principles identified in syntax–. In Nanosyntax, one technical device that addresses this issue in part is the notion of "pointer" (see Starke, 2009; Caha and Pantcheva, 2012; Caha, 2018). A pointer is a device that, within one lexical entry, refers to another lexical entry. Consider one example. Assume a simple syntactic structure like (20).

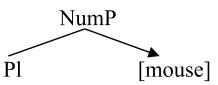
(20)



Imagine that the first head, N, is spelled out somehow as *mouse*. Once that layer is spelled out, or lexicalized, the Spell-Out operations applies to the second layer, but of course the spell out of [Pl] in this context would not be *-s*. Because of the lexical item introduced as N, its lexicalization would be irregular, as *mice* (21a). In a nanosyntactic system with pointers, the lexical entry of (21a) would look like (21b), stating specifically that that exponent is materializing the lexical item *mouse* in the context of plural number.

(21) a. mice/maɪs/

b. /maɪs/ < — > NumP



The entry in (21b) stores a "phonological idiom" of sorts, which blocks the materialization **mouse-s*, where each layer is spelled out independently. Instead of simply adding *-s* as the spell out of [pl], (21b) replaces the lexical item *mouse* with *mice* in the context where it appears under plural number. The hierarchical organization of linguistic information turns out to be a non-trivial architectural design feature, as it provides a systematic way to make predictions regarding how syntactic structures shape the lexicalization of these structures at PF (Embick and Marantz, 2008). This design feature; namely, the requirement that syntactic information is hierarchically organized is not emphasized in most variants of CxG. For example, Jackendoff and Audring (2020), in spite of arguing for a tripartite structure of "lexical items" consisting of semantic interpretation, syntactic structure, and morphophonology (similar to what is maintained in Nanosyntax), call for a parallel, rather than a hierarchical architecture of syntactic representation. On the other hand, the chunk-and-pass nature of language processing described by Christiansen and Chater (2016) can be thought of as a hierarchically organized representation of utterances in the form of a processing trace. An reviewer raises the question as to whether these particular design features in the exoskeletal approach can be incorporated into experimental research, leading to predictions that would illustrate how this architecture is potentially superior to CxG-approaches. Such work, in fact, does exist, showing the empirical advantage of redefining the notion of the traditional "morpheme," understood as a stored unit of sound and meaning (much like a "construction"), to include abstract hierarchical structure facilitates processing gains (Marantz, 2013; Gwilliams, 2019).

The pointer in (21b) alleviates the need to introduce chunks as units of Spell-Out, but it does not solve the problem entirely. A pointer makes it possible to make direct reference to a lexical entry within a lexical entry, allowing the Spell-Out procedure to apply at each layer of structural complexity: instead of having to wait until [pl] is spelled out to spell out the whole chunk, the NP-layer can first be spelled out, and then the spell out of [pl] overwrites the previous lexical item because the lexical entry has a pointer referring to it. Thus, in this system spell out can happen at each single layer, without having to consider complex chunks as units. However, reference to a chunk is still needed in order to select the portmanteau exponent in the second instance of Spell-Out. The chunk is needed to introduce, and realize, exponents, even if Spell-Out applies sequentially at each layer: we have not removed the chunk, just changed the level of representation where it is relevant. In toto, we believe that, just in the same way that chunks are necessary in establishing the connection between structure (i.e., syntax) and meaning (i.e., semantics), they are also necessary at PF to spell out structures. Exoskeletal variants of Minimalism, such as Nanosyntax, possess the necessary tools to derive both idioms and larger structures (i.e., constructions) with arguably only minor necessary adjustments to structure-building operations such as Merge. An implementation of this principle can be found in Fasanella and Fortuny's (2016) *Chunking Procedure*:

(22) Chunking Procedure:
Given a head *H*, the learner determines:
   a. whether *H* is phonological dependent of other heads ([+ bound]) or not ([-bound]),
   b. whether *H* conveys only one morpheme ([-synthetic]) or more than one morpheme ([+ synthetic])

Assuming an architecture of syntax in which each functional head consists of one and only one feature (as is the case in Nanosyntax), the learner will be able to detect how a given language encodes information as minimal units (such as morphemes) or whether or not additional structure may be required. Returning to our previous discussion of cumulative exponency, learners must acquire the knowledge whether for a given category the grammar they are acquiring prefers the setting of [+ synthetic] for a particular form-meaning-sound pairing. This fits the basic criteria of construction introduced in see section "Constructions: Decomposition and Composition"

of this paper and represents that essential empirical cue that will leads to the successful acquisition of this attribute of the grammar. Although experience will ultimately determine the parametric settings that differentiate one language from another, an exoskeletal architecture with only two proposed binary axioms can effectively govern and shape this acquisition process. These first order operations and the way they determine how syntactic structures (i.e., representations, or "constructions"), are for principle concern of generative linguists.

Ultimately, both CxG and Nanosyntax acknowledge the existence and important role that "constructions" play in language acquisition and development. In this respect, one could boldly state that certain aspects of these respective research programs are mutually supportive of one another, and that there are even avenues of research in which one could envisage some form of collaboration between scholars from both traditions.

CONCLUSION

In this abbreviated positional essay we have attempted to highlight substantial areas of convergence between generative and emergentist traditions while at the same time acknowledging points where they (critically) diverge from one another. Taking stock of the discussion above, we ascertain that both approaches adopt the following position on constructions/chunks:

(22) Points of agreement

(a) In both domain-specific and domain-general approaches, constructions are interpreted as specific domains for interpretation, both with respect to semantic and morphophonological information, that in principle can exceed a single terminal, and

(b) Constructions must be "fixed" (at least to a certain extent), in the sense that they must be related to a particular representation which contains some invariable elements. These invariable elements may consist of specified morphophonological representations, the requirement of a particular semantic interpretation, or even the assignment of specified grammatical classes.

In turn, we highlight several particular domains that are still disputed by researchers who ascribe to one of these two camps:

(23) Points of divergence

(a) The degree of idiosyncrasy that constructions may contain. From the perspective of Spell-Out in a derivational model such as in Nanosyntax (and Minimalism more generally), domain-specific frameworks accept that the relevant chunk is idiosyncratic in the sense that the information that these units add is not predictable from the properties of the terminals that they contain. In this sense a spelled-out chunk is not different from a spelled-out single terminal, because in both cases the assumption is that the morphophonological entries are not motivated. In contrast, with respect to semantic interpretability, Nanosyntax still expects compositionality to apply – even if the full interpretation of some elements of structure (i.e., heads) are not satisfied locally, within the chunk it should still be traceable which part of meaning each one of the heads contributes to the whole. CxG does not commit to compositionality in this sense and allows for a system where the semantic interpretation is entirely due to the construction without the possibility of determining which internal component carries which portion of meaning.

(b) Their extensions across levels of grammar. Minimalism and other generative approaches do not accept construction-like units as primitives, but rather as devices that in some cases are necessary to account for the semantic and phonological properties of those structures. In contrast, CxG takes constructions as the minimal building blocks, i.e., the construction itself gives a template that defines some structural properties. In this sense, one could argue that in Minimalism and other generative approaches, construction-like units are second-order objects used to associate the syntactic structure with the information of other levels – semantics and phonology – but never centrally involved in building the structure itself. While one can say that construction-like units are second-level objects in Minimalism, this is not the case in other traditions, that put usage at the center and thus use constructions as building blocks for production and comprehension.

(c) Their stored or derived nature. Late-insertion approaches where one exponent corresponds to more than one unit tends to advocate for a view where the chunk corresponding to an exponent or a particular semantic interpretation is not stored, but actively built – derived – anew by structure-building processes such as Merge (see Embick, 2015 for a detailed explanation of this position). Even when the exponent corresponds to a chunk and therefore must be listed, the chunk that it replaces through PF-insertion (i.e., the realization of morphophonological material associated with a particular chunk/structure) is not stored: the computational system builds it up from specific units and the relevant exponent(s) that correspond to the resulting structure are introduced when the structure interfaces with Phonological Form (PF). In CxG, the construction is pre-assembled in a sense, because constructions are stored and they themselves correspond to the relevant level of structure that is used to produce and interpret linguistic sequences. Nevertheless, though they are stored, constructions may also be decomposed into smaller units, depending on their relationships with other constructions in the user's experience, and in this sense they can be thought of as simultaneously first-order and second-order objects.

(d) The existence of a set of primitive units, from which all others are derived. It is not so much that generative grammar argues for, and CxG against, this idea. Under

CxG, the units by which language is represented are those that are accessible to the user at the time of processing, based on her prior experience and current conditions. At most, it might be possible to identify a "most finely articulated" parse of a given utterance, that anyone with sufficient experience might achieve. The structure of this parse could be understood as the product of the structure of the world (e.g., cause-and-effect, the flow of time) and the properties of human cognition, even including domain-specific adaptations in the human mind (which we identified as a secondary issue at the outset of this essay), given sufficient reason to posit their presence. However, since units of any scale are held to be emergent, there is no reason to expect any universal, species-wide inventory. Whatever deep commonalities there appear to be across cultures and history, they may be too general to explain the richness of linguistic structure (e.g., not much mileage comes from the observation that we all appear to have a Noun category). Of greater consequence, even if we could identify a set of units that would yield a most basic parse of any utterance, an emergentist view (like CxG) offers no reason to think of this as any kind of an endpoint toward which all users of that language are headed. Language development is not held to be linear, and the optimal use of language sometimes requires that finer-grained structure be ignored (Plag and Baayen, 2009).

The plea for more attention to mental representations (Arntz, 2020) requires us to revisit the central role that the structure of language plays in attaining a better understanding of its ontogenetic and phylogenetic development in our species (Stroik and Putnam, 2013). The concept of construction is certainly a loaded term, with different camps of linguists and language scientists adopting diverging definitions of these units and the role that such items play in these respective research programs. There are indeed attempts to unify aspects of these programs, or at the very least, address how the architecture of some versions of formal grammar may be mutually compatible to both camps, at least to a certain degree (see especially Culicover and Jackendoff, 2005 and Trotzke and Zwart, 2014). In a sense, we are arguing for a "yes-both" approach to the question of mental representation of language, which will necessitate further work on the conceptual basis for theory, leading to testable predictions.

To this end we propose a series of questions that may lead to greater synergy among Exoskeletal and CxG, Emergentist and Minimalist, and domain-specific and domain-general approaches to language: (1) If CxG allows for the emergence of decomposed representations of constructions as language development progresses, what are the consequences for the notion that the construction is a primitive unit? Can constructions come to behave as second-order units with regard to the mental representations in play for specific language users at specific times? (2) How shall we characterize the (maximal?) potential structure available to members of a speech community, given enough experience?, and (3) How universal is that potential structure across languages, and what is the source of this (apparent?) universality? In our view, exploring these questions will bring together researchers from the two traditions in the common enterprise of understanding the human capacity of language, and, whichever the answers ultimately are, in a more comprehensive view of human cognition.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

AF took the lead on sections "Constructions in Minimalist Grammar: Semantic Interpretation" and "The Role of Constructions in the (morpho)Phonological Interpretation of Objects." MC on section "Constructions: Decomposition and Composition." MP sections "Introduction" and "Conclusion." All authors contributed to the writing and revision of this manuscript.

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Hungarian Structural Focus: Accessibility to Focused Elements and Their Alternatives in Working Memory and Delayed Recognition Memory

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The present work investigates the memory accessibility of linguistically focused elements and the representation of the alternatives for these elements (i.e., their possible replacements) in Working Memory (WM) and in delayed recognition memory in the case of the Hungarian pre-verbal focus construction (preVf). In two probe recognition experiments we presented preVf and corresponding focusless neutral sentences embedded in five-sentence stories. Stories were followed by the presentation of sentence probes in one of three conditions: (i) the probe was identical to the original sentence in the story, (ii) the focused word (i.e., target) was replaced by a semantically related word and (iii) the target word was replaced by a semantically unrelated but contextually suitable word. In Experiment 1, probes were presented immediately after the stories measuring WM performance, while in Experiment 2, blocks of six stories were presented and sentences were probed with a 2-minute delay measuring delayed recognition memory performance. Results revealed an advantage of the focused element in immediate but not in delayed retrieval. We found no effect of sentence type on the recognition of the two different probe types in WM performance. However, results pertaining to the memory accessibility of focus alternatives in delayed retrieval showed an interference effect resulting in a lower memory performance. We conclude that this effect is indirect evidence for the enhanced activation of focus alternatives. The present work is novel in two respects. First, no study has been conducted on the memory representation of focused elements and their alternatives in the case of the structurally marked Hungarian pre-verbal focus construction. Second, to our knowledge, this is the first study that investigates the focus representation accounts for WM and delayed recognition memory using the same stimuli and same measured variables. Since both experiments used exactly the same stimulus set, and they only differed in terms of the timing of recognition probes, the principle of ceteris paribus fully applied with respect to how we addressed our research question regarding the two different memory systems.

Keywords: linguistic focus, memory accessibility, representation, probe recognition, working memory, delayed recognition

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INTRODUCTION

The present work investigates the memory accessibility of linguistically focused elements in Hungarian and their representation in Working Memory (WM) and with a delay before retrieval. There are a multitude of theories regarding how focused elements and their alternatives are represented in memory predicting contradictory outcomes. Therefore, the primary aim of the present work is to further investigate the issue at hand, and to offer an explanation for findings based on general psychological principles pertaining to human memory. Since currently there is no data regarding the memory representation of the focused element and its alternatives for Hungarian focus, a secondary aim is to fill this gap by investigating how this particular focus construction affects WM performance, and memory performance when one is not able to rely exclusively on processes for maintaining information in WM (i.e., in a delayed recognition memory task). A tertiary aim is to investigate what can potentially belong to the set of alternatives evoked by focus.

Regarding these issues, we formulated and tested the following predictions. We predicted that focused elements are more readily accessible in WM than corresponding non-focused elements. Since results on delayed retrieval are scarce in the literature, we made no predictions regarding the accessibility to focused elements when there is a delay before retrieval, and hence one can not rely on WM processes. However, we made the tentative suggestion that the facilitatory effect observed in WM disappears. As far as focus alternatives are concerned, earlier results are contradictory, therefore, we aimed to adjudicate between the two conflicting predictions that focus enhances the representation of focus alternatives or it does not. Regarding the question of what constitutes the set of focus alternatives, we tested the prediction that—if alternatives are generated at all, not only semantically but contextually related alternatives are also activated.

Functional Characterizations of Linguistic Focus

Linguistic focus is an information packaging device (Chafe, 1976; Krifka, 2008) which pertains to "the information in the sentence that is assumed by the speaker not to be shared by him and the hearer" (Jackendoff, 1972, p. 16), hence focus expresses new, non-presupposed information (see also Kiss, 1998). In generative linguistic frameworks, focusation is often analyzed as movement to a functional projection. An interesting work from this domain suggests that certain movements or extraction phenomena (like movements from islands) may be related to a principle called semantic dominance (Erteschik-Shir, 1973) or dominance (Erteschik-Shir and Lappin, 1979). According to the principle of dominance, "a constituent c of a sentence S is dominant in S if the speaker intends to direct the attention of his hearers to the intension of c, by uttering S" (Erteschik-Shir and Lappin, 1979, p. 43). This principle clearly predicts that a to be focused element should appear in a designated syntactic focus position if the adopted theoretical linguistic framework assumes that sentences are derived and that derivations involve movements. Positing movements, together with the corollary that traces are left behind, gives rise to a number of psycholinguistic questions regarding how these structures are processed and represented. Since these questions are beyond the scope of the present work, we will confine our investigation to the memory representation of focused elements and their alternatives without committing ourselves to any formal theory of syntax on focus. There are two central functional characterizations of focus in the literature.

First, it is claimed that the function of focus is to partition the sentence into two parts: the foreground and the background (see e.g., von Stechow, 1991; Krifka, 1992). Focus is claimed to mark the foreground, highlighting important, emphatic, interesting, contrasted or new information against the background, which is often but not necessarily taken to be part of the common ground of the interlocutors.

Second, based on Rooth's alternative semantics approach (Rooth, 1985, 1992), it is commonly held that the function of focus is to evoke a set of alternatives: it expresses that there is a set of entities whose subset is selected by focus. Both functional definitions, namely the function of highlighting against a background and the function of signaling the presence of alternatives have been taken up by psycholinguistic enquiry and shown to have psychological reality.

Psycholinguistic Results on the Functional Aspects of Focus

The highlighting function of focus has been related to attention in the psychology of language processing: a wide array of studies have shown that the psychological function of focus is to guide the attention of the listener to the focused element. For example, in a seminal paper Bredart and Modolo (1988) used it-cleft constructions, a type of syntactic focus, to investigate whether the so-called Moses illusion is modulated by focus. The authors presented anomalous cleft sentences, such as *It was Moses who took two animals of each kind on the Ark*. The sentence is anomalous, since according to the Biblical story, it was Noah who brought two animals of each kind onto the ark before the flood. Participants were instructed to carry out a sentence verification task. The variable of interest was how frequently participants spotted the anomaly as a function of whether the incongruous item (i.e., *Moses* in the above example) was focused or unfocused. The results indicated a higher detection rate in the focused condition lending support to the idea that focus indeed guides attention to the focused element.

Relying on the findings of Bredart and Modolo (1988) and Sturt et al. (2004) investigated how the level of detail with which a word is represented in the mind is modulated by focus. The authors hypothesized that since focus directs attention to the focused element, this element is subject to in-depth processing, and consequently its representation is more fine-grained than those of unfocused elements. Sturt et al. (2004) tested this hypothesis using a change detection paradigm in which participants read short texts containing a cleft sentence in which the target word was either focused or not. Critical probes were the same texts containing one change: the target word was either replaced by a semantically related word, or a semantically unrelated word. The results revealed that the detection rates were

equally high irrespective of focus in the unrelated condition. However, in the semantically related condition, focus made a difference: while changes were significantly less likely to be detected when the critical noun was not focused, detection rates remained high in the related condition when it was in focus. Based on these results, the authors concluded that focus indeed directs attention and thus can modulate the specificity or granularity of the meaning representation of linguistic expressions (on granularity see Hobbs, 1990). This account of focus representation was named the granularity account by Sanford et al. (2006) and has been tested by a number of subsequent studies with confirmatory results (see e.g., Sanford et al., 2006, 2009; Ward and Sturt, 2007).

Another approach to the highlighting function of focus is the identification account formulated by Almor and Eimas (2008). This account proposes that the primary function of focus is to facilitate the identification of the focused element in order to enhance the efficiency of the discourse integration of linguistic elements. To test this hypothesis, Almor and Eimas (2008) investigated how syntactic focus (i.e., the cleft construction) modulated the accessibility of linguistic elements immediately after the focus-containing sentence has been processed in a lexical decision paradigm using reaction time (RT) as a dependent variable. The results showed that participants responded faster when the antecedent of the subject was focused compared to when it was not, lending support to the hypothesis that focused elements are more accessible in online processing. Almor and Eimas (2008) also investigated the long-term accessibility of the focused elements using a questionnaire in which questions elicited the delayed recall of critical focused words. In the recall task, the authors found an adverse effect for focus: if the critical word was marked for focus earlier during the experiment, its recall rate was lower compared to when it was unfocused.

In sum, the results of experimental work on the highlighting or attention capturing function of focus inspired the formulation of two mutually non-exclusive accounts of focus representation: the identification account and the granularity account. Note, that the granularity account is a stronger one: it includes the predictions of the identification account, since it claims that focus has an attention capturing property: if a linguistic element captures the attention of the addressee, its identification will also be fostered. Furthermore, the granularity account claims that focus leads to an in-depth processing of the focused element resulting in a more fine grained representation. For these reasons, we abandon the identification account, and test the predictions of the granularity account in the present work.

The strand of research inspired by the alternative semantics approach to focus (Rooth, 1985, 1992; Krifka, 1992, 2008) concentrates on the activation of alternatives generated by a focus containing expression. An account formulated in this vein is the so-called contrast account (see e.g., Braun and Tagliapietra, 2010; Fraundorf et al., 2010), which proposes that in the case of contrastive focus, the contrast set of the focused elements receives a higher activation with respect to semantically related, but not necessarily contrasted elements, or to unrelated elements.

For example, testing the contrast account, Fraundorf et al. (2010) investigated the accessibility of the contrast set generated by test sentences with a contrastive accent (L + H* accent) as opposed to sentences with a non-contrastive accent (H* accent associated with new, non-contrasted information) using a delayed forced choice recognition task on the target words. The results showed improved performance on the contrastively accented words relative to the words with non-contrastive accent. Fraundorf et al. (2010) concluded that the observed long-term effect rules out the identification account, but it is compatible with both the granularity account and the contrast account. To tease apart these accounts, the authors carried out a sentence verification experiment using the same materials. In this experiment participants were presented statements in three conditions and had to verify their truth with respect to the sentences heard earlier. Statements belonging to the three conditions (i) contained the same target item as the test sentence, (ii) contained a mentioned contrast item, or (iii) contained an unmentioned but within-category item. The granularity account predicts an enhanced representation primarily for the focused item, whereas the contrast account predicts that the representation of both the focused item and the members of its contrast set should be enhanced. Therefore, Fraundorf et al. (2010) argue that if the former account is tenable, no advantage should be observed for either the mentioned contrast item or the unmentioned alternative. According to the contrast account, however, the sentence containing the mentioned contrast item should be enhanced while the advantage should not extend to the sentence containing the unmentioned alternative, since the unmentioned item was not a member of the original contrast set. The results were found to support the contrast account.

Another account using Rooth's (1985) alternative semantics as a point of departure is the focus association account, which proposes that alternatives for focus are enhanced whether they are in the contrast set or not. In one experiment by Gotzner et al. (2013) the authors compared the accessibility of prosodically focused elements using the contrastive L+H* accent used also by Fraundorf et al. (2010) and elements marked for focus by the particles *only* (*nur*) or *also* (*auch*) together with the L+H* contrastive accent. Participants performed a probe recognition task after hearing stories as in (1) (contrastive accent marked by capital letters).

(1) Context sentence: The judge and the witness followed the argument.
Critical sentence: (Only/also) the $[\text{JUDGE}]_{\text{Focus}}$/the $[\text{judge}]_{\text{Focus}}$ believed the defendant.
Extra filler sentence: He announced the verdict.

After the story, a probe word was presented which was the mentioned alternative in the context sentence of the critical conditions (*witness*). The task of the participants was to decide if the word had appeared in the story or not. The results revealed that RTs were fastest in the contrastive accent condition indicating that the accessibility of alternatives was enhanced by contrastive focusing. However, inclusion of the focus particles resulted in longer RTs, which, as the author argues, is the consequence of interference: if focus is explicitly used to mark the presence of alternatives (as in the case of *only* and *also*), the focus alternatives become more activated. According to the authors,

this higher activation of the set of alternatives in turn led to a greater level of competition during the probe recognition task manifest in an interference effect, i.e., in longer RTs when focus particles were used together with contrastive accent.

In another experiment, Spalek et al. (2014) presented stories containing sentences marked for focus by particles (*nur* ∼ *only* and *sogar* ∼ *even*) in blocks of ten, and investigated the memory accessibility of alternatives using a delayed recall task. The results revealed that while there was no facilitative effect of focus particles on the recall of the focused elements themselves, the presence of a particle significantly increased the recognition rate of the focus alternatives.

The rather selective summary of experimental studies above reveals that there is considerable diversity in the methods of inquiry, the investigated focus types (within and across languages), the findings, and also in the theories of focus representation. Note that findings pertaining to the memory representation of focused elements and alternatives come both from tests given immediately after the presentation of the critical sentence (e.g., Bredart and Modolo, 1988; Sturt et al., 2004; Ward and Sturt, 2007; Almor and Eimas, 2008; Gotzner and Spalek, 2016), and tests given after a delay of a few seconds (e.g., Almor and Eimas, 2008; Spalek et al., 2014). Authors in the field argue that these results reflect the interaction of focusing with two separate memory systems: Working Memory (WM) and Long-Term Memory (LTM). WM is the cognitive system responsible for storing, processing and manipulating information needed for a given cognitive task for a limited period of time (Baddeley, 2003, 2009; Unsworth and Engle, 2007; Cowan, 2008), while LTM is responsible for storing information over long periods of time (Cowan, 2008; Baddeley, 2009).

Apart from issues related to the representation and accessibility of focus alternatives, the question of what constitutes this set has also been taken up by psycholinguistic research.

As fleshed out by Gotzner (2017), there is a permissive and a restrictive view. The permissive view, based on Rooth (1992), claims that it is the context that serves to designate the alternative set, therefore, alternatives are selected based on pragmatic principles. On the other hand, the restrictive view claims that only those elements can constitute such a set that are semantically contrasted (Wagner, 2006). Consider example (2) (adopted from Wagner, 2006).

(2) a. He produces high-end convertibles. What did he bring as a present to the wedding?
b. He brought a $[\text{cheap}]_{\text{Focus}}$ convertible.
c. * He brought a $[\text{blue}]_{\text{Focus}}$ convertible.

According to the restrictive view, since color has no relation to quality or cheapness, being blue (2c) cannot constitute an alternative to being high-end, as being cheap can (2b). In order to test the predictions of the permissive and restrictive views, Gotzner (2017) re-analyzed data from a lexical decision experiment (Gotzner et al., 2016) by categorizing the stimuli into two groups. In one group (replacement group) the unmentioned probe could be a potential replacement of the focused element in the test sentence (test sentence: *He only bought jackets*, related probe: *trousers*, unrelated but possible probe: *lychees*). The other group contained trials in which the unmentioned probe could not be a possible replacement of the focused element (test sentence: *He only caught flies*, unrelated and impossible probe: *sofas*). Including the factor of Replacement in the analysis revealed that responses for semantically unrelated but possible replacements and unmentioned but semantically related items were equally fast leading to the conclusion that unrelated items can be a part of the set of alternatives if they are possible replacements.

In a subsequent study Jördens et al. (2020) investigated the activation of contextually suitable but taxonomically different alternatives in a cross-modal priming paradigm experiment with probe recognition. Participants were presented with sentences (e.g., *The farmer brought straw into the barn*) in which either the element to be probed (i.e., prime word, e.g., *straw*) was marked for focus by accent or another element (e.g., *farmer*). Two types of probes were presented: one type was either a contextually related and potential focus alternative to the prime word (e.g., *cow* when *straw* is focused) or it was related to the sentence, but not a potential alternative (e.g., *cow* when *farmer* was in focus). The other probe type was both semantically unrelated and contextually inappropriate (e.g., *elevators* with respect to the example sentence above). The experimental task was to indicate whether the probe had appeared in the sentence. RT data revealed that participants were fastest responding to unrelated probes, most probably due to their marked deviation from the prime words. More interestingly, RTs measured for potential alternatives were faster than for inappropriate alternatives indicating a higher activation level for the former probe type. Thus, Jördens et al. (2020) concluded that the set of alternatives that focus generates is contextually determined. The findings of Gotzner (2017) and Jördens et al. (2020) support the permissive view of the generation of focus alternatives.

Hypotheses derived from the accounts mentioned so far can be summed up as follows. Regarding the short-term effects of focus on the representation of the focused element, all accounts make the same claim: the representation of the focused element is enhanced. Hypotheses regarding the activation of focus alternatives do not entirely diverge either. The granularity account is not explicit regarding this question, however, it makes it possible to derive a hypothesis about alternatives: since the focused element has a finer grained representation (Fraundorf et al., 2010), we can expect that semantically related alternatives may be rejected more readily. Note, however, that this is expected as a consequence of the high activation and detailed representation of the representation associated with the focused element itself. In contrast, the focus association account makes the explicit hypothesis that the representation of focus alternatives is enhanced. Furthermore, the permissive view on focus alternatives suggests similar activation levels for semantically and contextually related alternatives, while the restrictive view claims that facilitation should only be observed in the case of semantically related alternatives.

As mentioned earlier, few studies have investigated the memory accessibility of the focused element and its alternatives when there is a delay before retrieval (when the task cannot be completed by involving only WM processes). With respect to such so-called long-term effects, theories on the representation

of both the focused element and its alternatives diverge. Regarding the focused element, the granularity and contrast accounts hypothesize that its representation is enhanced, while the identification and focus association accounts do not make any specific claim on this matter. Note that when testing the identification account, Almor and Eimas (2008) found an adverse effect which was explained in terms of the repeated name penalty. The repeated name penalty is an adverse effect on processing that occurs when a referring NP is repeated in consecutive sentences. It does not occur when an anaphor is used in the second sentence. Since in our experiment there were no repeated names, this explanation is irrelevant here. Note also that although the focus association account does not make any specific claim about the representation of the focused element, testing this account, Spalek et al. (2014) found no facilitation in the case of German focus particles *nur* (*only*) and *sogar* (*even*).

Regarding focus alternatives, the identification account along with the granularity account does not make a claim regarding the activation level of these items. On the other hand, the contrast and focus association accounts claim that there is an enhancement in the representation of alternatives.

The Hungarian Pre-verbal Focus

In Hungarian, focus is simultaneously marked syntactically and prosodically. As exemplified in (3a), the focused element is situated pre-verbally while if present, the verbal modifier (VM) occupies a post-verbal position. Also, the focused element carries a so-called eradicating stress, i.e., it bears the most prominent sentential stress deleting all consecutive stresses within the following sentential domain (Kornai and Kálmán, 1988). Since the pre-verbal position exemplified in (3a) is strictly associated with focus, we will refer to this sentence type as pre-verbal focus (preVf). In focusless, neutral sentences such as (3b), however, it is the VM that occupies the pre-verbal position, while the element corresponding to focus in (3a) sits in a neutral post-verbal position.

(3) a. Miki [egy'tányért]$_{\text{Focus}}$ rakott be a szekrénybe.
Mike [a plate]$_{\text{Focus}}$ put into$_{\text{VM}}$ the cupboard-in
Miki put a plate in the cupboard.
b. Mike be-rakott egy tányért a szekrénybe.
Miki into$_{\text{VM}}$-put a plate the cupboard-in
Mike put a plate in the cupboard.

The function of identification and highlighting, as well as the function of evoking alternatives have also been discussed with respect to preVf in the theoretical literature.

Concerning the foregrounding or highlighting function of focus, Brassai made influential observations already in the middle of the nineteenth century. The author divided the sentence into two parts and claimed that the elements in the part that we today identify as focus "practically lay a basis for the meaning of the sentence in the listener's mind, i.e., they are calling attention, and pointing forward, connecting the mental activity of the listener with that of the speaker" (1860, p. 341; translation by Kiss, 2008, p. 55). This psychological and functional definition is especially appealing, since it is exactly in line with the literature on the attention capturing properties of focus.

Regarding the function of evoking an alternative set, Kenesei (2006), in the vein of alternative semantics of Rooth (1985) and Roberts (1998), proposes that preVf selects a proper subset of a contextually available set, therefore inevitably creating a complementary set containing focus alternatives. The author adds that as a consequence of this property, preVf is necessarily contrastive. Other authors take a more permissive approach regarding the contrastive nature of preVf, and claim that it is only contrastive if it operates on a closed set of (contextually defined) elements (Kiss, 1998). This stance is compatible with the more general formulation of the contrastive function of focus by Krifka (2008), who claims that contrast is only present if the alternatives are directly mentioned and contrasted in a corrective or additive way.

One empirical work studied the relation of preVf and its function of evoking sets. Káldi et al. (2020) examined the contextual effects that trigger the use of preVf in a semi-guided production study. Results revealed that preVf is produced reliably in contexts that contain an explicit or implicit set of focus alternatives. Contexts that lack such a set do not reliably trigger the sentence type at hand. The authors conclude that the alternative semantics definition of focus (Rooth, 1985, 1992; Krifka, 2008) is also applicable to preVf.

Taken together, it has been proposed that preVf has the properties that have also been described by more general treatments of focus: it serves to identify, highlight, and in certain contexts, contrast information.

As stated earlier, the aims of the present work are 3-fold. The first aim is to gain further insight into the focus representation accounts. The secondary aim is to investigate the accessibility and representation of focused elements and its alternatives in the case of the Hungarian preVf. We investigated the issue in a WM task, and in a task that does not measure WM performance, such as a delayed recognition memory task. The tertiary aim pertains to the debate between the restrictive and permissive view of focus alternatives and amounts to investigating what can potentially belong to the alternative set evoked by preVf.

To investigate WM processes, we assessed immediate recognition memory performance in Experiment 1. This task required not only the storage but also the manipulation of WM representations; therefore, we refer to this paradigm as a Working Memory task instead of a short-term memory task (see e.g., Daneman and Carpenter, 1980). The aim of Experiment 2 was to assess the accessibility of memory representations with a delay before retrieval when participants are prevented from relying on WM processes. Since we did not aim to investigate long-term forgetting, following the tradition of experimental psychological research (see e.g., Tulving, 1985; and psycholinguistic research, see e.g., Spalek et al., 2014), we did not use a delay of days or even weeks between study and test, but a delay of a few minutes. During a delay participants are likely to keep repeating the verbal stimuli, and hence keep this information in WM (Cowan, 2008). To eliminate the possible effect of such rote rehearsal on memory performance (see e.g., McCabe, 2008), participants were asked to complete a non-interfering visual task with no memory component during this short delay.

EXPERIMENT 1

Predictions

Experiment 1 tested the potential effects of preVf on the accessibility and representation of focused elements and their alternatives using a probe recognition task in WM: participants were presented with stories in which we embedded a preVf containing sentence (PreVf sentence condition) or its focusless neutral counterpart (Neutral sentence condition). Immediately after each story, a probe sentence was presented to test the critical sentence. Three types of probes were used: (i) the probe was the same as the critical sentence in the story (Same probe condition), (ii) the focused word (or the corresponding word in the neutral sentence) was replaced by a semantically related word (Semantically related probe condition), or (iii) the focused word (or the corresponding word in the neutral sentence) was replaced by a semantically unrelated, but contextually suitable word (Contextually related probe condition). Conditions (ii) and (iii) will be collectively referred to as Different probe conditions.

The variables of interest were response latencies (which we will refer to as RT for reasons of convenience) and accuracy (i.e., rates of correct acceptance and rejection). In line with the probe recognition literature (see e.g., Sturt et al., 2004; Sanford et al., 2006; Jördens et al., 2020), these variables are taken as correlates of activation level. Also, RTs and correct rejection rates are a measure of relatedness in the Different probe conditions, since items which bear no semantic (or any other) relation to the critical item, i.e., those that are completely unrelated, are expected to be rejected highly accurately and fast compared to those which are in closer relation to the critical item. For this reason, results in RTs and correct rejection will show how the relatedness effect is modulated by activation level due to sentence type.

Regarding the Same probe conditions, we formulated our predictions as follows. Since all focus representation accounts claim that the representation of the focused element is enhanced relative to the non-focused elements, we predicted higher accuracy rates and lower RTs in the PreVf sentence condition relative to the Neutral sentence condition.

The Different probe conditions were introduced to test the predictions of the various focus representation accounts regarding alternatives. In terms of our dependent variables, the predictions derivable from the various accounts are formulated as follows. Regarding the semantically related alternatives, the granularity account suggests that alternatives of focused elements should be rejected faster and at a higher rate than items associated with non-focused elements. However, such patterns are not the consequence of a higher activation for focus alternatives, but are the result of a more fine grained representation of the focused element which even close associates are discriminated against. In contrast, the focus association account, whose point of departure is the claim that the function of focus is to indicate the presence of alternatives (see Krifka, 2008; Gotzner, 2017), explicitly predicts higher activation of focus alternatives. Thus, based on this account, we would expect to see faster reaction times and a higher rate of correct rejections of semantically related probes in the case of preVf sentences, than in the case of neutral sentences. Altogether, the predictions for the RTs and rejections of semantically related alternatives in the case of immediate recognition do not differ for the granularity and focus association theories, since these both suggest faster RTs and a higher correct rejection rate in the case of focus, albeit for different reasons. However, we will see that the predictions diverge for the delayed recognition experiment.

The Semantically related probe and the Contextually related probe conditions were introduced to test the predictions of the restrictive and permissive accounts of focus alternatives. As stated earlier, the restrictive view of focus alternatives suggests that focus activates semantic associates, while the permissive view claims that contextually suitable alternatives should also be activated even if they are not semantic associates. Along these lines, the restrictive view predicts that in the case of preVf, RTs should be faster and the rate of correct rejections should be higher only for the semantically related probes but not for the contextually suitable (but semantically unrelated) probes, since only semantically related focus alternatives should receive higher activation. On the contrary, the permissive view predicts that probes containing contextually suitable alternatives should also be responded to faster and should be rejected correctly at a higher rate in the case of preVf sentences. Thus, if the permissive view and the focus association account are correct, we expect to observe higher accuracy rates and faster responses in the PreVf sentence condition irrespective of the probe type.

The predictions will be tested using mixed effects models in which trial and participant will be included as random effects. The analysis will be carried out as outlined in Mirman (2014) and Bates et al. (2015).

Method

Participants

Sample size for both Experiment 1 and 2 was determined based on previous work (e.g., Fraundorf et al., 2010; Gotzner et al., 2013). Forty undergraduate students recruited from the Budapest University of Technology and Economics participated in the experiment for course credit (27 females, $M_{age} = 21.4$ years, $SD = 2.1$). All participants in the experiments outlined in the present paper provided informed consent approved by the Hungarian United Ethical Review Committee for Research in Psychology. The study was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. Participants in both experiments were native speakers of Hungarian and had normal vision or vision corrected-to-normal. Subjects had no history of psychiatric or neurological disorders.

Materials

The stimuli for the experiment were recorded in a sound treated room by a professional speaker. The speaker was asked to produce the linguistic material in a natural story-telling manner.

During the experiment, 36 experimental trials and 36 filler trials were presented auditorily. All trials contained a five-sentence story and a probe sentence with a 500 ms delay between the presentation of the story and the probe. An example of one experimental trial is provided in **Table 1**.

TABLE 1 | Conditions and examples.

Stimulus	Sentence-condition	Probe-condition	Example
Story	PreVf: or Neutral:		A házibuli után Annára és Mikire hárult az elpakolás feladata. "After the party Ann and Mike undertook the work of tidying up." Rendeztek mindent, ami a kezük ügyébe került. "They created order everywhere they went." A konyhában is volt teendo elég. "There was a lot to do in the kitchen, as well." Miki [egy tányért]$_{Focus}$ rakott be a szekrénybe. "Mike put [a plate]$_{Focus}$ in the cupboard." Miki berakott [egy tányért] a szekrénybe. "Mike put [a plate] in the cupboard." Aztán tovább sietett, és a bútorokat rendezgette. "Then he hurried on to arrange the furniture."
Probe	PreVf	Same	Miki [egy tányért]$_{Focus}$ rakott be a szekrénybe.
		Sem.-rel.	Miki [egy edényt]$_{Focus}$ rakott be a szekrénybe (*plate* replaced with *pot*)
		Cont.-rel.	Miki [egy dobozt]$_{Focus}$ rakott be a szekrénybe (*plate* replaced with *box*)
	Neutral	Same	Miki berakott [egy tányért] a szekrénybe.
		Sem.-rel.	Miki berakott [egy edényt] a szekrénybe (*plate* replaced with *pot*)
		Cont.-rel.	Miki berakott [egy dobozt] a szekrénybe (*plate* replaced with *box*)

Critical NPs are in square brackets (Sem.-rel., Semantically related; Cont.-rel., Contextually related).

In experimental trials, the story contained either a preVf (PreVf sentence condition) or a neutral critical sentence (Neutral sentence condition). The critical sentences were either six or seven words long ($M_{words} = 6.8$, $SD = 0.4$), while the length of the stories varied between 39 and 43 words ($M_{words} = 41.1$, $SD = 1.9$). Each critical sentence contained a target word, which was the grammatical object of the sentence: an indefinite noun phrase (NP) in pre-verbal position in the PreVf sentence condition and in post-verbal position in the Neutral sentence condition. The critical sentence was the second, third or fourth sentence within the story. We varied the position of the critical sentence within the stories in order to eliminate potential confounds resulting from learning or practice effects: if the to-be-probed sentence was always in the same position within the stories, participants might develop an intuition about which sentence would be probed and might allocate extra attention to those sentences. The critical sentences were presented in the second, third, and fourth positions in an equal proportion of trials. Critical sentences never came first or last for two reasons. First, we wished to control for potential primacy and recency effects (Postman and Phillips, 1965). Second, it has been shown by Glenberg et al. (1987) that including a sentence between the critical sentence in the encoding phase and the probe sentence in the test phase allows sufficient time for a discourse representation to build up. Since in Experiment 1 probes immediately followed the stories, it was advisable to include at least one additional sentence intervening between the critical sentence and the probe.

Since sentences of two different information structure types (preVf and neutral) were presented in the same stories, the question arises whether these sentences differed in acceptability in their respective contexts. In order to ascertain that our results would not be confounded by different degrees of acceptability between the two sentence conditions, we conducted an online survey. In the trials of the survey, participants simultaneously read and heard the stories. In each story, the critical sentence was set in bold typeface. Participants rated the naturalness of these sentences using a 10-point Likert scale: value 1 corresponded to completely natural, while 10 corresponded to completely unnatural. Participants responded by clicking the numbers on the scale. We created two lists in order to eliminate the potential confounds resulting from presenting the same stories with both sentence types within one story: if the critical sentence was a preVf sentence in one story in one of the lists, this story contained its neutral counterpart in the other list. All 36 stories were presented together with 36 filler trials. In the filler trials the second, third, and fourth sentences were tested in an equal proportion, just as in the case of the test trials. Test and filler trials were presented in a randomized order. Thirty-nine university students took part in the survey (38 females, $M_{age} = 20.7$ years, $SD = 1.2$) for course credit. Participants were assigned to the lists randomly.

Results of the survey showed that the mean rating of preVf sentences was 3.028 ($SD = 0.798$), while the mean rating of neutral sentences was 3.027 ($SD = 0.799$). In order to test the hypothesis that the ratings of the two sentence types did not differ significantly, we built a Linear Mixed Effects Model using Sentence Type as fixed factor, and random intercept for Participant and Item. Models were built using the 1.1-21 version of the lme4 package (Bates et al., 2015). Running the model revealed that the variances in the data were close to zero (i.e., the model resulted in a singular fit), and therefore the model could not be built. In order to establish whether using a different distribution should lead to a better model, we used the fitdistrplus R package by Delignette-Muller and Dutang (2015) to estimate the distribution of our data. The analysis revealed a platykurtic distribution unsuitable for analysis by Mixed Models. For this reason, we resorted to using the Wilcoxon Signed-Rank Test (using the coin R package by Hothorn et al., 2006) which showed that the naturalness ratings of the two sentence types did not differ significantly ($Z = 0.160$, $p = 0.873$). Thus, we concluded that both sentence types fit the stories naturally, and potential confounds resulting from the use of unnatural linguistic stimuli could be eliminated.

Probe sentences were presented in three conditions: in the Same probe condition the probe was identical to the critical sentence; in the Semantically related probe condition the target

NP was replaced by a semantically related word (e.g., *plate* replaced by *pot* for the example in **Table 1**); and in the Contextually related probe condition the target NP was replaced by a word that was contextually plausible but semantically unrelated to the target word (e.g., *plate* replaced by *box*). Probe sentences were recorded as whole. In other words, instead of splicing the critical words into the sentences, we made three recordings for each sentence type for the three conditions. This was done so that the prosodic characteristics of the preVf and neutral sentence type could be preserved, and thus the probe sentences sounded natural.

Using corpus data (the Hungarian National Corpus of 1.04 billion words, Oravecz et al., 2014), we matched the frequencies of words used as target in the critical and probe sentences: a comparison revealed that there was no significant difference between the words in the three conditions (Same, Semantically related, and Contextually related probe conditions), $F_{(2,107)} = 0.705$, $p = 0.496$. Also, the lengths of these words were controlled: we used nouns with lengths of two or three syllables in their accusative case. Within trials, word forms of the same number of syllables were used.

The structure of the 36 filler trials was identical to those of the critical trials: each contained a five-sentence story and a probe. Half of the probes were identical to one of the sentences in the story while the other half contained a change. The position of the probed sentence within the stories was also balanced in the fillers. None of the filler sentences had a preVf structure, and no replacements in filler probes involved the object NP.

Procedure

The experiments presented in the current paper were programmed with Matlab R2014a using the Psychtoolbox version 3.0 (Brainard, 1997; Pelli, 1997; Kleiner et al., 2007; MATLAB, 2010).

After filling in the consent form, participants were seated in front of a computer screen with headphones on and were given instructions. They were informed that the probes would occasionally contain some change, therefore they were requested to pay special attention to all aspects of the stories and give their response as accurately and as fast as possible. Thus, the encoding was intentional, as subjects were required to memorize the stories. Participants responded by button presses corresponding to the following instruction: If the sentence you just heard is identical to any of the sentences in the previous story, press "yes," if you detect any change, press "no." Practice trials were not included, since as a consequence of the block structure (i.e., all blocks started with a filler) no experiment started with a critical trial. One trial was sufficient for participants to understand the experimental task.

Each item appeared in only one condition for each participant. The structure of one trial was as follows: a fixation cross appeared on the screen, and the story was presented auditorily. The fixation cross appeared at the onset of the story and remained on the screen until its end. Following the story, a black question mark appeared in the place of the fixation cross and the probe sentence was presented. Both the presentation of the story and the probe sentence were preceded by a 500-ms inter-stimulus interval.

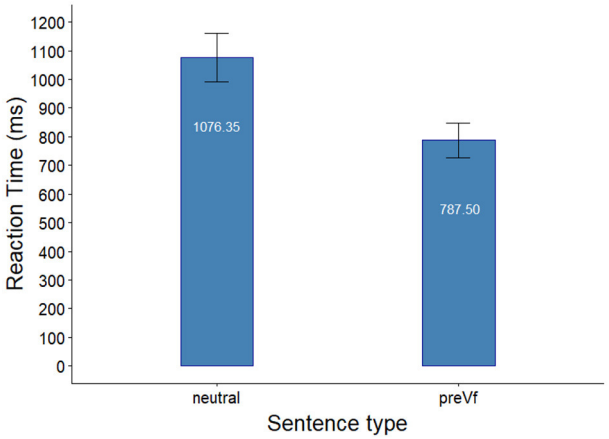

FIGURE 1 | RTs in the Same-conditions in Experiment 1. Error bars indicate the standard error of the mean.

When the probe sentence ended, the question mark turned green and the participant could press the button corresponding to their response. Participants were encouraged to respond as quickly and as accurately as they could. Maximally 8 s were allowed for responses to be made. Trials were presented in six blocks, and each block contained 12 trials. The allocation of trials to the blocks was randomized, as well as their order within the blocks with one constraint: the first and last stories of each block were fillers. Between the blocks, participants played a visual game on a tablet for 2 min to eliminate the possible effect of rote rehearsal on memory and to circumvent fatigue effects. The average duration of a recording session was 60 min.

Results

All analyses presented in the current paper were carried out in R version 3.5.3 using the 1.1-21 version of the lme4 package (Bates et al., 2015; R Core Team, 2019). Data obtained in the Same and Different probe conditions were analyzed separately for reasons outlined in the Predictions section.

Looking at the Same probe condition, response accuracies were fairly high in both sentence conditions ($M = 82.9\%$, $SD = 16.7$ for neutral sentences, $M = 86.60\%$, $SD = 15.2$ for preVf sentences). In order to test our predictions regarding this measure in the Same probe condition, we built generalized linear mixed effect models to predict Accuracy using the binomial distribution in successive steps (Bates et al., 2015). First, a base model was built with an Intercept and then a model with Sentence Type as predictor. Random effects included random intercept for trial and random intercept for participant. A likelihood ratio test comparing the two models did not show an improvement in fit [$\chi^2_{(1)} = 1.126$, $p = 0.289$]. Thus, contrary to our expectations, Accuracy in the Same probe condition did not differ significantly between the two sentence types.

RT data from the Same probe condition is presented in **Figure 1**.

As a next step, we analyzed RT data obtained in the Same probe condition. Trials in which participants gave incorrect

TABLE 2 | The best fitting model and its parameter estimates predicting RT in the same condition in Experiment 1.

RT ~ sentence_type + (1 | Participant) + (1 | Trial)

	Estimate	Std. Error	*df*	*t*	*p*
Intercept	1087.631	98.040	74.078	11.094	0.000
Sentence type_ preVf	−293.640	95.049	359.749	−3.089	0.002

responses were excluded from the analysis of RT (15.3%). We fitted mixed effects regression models to the data in two successive steps. First, an intercept-only base model was built, second, Sentence Type was added as predictor. The random effect structure for the models was random intercept for Participant and random intercept for Trial. Addition of further random effects resulted in non-convergence of the models. The comparison of the two models was carried out using the likelihood ratio test, which showed a significant improvement in fit by the addition of Sentence Type [$\chi^2_{(1)} = 9.388$, $p = 0.002$] revealing that participants responded faster in the PreVf sentence condition than in the Neutral sentence condition. The model including the predictor Sentence Type and its parameter estimates are presented in **Table 2**.

Accuracy rates in the Different probe conditions are presented in **Figure 2**.

Accuracy in the Different probe conditions was analyzed using logistic mixed effects models with binomial distribution. The predictors Sentence type and Probe type were contrast coded using the effects R package by Fox and Sanford (2019). The random effect structure was random intercept for participant and random intercept for trial. Models were built in successive steps by adding fixed effects to an intercept only base model. Addition of Probe Type resulted in a better fit [$\chi^2_{(1)} = 30.827$, $p < 0.001$] showing better performance in the case of contextually related probes, while the inclusion of Sentence Type missed the level of significance [$\chi^2_{(1)} = 3.499$, $p = 0.061$] in the improvement of model fit. Adding the interaction term Sentence Type × Probe Type did not improve fit [$\chi^2_{(1)} = 0.389$, $p = 0.533$). The specification and parameter estimates of the best fitting model are presented in **Table 3**.

Finally, we analyzed the RTs of correct rejections in the Different probe conditions [PreVf—semantically related: $M_{RT} = 893.535$ (1118.442), contextually related: $M_{RT} = 555.387$ (565.020); Neutral—semantically related: $M_{RT} = 912.105$ (1002.323), contextually related: $M_{RT} = 683.562$ (789.095)]. We included Probe Type and Sentence Type as contrast coded predictors in the statistical analysis. The random effect structure of the models was random intercept for participant and random intercept for trial. First, a base model was built and the two predictors were added in two successive steps. Models were compared using the likelihood ratio test. Addition of Probe Type resulted in a better fit [$\chi^2_{(1)} = 11.394$, $p < 0.001$], showing faster RTs for the contextually related probes. However, the inclusion of Sentence Type did not result in a better fit [$\chi^2_{(1)} = 1.982$, $p = 0.159$] indicating that sentence type did not have an effect on RTs.

Discussion

Experiment 1 investigated the memory accessibility and representation of the focused element and its alternatives in the case of preVf in WM. Regarding the accessibility of the focused element, accuracy (i.e., correct responses on the immediate recognition memory test) did not indicate an advantage. However, RT did show that preVf had a facilitative effect. Despite the lack of advantage in the case of accuracy, we

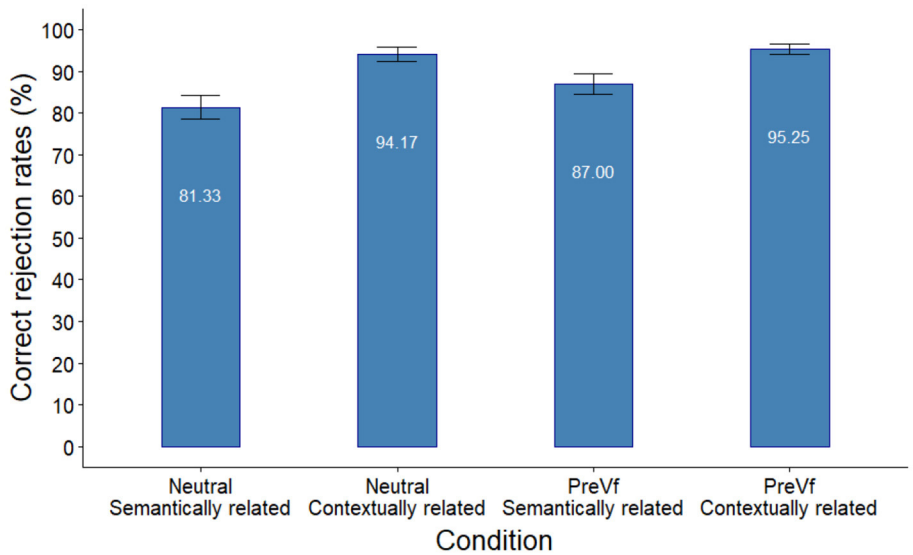

FIGURE 2 | Accuracy rates in the different probe conditions in Experiment 1. Error bars indicate the standard error of the mean.

TABLE 3 | The specification and parameter estimates of the best fitting model predicting accuracy in the different probe conditions in Experiment 1.

accuracy ~ probe_type +
sentence_type +
(1 | Participant) +
(1 | Trial), family = binomial

	Estimate	Std. Error	*z*	*p*
Intercept	2.547	0.209	12.171	<0.001
Probe type	0.660	0.126	5.225	<0.001
Sentence type	−0.212	0.114	−1.856	0.063

conclude that RT alone shows the facilitatory effect of focus on the accessibility of the critical element, since this measure is a correlate of the durations of processes (or stages) that take place when the correct recognition of an item occurs (Sternberg, 1969). The discrepancy between accuracy and RT may be attributable to the difference in the sensitivity of these measures of memory accessibility. Furthermore, the reason we did not find an effect in terms of detection rates found by for example Sturt et al. (2004) and Sanford et al. (2006) may be a methodological one: while these authors used three-sentence texts, we used five-sentence stories which may have made the experimental task used in our investigation more difficult. Since, as mentioned above, accuracy is a less sensitive measure regarding accessibility than RT, accuracy did not show a difference in this more difficult task. This assumption needs to be addressed in later work.

Regarding the different conditions, it has been found that relatedness has an effect: overall, contextually suitable but semantically unrelated alternatives were better recognized than semantically related alternatives. This is an expected result, since the difference between semantically unrelated items is more salient irrespective of context and sentence type. No statistically reliable difference has been found, however, between the two sentence types in the rejection rates of different probes, i.e., the data provide no support for the focus association account, which claims that focus leads to the relatively higher activation of alternatives. Nevertheless, the close to significant effect indicates that this activation may be higher which may have remained undetected due to methodological reasons. This suggestion will be addressed in the General Discussion section, and it will be shown that there is indirect evidence for the higher activation of focus alternatives compared to non-focused ones. Since the effect of preVf on the activation of alternatives was not detected in Experiment 1, our results are also inconclusive regarding the restrictive versus the permissive accounts of focus alternatives. In future work, methodological improvement is needed to address this question.

As far as RT is concerned, we found an effect of probe type: participants responded to probes containing a semantically unrelated but contextually suitable alternative faster than to probes with semantically related alternatives. We believe that the observed difference in RT is also attributable to the relatedness effect discussed above. However, contrary to our predictions, sentence type did not have an effect, that is, participants responded to both probe types similarly fast.

EXPERIMENT 2

The purpose of Experiment 2 was to test the predictions of the different focus representation accounts regarding delayed recognition, i.e., when an individual is not able to rely on WM processes for maintaining information. For this reason, the stories were presented in blocks, and probes were presented after the stories with a delay (for a similar method, see Spalek et al., 2014).

Predictions

As in the case of Experiment 1, we made predictions regarding accuracy rates and RTs. As far as the accessibility of the focused element is concerned (i.e., Same probe condition), the granularity account and the contrast account both predict an enhancement in the accessibility of the focused element. Therefore, if either one of these theories is tenable, we should see an advantage of preVf sentences which should be manifest in higher accuracy rates and lower RTs relative to the Neutral sentence condition. Additionally, the focus association hypothesis makes no specific prediction but when testing this account, Spalek et al. (2014) found no effect for the German particles *nur* (only) and *sogar* (even).

Regarding the accuracy rates in the Different probe conditions, the granularity account does not make a prediction regarding the accessibility of focus alternatives. On the other hand, the contrast account predicts an enhancement in the accessibility of mentioned contrastive alternatives, but not for unmentioned alternatives (Fraundorf et al., 2010). Since we did not use mentioned alternatives in our context stories, the contrast account predicts no effect of focus on the correct rejection of the different probes. At the same time, the focus association account predicts that interference should occur: since focus alternatives (which can be either mentioned or unmentioned) receive a higher activation in WM, we should see an interference after a delay. Such an effect is expected, as representations of similar semantic content have been shown to interfere (Baddeley and Dale, 1966; see also Baddeley, 2009; Baddeley et al., 2020) when there is a delay before the retrieval of memory elements. In terms of our dependent variables, this translates as higher RT and a lower correct rejection rate in the PreVf sentence condition relative to the Neutral sentence condition for the different probes.

Just as in the case of Experiment 1, the predictions will be tested using mixed effects models in which trial and participant will be included as random effects. The analysis will be carried out as outlined in Mirman (2014) and Bates et al. (2015).

Method

Participants

Forty undergraduate students recruited from the Budapest University of Technology and Economics participated in the experiment for course credit (34 female, $M_{age} = 23.0$, $SD = 1.8$).

Materials

The stimulus set used in Experiment 2 was identical to the one used in Experiment 1.

Procedure

The experimental design and the procedure were identical in Experiments 1 and 2 with only one crucial modification. While the presentation of a story was always immediately followed by the presentation of a probe in Experiment 1, probes were presented at the end of each block in Experiment 2. Each item only appeared in one condition. The experiment consisted of 12 blocks, each containing six trials. The allocation of trials to the blocks was randomized, as well as their order within the blocks. The structure of the blocks in Experiment 2 was as follows: first, a set of six stories (with 500 ms delays between each) was presented followed by a 2-min delay. During the 2-min delay participants played a visual game on a tablet in order to eliminate the effect of rote rehearsal on memory retention. After the game, participants returned to the computer and were presented a series of probes. The order of the probes corresponding to the stories was identical to the order of the stories. As in Experiment 1, participants saw a black question mark during the probe. When the probe sentence ended, the question mark turned green, and the participant could give their response. The experimental task was the same as in Experiment 1: participants were asked to respond by button presses corresponding to the following instruction: If the sentence you just heard is identical to any of the sentences in any of the stories you heard in the previous set of stories, press "yes," if you detect any change, press "no." Participants were allowed a maximum of 8 s to respond. The duration of one experimental session was ∼60 min.

Results

As in the case of Experiment 1, data obtained in the Same and Different probe conditions were analyzed separately.

First, we carried out a statistical analysis of the accuracy rates in the Same probe condition. The same procedure was followed as in the case of Experiment 1: a base model with Intercept and a model with Sentence Type as predictor was built. Comparison of the two models did not reveal an improvement in fit [$\chi^2_{(1)} = 3.075$, $p = 0.08$], showing that Sentence Type had no effect on Accuracy in the same-condition. Note, however, that the difference between the two sentence types suggests a tendency in the opposite of the predicted direction: 63.33% ($SD = 20.74$) for preVf sentences and 71.25% ($SD = 23.56$) for neutral sentences.

After the exclusion of trials in which participants gave incorrect responses (32.71 %), RT data from the Same probe condition were analyzed using mixed effects models with random intercept for Participant and random intercept for Trial as random effects. First, a base model with Intercept as predictor was built to which we added Sentence Type as predictor. The likelihood ratio test showed no significant improvement in model fit for sentence type [$\chi^2_{(1)} = 1.678$, $p = 0.195$] meaning that response latencies for the two sentence types did not differ significantly. RT data are presented in **Figure 3**.

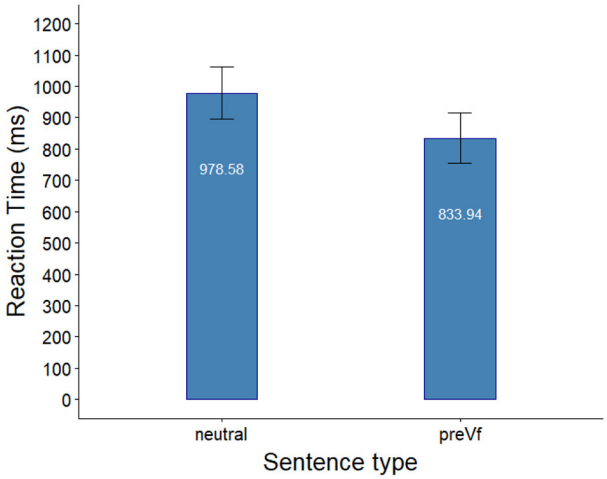

FIGURE 3 | Response latencies in the same-condition in Experiment 2. Error bars indicate the standard error of the mean.

Accuracy data obtained in the Different probe conditions are presented in **Figure 4**.

We built logistic mixed effects models using binomial distribution to analyze Accuracy in the Different probe conditions. The predictors Sentence type and Probe type were contrast coded using the effects R package by Fox and Sanford (2019). Random factors included random intercept for Participant and random intercept for Trial. Addition of further random factors led to non-convergence. Models were successively built by adding fixed effects to an intercept only base model. Addition of Probe Type resulted in a better fit [$\chi^2_{(1)} = 15.266$, $p < 0.001$] showing worse performance in the case of semantically related probes, and crucially, so did addition of Sentence Type [$\chi^2_{(1)} = 6.794$, $p = 0.01$] indicating that participants' memory performance was worse in the PreVf sentence condition. However, inclusion of the Probe Type × Sentence Type interaction term did not improve fit [$\chi^2_{(1)} = 0.134$, $p = 0.714$]. The specification and parameter estimates of the best fitting model are presented in **Table 4**.

As a final step, we analyzed RTs of the correct rejections in the Different probe conditions [PreVf—semantically related: $M_{RT} = 997.130$ (1147.003), contextually related: $M_{RT} = 975.848$ (1194.569); Neutral—semantically related: $M_{RT} = 879.031$ (916.145), contextually related: $M_{RT} = 916.259$ (923.020)]. In the statistical analysis, we included Probe Type and Sentence Type as contrast coded predictors. The random effect structure of the models was random intercept for participant and random intercept for trial. First, a base model was built and the two predictors were added in two successive steps. Models were compared using the likelihood ratio test. Addition of Probe Type did not result in a better fit [$\chi^2_{(1)} = 0.078$, $p = 0.779$], and neither did the inclusion of Sentence Type [$\chi^2_{(1)} = 0.024$, $p = 0.878$] indicating that none of the two predictors had an effect on RTs.

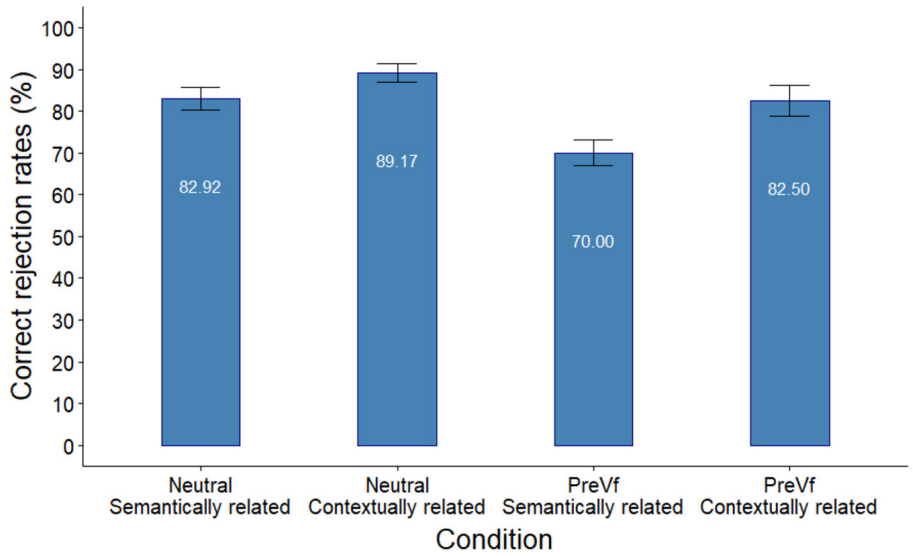

FIGURE 4 | Accuracy rates in the different probe conditions in Experiment 2. Error bars indicate the standard error of the mean.

TABLE 4 | The specification and parameter estimates of the best fitting model predicting accuracy in the Different probe conditions in Experiment 2.

accuracy ~ probe_type +
sentence_type +
(1 | Participant) +
(1 | Trial), family = binomial

	Estimate	Std. Error	*z*	*p*
Intercept	1.858	0.209	8.887	<0.001
Probe type	0.360	0.091	3.932	<0.001
Sentence type	0.399	0.147	2.707	0.007

Discussion

Experiment 2 investigated the memory accessibility and representation of the focused element and its alternatives in the case of preVf as measured by response accuracy and RTs of correct responses on a delayed recognition memory test. In delayed recognition memory tests we assume that participants are not able to rely exclusively on processes for maintaining information in WM. Regarding the focused element, we found a tendency toward a difference in accuracy rates opposite of what we predicted: memory performance for focus seems to be worse than for neutral counterparts in delayed recognition. In the current framework this result is highly surprising, and it is very difficult to offer a non-speculative explanation, especially in the light of results on RT, which suggest that preVf may not have a facilitative effect in a delayed recognition memory task. Note again, however, that there may be some degree of ambiguity in the results, as the experiment contained only six trials in the given condition leading to an insufficient level of statistical power. Nevertheless, the results on accuracy and RT jointly suggest that the lack of facilitative effect in delayed recognition. Indeed, this finding is in line with the results of Spalek et al. (2014), which demonstrated that German focus particles (*nur* and *sogar*) had no facilitative effect on the recall of the focused elements themselves. A potential explanation as to why focus may indeed not have a facilitative effect will be offered in the General Discussion section. With respect to the alternatives (i.e., Different probe condition), the results show that the accuracy of rejections was overall lower for the preVf sentences than for the neutral sentences. This overall effect is a consequence of semantic interference (Baddeley, 1966, 2009; Baddeley et al., 2020) and is in line with the predictions of the focus association account: Since the function of focus is to mark the presence of alternatives, not only the focused element but also its alternatives are activated. Following a delay, these activated elements interfere with each other, which is reflected in the deterioration of memory performance for these items. Also, as in Experiment 1, overall accuracy for semantically unrelated but contextually related alternatives was better than for semantically related alternatives. Just as previously, this was an expected result since the difference between semantically unrelated items is more salient than between semantically related ones. Regarding the restrictive and permissive views of focus alternatives, the lack of interaction does not enable us to adjudicate between the two accounts. Just as in the case of Experiment 1, further refinement of methodology is needed to address the question of what constitutes the set of alternatives in the case of the Hungarian preVf.

Similarly to Experiment 1, none of our predictions regarding RTs have been confirmed: we found no effect of probe type and no effect of sentence type. These results will be discussed jointly with the ones from Experiment 1 in the General Discussion section below.

GENERAL DISCUSSION

The current study investigated the representation and the accessibility of focused elements and their alternatives in the case of Hungarian pre-verbal focus (preVf) in two probe recognition experiments with no delay and with a two-minute delay between encoding and retrieval. The study investigated three main questions related to focus representation in WM, and the accessibility to these representations when one is not able to rely on processes for maintaining information in WM: (i) the accessibility of the focused element, (ii) the activation of the focus alternatives, and (iii) the question of what constitutes the set of focus alternatives. In the following, our findings pertaining to these questions will be discussed.

First, however, a note regarding the use of the preVf construction is due with relation to our research questions. As outlined earlier, focus in preVf is marked by two features: (i) the inverted configuration of the verbal modifier (if there is one) and the verb with the focused element sitting immediately pre-verbally (a syntactic feature), and (ii) the eradicating stress on the focused element (a prosodic feature). One could consider the objection that observing any memory-related effect in the case of this construction introduces an indeterminacy regarding what can be inferred from the data: perhaps, prosody alone would produce the observed effects. However, this objection is hardly tenable, since the Hungarian structural focus is jointly characterized by the immediately pre-verbal position and the eradicating stress assigned to it, even if a verbal modifier is absent from the sentence. In other words, the focus type at hand has two central defining features and any study separately investigating the potential effects of these features would be questionable regarding its content validity. Furthermore, such an objection would render findings inconclusive also on clefts, since focus is also doubly marked in this type of construction, i.e., by syntax and prosody. Finally, since no work has been carried out addressing the issue of memory accessibility and representation of Hungarian focus so far, we decided to start investigating the construction that is the most representative example of Hungarian focus; namely, the pre-verbal focus as presented in (3a).

With respect to the memory accessibility of the focused element in WM, our results are in line with findings in the international literature: response latencies revealed that the focused element is more readily accessible in memory. This finding supports the traditional theoretical and functional definitions (see e.g., von Stechow, 1991; Krifka, 1992) according to which focus highlights or foregrounds information, or, as Sanford et al. (2006) phrased it, focus functions as an attention capturing device.

We believe that this psychological effect is utilized in organizing discourse in a coherent and efficient way. For example, the relatively higher accessibility of focused elements may explain the observations made in the theoretical literature regarding "focused topics." Such phenomena are called continuous-topic constructions, and have been observed in English (Prince, 1978; den Dikken, 2013), German (Huber, 2004), and also in Hungarian (Gécseg, 2020). An example by Kayne (2014, p. 195) is given in (4).

(4) A: Do you know Mary?
B: Yes, in fact it was [Mary] who/that I learned linguistics from in the first place.

Note, that the clefted, i.e., syntactically focused element in B's answer in (4) functions as topic: it encodes an entity that has been introduced into the discourse, and also this entity is the one about which the wh-clause makes a statement. We posit that the reason why such so-called aboutness topics tend to be focused syntactically is that in this way they become more accessible in memory while discourse about the topic unfolds. This mechanism is thus key in efficiently managing discourse by locally enhancing the representation of the entity or entities that are central during an act of communication. Note also, that we found no advantage for the focused element after a delay which also suggests that this property of focus is used for relatively local purposes, such as discourse organization. This consideration is also supported by brain imaging results which have shown that the processing of focus containing sentences activates areas implicated in discourse processing (see e.g., Spalek and Oganian, 2019).

As far as the focus alternatives are concerned, Experiment 1 found no direct evidence for an increased activation in WM as measured by immediate recognition memory performance. However, it must be pointed out that the effect was close to significant, and that the observed accuracy rates showed a tendency in the predicted direction. One might argue that these results suggest that a higher activation of alternatives takes place, while the lack of significant results is a consequence of an insufficient amount of data. Note, however, the pattern of results obtained in the Different conditions in Experiment 2, may serve as independent evidence for the claim that focus *indeed* activates alternatives (just as the close to significant effect in Experiment 1 might also be indicative of this higher activation). We conjecture that the pattern of results in Experiment 2 is the consequence of semantic interference. The interference observed in the case of both probe types was most probably the result of a higher activation of both semantically related and contextually suitable alternatives upon the processing of the focus containing sentences. For this reason, we conclude that the results on the correct rejection rates obtained in the two experiments jointly corroborate the psychological reality of theoretical accounts capturing focusation in terms of evoking alternatives (Rooth, 1992; Krifka, 2008). As far as the restrictive and permissive views on focus alternatives are concerned, however, our results are inconclusive. Thus, further research and a refinement of methodology is needed in order to adjudicate between the two views on what constitutes the set of alternatives.

As far as response latencies of correct rejections in the WM task are concerned, we found that probes with semantically unrelated but contextually suitable alternatives were responded to faster than probes with semantically related alternatives. Additionally, no effect on response latencies was found for

correct rejections in the delayed recognition memory task. It is highly likely that the effect of probe type in WM is associated with relatedness: since contextually related probes contained a semantically unrelated alternative, this probe type was more easily discriminable, which led to faster rejections. We speculate that the reason for why this effect was not observed in the delayed recognition memory is that our measurement was not sensitive enough for the measurement of such effects. Nevertheless, it is much more likely that there is no reliable link between response latencies associated with correct rejections and the activation strength of critical elements, as a number of different processes may be operative during a correct rejection in the tasks used in our experiments. These processes may for example be familiarity-based decisions or "recall-to-reject" processes. Therefore, response latencies may reflect different processes in different trials and different participants within an experiment, making this measure unreliable. This might also be the reason for why we found no effect of sentence type on RT as opposed to accuracies of correct rejections. The investigation of these possibilities requires further experimentation.

Before turning our attention to other aspects of our findings, let us discuss an alternative explanation of results also mentioned in section Discussion. According to this interpretation, the observed benefit of preVf on the correct rejection of alternatives in WM may have been the result of novelty instead of the generation of alternatives: perhaps, due to the attention controlling properties of focus, the focused elements had a higher activation, and consequently, the rejection of any element sitting in the focus position of the probe sentence may have been easier. If this was indeed the case, it is difficult to clearly understand why a worse performance was observed in the case of both probe types in the PreVf sentence condition in Experiment 2: only those elements can interfere that gain some level of activation.

Regarding the accessibility of focused elements in Experiment 2, as measured by delayed recognition memory performance (i.e., when one is not able to rely on WM processes), we found no reliable results. Accuracy results suggest a tendency in the opposite direction of what we predicted: memory performance seems to be worse for focus than for neutral sentences. However, we found no evidence for this effect in the RT data. As mentioned earlier, these results were not predicted by any of the focus representation accounts: while Fraundorf et al. (2010) found a facilitative effect on the accessibility to prosodically focused elements, Birch and Garnsey (1995) and Almor and Eimas (2008) found an adverse effect for syntactically focused elements. There was, however, one study which showed that elements marked by the German focus particles *nur* (*only*) and *sogar* (*even*) were not retrieved at a higher rate than elements without these particles (Spalek et al., 2014). Since our results are inconclusive regarding the accessibility of focused element in delayed recognitions, the question should be investigated in future studies.

One explanation for why there indeed may be a lack of enhancement in Experiment 2 is that the gist of the sentences is retained in memory for longer periods of time, while their exact syntactic realization is lost (see e.g., Sachs, 1967; Johnson-Laird et al., 1970; Samuel, 1972; Flores D'Arcais, 1974; Graesser and Mandler, 1975; Gernsbacher, 1985; Anderson et al., 2001). In the above studies, gist is defined as the semantic representation of the sentence as opposed to the representation of its surface form, or more specifically, a representation which may, for instance, eliminate the distinction between an active and a passive sentence. In other words, gist is nothing more than the core meaning of a sentence (Anderson et al., 2001). In the case of preVf and neutral sentences used in our experiments, it is reasonable to assume that the gist of these sentences was equivalent to the relation that they expressed between the subject and object determined or modified by the adverb. For example, in the case of the sentence *Miki [egy tányért]$_{Foc}$ rakott be a szekrénybe* (∼ *Mike put [a plate]$_{Foc}$ in the cupboard*), the gist is the relationship between the plate and Mike such that the former was put into the cupboard by the latter. However, one might raise the objection that exhaustivity is also part of the core semantic meaning of preVf sentences, as opposed to neutral sentences, in which exhaustivity is not assumed to be represented semantically. Such theories, however (see e.g., Kiss, 1998; Kenesei, 2006) have not been supported by experimental data (see e.g., Onea and Beaver, 2009; Kas and Lukács, 2013; Gerocs et al., 2014; Káldi et al., 2016; Káldi and Babarczy, 2018). Furthermore, recent experimental evidence suggest that the use of focus may not only be strictly motivated by linguistic factors, and that these factors should be best seen as pragmatic ones (Stevens and Roberts, 2019; Káldi et al., 2020). Therefore, we contend that the gist of the two sentence types at hand were the same in our experiments. Their apparent syntactic and prosodic differences belong to their surface characteristics.

The explanation relying on the assumption that the gist is retained as opposed to the form for longer periods of time becomes especially plausible, if we consider one of the central functional properties of focusation: namely, focus serves to organize discourse, partly by introducing new referents. Consider the dialogue in (5) in which A's question requests the identification of the individuals invited by John. The answer in B1 is acceptable, since the element carrying new information is marked for focus, while the answer in B2 sounds rather odd, since the respective element sits post-verbally (for further theoretical explanation see Roberts, 1998; Surányi, 2011, for experimental results see Káldi et al., 2020).

(5) A: Kit hívott meg János?
Who did John invite?
B1: János Marit hívta meg (preVf)
John invited 'Mary.
B2: #János meghívta Marit (neutral)
John invited Mary.

Note, however, that the "gist" of the two answers in (5) is the same: there is a relation between John and Mary such that the former invited the latter. The information structural properties of the sentence realized in a particular syntactic construction in the case of preVf serves local discourse purposes. For this reason, the syntactic form of the sentence may lose

its relevance for longer periods of time and is not retained in memory. The gist, however, is retained irrespective of the syntactic structure as revealed by the relatively high recognition rates. We believe that the above considerations may open up a new line of research studying the interrelation of syntactic structure and information structure in memory (for one such study see Pléh and Sinkovics, 2011). As noted earlier, our results are suggestive of, but inconclusive regarding the longer effects of focus on memory representation. Hence, we propose that the above outlined explanations should be considered as a basis for further research on the long term accessibility to focused elements.

With respect to both semantically and contextually related focus alternatives in the delayed recognition memory task, we found that memory performance for these items was poorer than for alternatives to non-focused counterparts. On the face of it, two explanations offer themselves for the observed results. One of these has already been mentioned: the poorer recognition rates may be attributable to semantic interference generally observed when there is a delay before retrieval (e.g., Baddeley, 1966, 2009; Baddeley et al., 2020): focus activates the representation of alternatives (as also suggested by the results of Experiment 1), and these highly activated semantic representations interfere with each other. The interference leads to low recognition rates. Alternatively, since the experimental task was to decide if the probe was identical to the target (i.e., old) or it was different (i.e., new) we can say that the observed poorer performance is not the result of a lower tendency to correctly recognize the critical element, but it is the result of a greater tendency to falsely recognize it. The effect of creating false memories at the level of associated items has been extensively studied and repeatedly replicated in the memory literature (Deese, 1959; Underwood, 1965; Anisfeld and Knapp, 1968; Hintzman, 1988). For example, Roediger and McDermott (1995) presented lists of associated words to their participants which had to be recalled or recognized after a 5-min delay. The main finding of the study relevant to our purposes was that recognition memory was affected by the semantic association between list items: the proportions of hit rates and false alarm rates were identical suggesting that participants had not been able to distinguish between actually presented items and items that had not been presented in the lists. According to Roediger and McDermott (1995, p. 810) the effect is "produced by means of activation of implicit associative responses." Thus, one may raise the objection that the effect observed in the Different probe condition of Experiment 2 is at least partly attributable to this activation mechanism. However, it is hard to see how focus could modulate this mechanism without assuming that it indeed activates alternatives. To conclude, the most plausible explanation is that the lower rate of correct rejections in the case of preVf sentences was the result of a greater semantic interference of activated alternatives. This explanation is also in line with other findings in the literature (see e.g., Spalek et al., 2014; Gotzner, 2017).

In sum, the present work investigated the memory accessibility of linguistically focused elements and their representation in WM and when one is not able to rely on processes for maintaining information in WM in the case of the Hungarian pre-verbal focus construction. It has been shown that focus enhances the accessibility of the focused element in an immediate recognition memory task and most probably it has no facilitating effect on a delayed recognition memory test indicating a dissociation between WM and delayed recognition memory performance. While the former effect can be explained by the attention capturing property of focus (Brassai, 1860; Sanford et al., 2006), the latter observation may be attributable to the tendency that gist is retained longer than form. Furthermore, we have provided indirect evidence that preVf evokes the representation of a set of alternatives. This indirect evidence comes from the finding that the memory performance for focus alternatives is poorer for longer periods of time: this effect is most probably the result of semantic interference, for which the best explanation is that focus does activate alternatives in WM.

Finally, let us discuss two potential methodological limitations of our study. One of the limitations concerns tendencies toward a difference regarding sentence type in the Different-conditions in Experiment 1, and in the Same-condition in Experiment 2. As pointed out earlier, these almost significant results may have been the consequence of an insufficient amount of data, as the number of trials in the conditions was rather low. It is highly likely that this has lent some ambiguity to our results. Reducing the number of conditions would enable the future researcher to increase the trials in one condition without dramatically increasing the length of the experiment. The other potential limitation concerns RT measures. Note that while earlier studies, such as Fraundorf et al. (2010), Gotzner and Spalek (2016), etc., used words as probes, our experiments used sentences. This may have led to a substantial variability in the measured RT values which also makes it difficult to formulate solid conclusions regarding our research questions. However, we firmly believe that the results presented here are valuable for both the psycholinguistic theories of focus in general and for the Hungarian focus in particular, and that the limitations outlined above will motivate further research on the issues at hand.

As far as the methodological novelty is concerned, since both experiments used exactly the same stimulus set (auditorily presented stories followed by probe sentences), and they only differed in terms of the timing of recognition probes, the principle of ceteris paribus fully applied with respect to how we addressed our research question regarding the two different memory processes. Thus, to our knowledge, this is the first study that investigates the focus representation accounts for WM and delayed recognition of focus alternatives in this principled manner. Also, no study has been conducted on the memory representation of focused elements and their alternatives in the case of the Hungarian pre-verbal focus construction.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Hungarian United Ethical Review Committee for Research in Psychology. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

TK conceived of the presented idea. The experimental materials were created and recorded by TK and ÁS. Data analysis was carried out by TK with the supervision of AB. The manuscript was written by TK with support of AB and ÁS. All authors were involved in the development and refinement of the methodology of the experiments.

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Verbing and Linguistic Innovation

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Denominal verbs are produced by a syntactic category shift, *conversion*, in which the word's inflectional and combinatory potential change while its internal composition does not (Valera, 2015: 322). Perhaps no language owes as many of its verbs to the conversion strategy as English (Koutsoukos, 2021), the majority being denominal (noun-derived) verbs, e.g., *Widespread seedless cultivars typically* fruit *twice yearly in the Caribbean*. Denominal conversion has been the predominant method of verb creation since the 13th century (Gottfurcht, 2008), with the result that denominal verbs present a continuum of conventionality ranging from conventional verb-phrase replacements like *paint, trash, pocket, mother* to evanescent innovations like *adulting* and *criming*. Language users must rely on certain inferential strategies to figure out what novel denominal verbs mean, combining information from multiple sources, including salient properties of the source noun's denotatum, the event structure of the clause in which that noun serves as a predicator, and socio-cultural knowledge. How exactly does this work? Our answer recalls the major lessons of Clark and Clark's seminal 1979 paper "When Nouns Surface as Verbs": denominal verbs have context-dependent rather than fixed meanings, and their interpretations rely on cooperation between speaker and hearer. These are lessons seemingly forgotten by proponents of recent, influential derivation-based accounts, which leverage the formal similarity between denominal verbs and noun-incorporating verbs like *backstab* and *manspread*. While, as discussed here, syntacticized approaches to semantic representation fail to account for the interpretive latitude that denominal verbs actually display, there are reasons to reject a strong view of context dependence as well. For Clark and Clark, interpretations of innovative denominal verbs either directly reflect criterial features of their source nouns or are *ad hoc*, derived from "moment-to-moment cooperation," including gestures, allusions, and "other momentarily relevant facts about the conversation" (1979: 783). We argue that denominal interpretations are more tightly regulated, and involve reconciling the results of four distinct interpretive strategies: nominal frame computation, verb-construction integration, co-composition and, finally, conceptual blending. To describe these interpretive strategies, we bring to bear a suite of analytic tools developed to model everyday language understanding: Construction Grammar (Michaelis, 2004; Goldberg, 2006; Michaelis, 2011), enriched composition (Pustejovsky, 1998; Pustejovsky, 2012), Conceptual Blending Theory (Fauconnier and Turner, 2004), and Frame Semantics (Fillmore, 2006; Andor, 2010). In line with Clark and Clark's (1979) convention for the interpretation of innovative denominal verbs, we argue that nouns used in innovative denominal formations are chosen based on relational properties of entities denoted by those nouns, whether common or proper (e.g., shape, behavior, composition,

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use, provenance). At the same time, the descriptive framework that we propose leaves fewer interpretive factors to vagaries of context.

Keywords: frame semantics, denominal verbs, lexical semantics, argument structure, linguistic innovation, conceptual blending, construction grammar

INTRODUCTION

In the approach to meaning taken by Grice (1957), Grice (1989) and other proponents of ordinary language philosophy, acts, including linguistic acts (utterances), are meaningful insofar as they are performed with intention. In Grice's account, it is the audience's recognition of the intention behind a linguistic act that gives it its meaning. This account is vulnerable to the "Humpty Dumpty objection": an utterance cannot be used to mean whatever the utterer wants it to (Batty, 2008); both the words and the structure of the sentence play a key role in its successful interpretation, particularly if it is novel or non-formulaic. At the same time, however, word meaning shifts are a staple of language play and verbal art. As Grice observes, "what a speaker or writer means by a sign on a particular occasion. . .may well diverge from the standard meaning of the sign" (1989: 197). This article suggests that determining the meaning of a novel sentence, in particular one containing a novel denominal verb, requires the interpreter to weigh intrinsic evidence (lexical meaning) against extrinsic evidence (syntactic context, utterance context, mutual knowledge).

A denominal verb is the product of a syntactic category shift (from noun to verb). It refers to a state, event or process that involves an instance of the class of entities denoted by the source noun. The derived word's status as a verb is signaled indirectly—by its inflectional and combinatory behavior rather than by its internal composition. For example, in *Colin watered his neighbors' plants* we know that *watered* is a verb both because it contains the past-tense ending *-ed* and occupies the head-word slot in the VP *watered his neighbors' plants*. This covert strategy is sometimes referred to as *conversion*: "a word-formation process where the form of the converted item does not change, while its inflectional potential, its syntactic function and its meaning do, such that the item displays inflectional, syntactic and semantic properties of a new word class" (Valera, 2015: 322). Perhaps no language owes as many of its verbs to the conversion strategy as English does (Koutsoukos, 2021). Denominal conversion has been the preeminent way we coin verbs since the 13th century (Gottfurcht, 2008). But conversion does not always yield new verbs. A denominal verb is just as likely to be a nonce formation—never to reappear. Novel denominal formations are often vehicles for humor, figuration, caricature and social commentary—sometimes all at the same time. On August 13, 2020, comedian George Wallace posted the tweet shown in (1):

1. 

The nonce verb *Herman Cain* is unlikely to outlive the curious episode alluded to in Wallace's tweet: for weeks after his death from coronavirus (contracted at a Trump rally), business man and Tea Party activist Herman Cain continued to "tweet from the grave", in one instance expressing doubt about the deadliness of the virus. For our purposes, what is interesting about the nonce eponymous verb *Herman Cain* is that it is allusive, evoking, through its syntax, idiomatic expressions of "laying waste", e.g., *blast/tear/smash the x out of y* (Schönefeld 2018). While using an unconventional verb, Wallace nonetheless relies on conventions about the use of language (Searle, 1975; Morgan, 1978). Clark and Clark's *innovative denominal verb convention* (IDVC; 1979: 787) captures such a convention of use:

In using an innovative denominal verb sincerely, [a] speaker means to denote

(a) the kind of situation
(b) that [they have] good reason to believe
(c) that on this occasion the listener can readily compute
(d) uniquely
(e) on the basis of their mutual knowledge
(f) in such a way that the parent noun denotes one role in the situation, and the remaining surface arguments of the denominal verb denote other roles in the situation.

When the "parent noun" is a proper noun, as in (1), Clark and Clark say that it is a contextual expression rather than a denotational one, because its meaning relies on shared knowledge about known persons and circumstances, and not properties intrinsic to the class of entities denoted by the parent noun (1979: 785). At the same time, however, the proper noun *Herman Cain* does not simply name a famous person; in the context of (1) it is a relational noun—meaningful only inasmuch as it serves to conjure the components of an act of retribution (the offense, the betrayers, the act of betrayal, the act of vengeance). What this suggests is that a noun (or other word) has the import it does when deployed in sentence not because of criterial properties of category referred to, but rather because of the scenes in which we can imagine entities of this type playing a role (Fillmore 1976). Accordingly, our approach to the meaning of denominal verbs is based on the frame-semantic framework developed by Charles Fillmore. Fillmore, 1969 (163) suggests that nouns and verbs have analogous arrays of semantic dependents and therefore denote similar situations (the basis of the FrameNet lexicon[1] that he later developed). Take, for example, the Framenet frame REVENGE, which includes the following frame elements (FEs): Offender, Injured party, Avenger and Punishment. Fillmore observes:

The words that evoke [the REVENGE] frame include simple verbs like avenge, revenge, retaliate; *phrasal verbs like* pay back;

[1]See the Framenet indices at https://framenet.icsi.berkeley.edu/fndrupal/.

TABLE 1 | *Categories of English denominal verbs* (based on Gottfurcht 2008: 100).

Class	Event structure	Example
Result	x causes y to become [source-noun']	*I powdered the pills*
Agent	x acts as [source-noun']	*We nerded out in this podcast.*
Performance	x enacts [source-noun']	*They tangoed.*
Theme	x causes [source-noun'] to go to or from a location	*They mudded the walls. She shelled the nuts.*
Locative	x causes y to go to [source noun']	*She bagged groceries.*
Instrument	x uses [source noun'] to perform some action	*Sue hammered the metal flat. I ubered over to campus.*

phrasal verbs with preposition-selections like get even (with), get back (at)*; support phrases like* take revenge, wreak vengeance *and* exact retribution*;* ***nouns like* vengeance, retribution, revenge***; and several more* (Andor 2010: 164; authors' emphasis).

If nouns, like verbs, evoke frames, then the semantic-role arrays that nouns have when converted to verbs have an obvious source: the frame or frames of the parent noun. In fact, the richness of the conceptual network in which a noun is embedded may be the reason the noun was a good candidate for conversion in the first place. According to the IDVC, a denominal verb can be classified according to the semantic role that the entity named by the source nominal plays in the event described by the sentence. **Table 1** gives a partial list of these categories, adapted from Gottfurcht, 2008, and incorporating labels and categories from Clark and Clark (1979), Kiparsky (1997), Plag (1999), Lieber (2004).

In **Table 1**, informal event-structure descriptions are used to capture the participant role of the source-noun denotatum. This classification scheme implies that each denominal verb is uniquely classifiable as Theme, Locative, Instrument, etc., and that each verb's classification is predictable from criterial features of the source-noun category. Clark and Clark (1979: 789) postulate that when source nouns of denominal verbs are grouped according to salient physical characteristics (e.g., shape), ontogeny (e.g., material) and function, the resulting classes "correspond closely [. . .] with the classes and subclasses [arrived at in the] analysis of denominal verbs". For example, words that denote transportable objects (like *water*) commonly give rise to Theme verbs, words for shapes (like *braid*) commonly give rise to Result verbs, words for vehicles (like *truck*) commonly give rise to Instrument verbs, etc. Clark and Clark, however, see these salient features as subject to override in context:

To select the unique sense intended on a particular occasion, the listener must decide which of the possible senses is most salient. Generally [they] can look to the predominant features of the generic theory associated with the parent noun, which will always be fairly salient. But salience is a relative notion, and depends on context (Clark and Clark 1979: 795).

The denominal verb *trash*, for example is both a Result verb "turn x into trash" (e.g., *I know you trashed my light-up Santa!*) and a Theme verb "place trash in x" (e.g., *Who is trashing the Columbia River gorge?*). As shown in **Table 1**, there is typically more than one semantic dependent in a predication containing a denominal verb. For example, while the instumental denominal verb *Uber* evokes the vehicle used in an act of directed motion in *I ubered over to campus*, it does so only in the context of a sentence in which the subject NP denotes the agent of that action and a directional PP denotes the goal of that action. This is so because predications express complex events involving motion (movement along a path) and causation (manipulation of entities, change of state/location). Studies in the tradition of semantic analysis pioneered by Clark and Clark (1979) offer insights into the mechanisms by which words referring to entities are integrated into contextually evoked event structures. Kiparsky (1997: 482) proposes an interpretive principle for denominal transfer verbs that "[i]f an action is named after a thing, it involves a canonical use of the thing". This principle could be used to explain why, for example, we would not refer to a tour guide allowing tourists inside a jail cell on Alcatraz Island as *jailing the tourists* (jail cells are designed to prevent suspected or convicted criminals from escaping). There are abundant exceptions to this principle, including the use of the denominal verbs *egg* and *toilet paper*, respectively, to the use of these items in acts of vandalism (e.g., *Woke up one morning to a front yard that had been completely toilet papered*). Noting that context may sometimes override subjects' object-affordance computations, Kaschak and Glenberg (2000) and Schönefeld (2018) conclude that the interpretation of a denominal verb relies on the grammatical construction in which it is embedded, especially in novel uses. Neuroimaging studies (e.g., Thierry et al., 2008) suggest that while subjects perceive novel denominal tokens from Shakespeare as formal anomalies (reading a novel denominal sentence triggers the P600 brainwave pattern associated with detection of word-inflection errors), such tokens are construed as semantically sensical, despite high integration costs (Thierry et al., 2008 find they also evoke the LAN brainwave pattern characteristic of revaluation of semantic content). This interpretive effort presumably involves a cascade of inferences. First, the interpreter must recognize that the noun in the context at hand has neither the syntactic behavior nor the ordinary referring properties of this noun lexeme. Second, cued by the syntactic context, the interpreter must retrieve the coarse event-structure in which the entity denoted by the noun would play a semantic role. Third, the interpreter must identify the real or imagined entity that fills that semantic role. Fourth, the interpreter must find the rationale for the syntactic-category shift in question. This would involve constructing a specific scenario that adheres to the general schema "event initiated by causal agent." How might these inferences work in the case of the novel *Herman Cain* example in (1)? While *Herman Cain* is a proper name, its referential properties are overridden in this context, in which *Herman Cain* is the complement of the modal verb *can*. *Herman Cain* is not merely a verb in this context, but an agentive verb of removal, in particular ("verb the *x* out of *y*"). To

translate our knowledge of the historic person Herman Cain into a Cain-type event, we must align entities from Cain's biography with verb roles: we identify the subject of the verb (George Wallace) with the agent of an act of destruction by artillery fire, the 8,000 stockpiled tweets with the ammunition and Twitter with the "place" being destroyed.

Understanding (1) requires an interpreter to combine disparate things: biographical details and semantic scripts of the kind that can be read off grammatical structure. This in turn suggests that interpreting a novel denominal verb is matter of optimization—finding the best fit between a nominal sign's constellation of semantic dependents and the syntactic pattern in which that sign is embedded. This procedure is neither pure syntax nor pure pragmatics. The purpose of this article is thus two-fold. First, we hope to show that neither rule-based nor mutual-knowledge-based approaches capture the combination of intrinsic factors (semantic properties of source nouns) and extrinsic factors (features of clausal and utterance context) that yield novel denominal interpretations. Second, we will demonstrate that a suite of analytic tools developed to model everyday language use and understanding provides a refined picture of the interpretive work that language users do when they encounter novel denominal verbs in context. For Clark and Clark, interpretations of denominal verbs either directly reflect predominant features of their source nouns or are *ad hoc*, derived from "moment-to-moment cooperation" including gestures, allusions, and "other momentarily relevant facts about the conversation" (1979: 783). We argue that denominal interpretations are more tightly regulated, and involve reconciling the results of four distinct interpretive strategies: nominal frame computation, verb-construction integration, co-composition and, finally, conceptual blending (including metaphorical mapping). One basic lesson for scholars of denominal meaning and use is that the nouns that become source nouns for innovative denominal formations are selected for this purpose because they are, in Fillmore's words, "semantically thick"—closely connected (through metaphor, metonymy, and other conceptual relations) to many other lexical concepts. Thus, denominal verb formation is not a matter of creating an argument structure for a noun, but rather one of exploiting semantic associates that the source nominal already has. Clark and Clark make much the same point, when they say that "[m]ost [denominal] verbs [. . .] should reflect the predominant features of the entities denoted by their parent nouns" (p. 793). The present work differs in its treatment of those innovative denominal formations whose interpretations come not from source-noun features, but rather from cues provided by the clausal context. The conventional denominal verb *clock* provides a simple illustration of this point:

2. Departure: I *clocked* out and gave Nancy my time card to cut me my last pay. (COCA)[2]
3. Measure: The radar *clocked* the pitch at 100 mph. (COCA)
4. Attack: Went upstairs, and I *clocked* the guy in the face. (COCA)

While (2–3) appear to belong to the Instrument class, (4) arguably belongs to the Locative class (with the locative source noun *clock* metaphorically representing a face). The distinct senses (departure, measure, attack) are products of syntactic context—the use of the directional particle *out* in (2), the use of a measure expression (*at 100 mph*) in (3), the animate direct object and body-part expression (*in the face*) in (4). While these verb senses derive from shared knowledge about clocks, they also rely on particular constellations of elements surrounding the verb.

The remainder of this article will be structured as follows. We will first discuss why derivational approaches (both transformational and lexical-rule-based) are unworkable, using attested innovative denominal verbs to illustrate (Why Derivational Approaches to Denominal Meaning do Not Work). Following this, we will discuss reasons to reject a strong view of context dependence, as represented by the IDVC (What the IDVC Does Not Capture). In Tools for Verbing Analysis, we will outline the integration-based approach to denominal interpretation by bringing to bear a suite of analytic tools developed to model everyday language understanding: Construction Grammar (Michaelis, 2004; Goldberg, 2006; Michaelis, 2011), co-composition (Pustejovsky, 1998; Pustejovsky, 2012), Conceptual Blending Theory (Fauconnier and Turner, 2004), and Frame Semantics (Fillmore, 2006; Andor, 2010). We will then provide extended illustrations involving three innovative denominal formations, two of which are Shakespeare coinages of the type noted by Thierry et al., 2008 (Application). A brief conclusion (Discussion) follows.

WHY DERIVATIONAL APPROACHES TO DENOMINAL MEANING DO NOT WORK

An influential account of denominal verbs treats them as the output of a syntactic derivation in which the constituent containing the source noun is adjoined to an unpronounced head verb representing a causal action (Hale and Keyser, 1993; Hale and Keyser, 2002). Sentence (5), for example, is said to be derived from (6) *via* movement of the PP *in the corral* to the head position of the verb, where it forms a compound verb (*put-in-the-corral*), thus deriving the denominal *corral*:

5. They corralled the mustangs.
6. They put the horse in the corral.

In this account, the most embedded constituent, *corral*, provides the phonological material for the matrix verb, and semantic conditions prohibit the overt instantiation of the incorporated constituent (as in, e.g., **John corralled the horse in the corral*). The incorporation account is implausible in numerous respects (McIntyre, 2016). For instance, in the attested *I know how to canoe a canoe* (COCA), the oblique

[2]The tag *COCA* follows an example retrieved from the Corpus of Contemporary American English (Davies 2008), while the tag NOW indicates an example retrieved from the News on the Web corpus (Davies 2013).

locative expression is overtly instantiated despite its putative incorporation into the noun. A collateral concern is just what happens to the prepositional head in the course of the derivation. An additional issue, noted by both Harley (2005), Rimell (2012), is that the account must assume incorporation of adjunct NPs, which are not sisters to the verbal head in configurational syntax, in order to represent instrumental denominals like *hammer* and *drill*. Another issue concerns the status of agent denominals like *parent* (one's children), *captain* (the ship), and *parrot* (propaganda). As McInytre (2016) observes, agent denominals are unpredicted because incorporation of specifiers (subjects) is barred by the Hale and Keyser account.

A lexical-rule-based account of denominal formation proposed by Michaelis and Ruppenhofer (2001) faces its own problems. According to their proposal, the derivation that creates a verb from a noun preserves the frame-semantic structure of the source noun: arguments may be added to the source noun in the course of this derivation but not removed. Denominal cases like those in (7–8) show that the argument roles selected by source nouns and their corresponding derived verbs may differ in a way that undermines a derivational view:

7. In January, someone keyed her car and her husband's truck (NOW)
8. The new laws would increase penalties for drivers who door a cyclist (NOW)

Both (7) and (8) are self-evident exceptions to Kiparsky's canonical-use constraint. Neither denominal formation describes a canonical use of the source-noun referent (key, door). The frame-semantic analysis of *key* involves an agent who gains access *via* an instrument to a location. It does not include causing damage to a car. By the same token, the FrameNet analysis of *door*, based on the frames Connecting Architecture and Vehicle Subpart, does not include a cyclist victim. We will take up the semantic analysis of these cases in the sections below on co-composition and conceptual blending.

WHAT THE IDVC DOES NOT CAPTURE

Our account draws heavily on the Clark and Clark approach, in particular in our emphasis on the manner in which novel denominal verb formations exploit relational properties of source noun denotations, as well as the manner in which contexts of use select the relevant relational properties. We differ in the way we characterize both the properties of nominal denotations and the selective contexts. Clark and Clark's focus is on predominant features (qualia) of common-noun denotata. For example, they point out that the noun *brick* denotes a class of objects with a particular shape, function and material composition, and therefore that the sentence *They bricked the ice cream* could refer in various context to shaping the ice cream, using it as a structural component, placing it on a brick surface, smashing it with a brick, or even hardening it to a bricklike consistency. We view the properties not as features of nominal designata but rather as frame-semantic networks evoked by source nouns. Frame semantics is a theory of lexical structure rather than of criterial properties for category membership. We think the frame-semantic approach offers a more flexible way to describe the semantic dependents of denominal verbs formed from proper names, as in the Herman Cain example in (1) above. Herman Cain is not a category of things but a historic person, whose biography contains various frames of the type recognized by FrameNet, including Personal Success (Person), Political Actions (Activist), Communication (Communicator), Death (Protagonist), and Revenge (Avenger). It is the clausal syntax that in (1) instructs us to foreground the Avenger role, and to evoke additional roles, Weapon, and Offender, that also map to grammatical roles in the clause. We thus view selective contexts not as particular conversational contexts but rather as syntactic constructions that trigger analogical processes like metaphorical mappings. In this connection, it is critical to note that the IDVC is incorrect in one of its crucial particulars. A major tenet of the IDVC is that "the parent noun denotes one role in the situation, and the remaining surface arguments of the denominal verb denote other roles in the situation" (Clark and Clark 1979: 787). This rule is inapplicable to agentive denominals like (9):

9. Davis apprenticed with Francis Ford Coppola (COCA)

The parent noun *apprentice* in (9) does not denote the agent role; rather, this role is expressed by the subject NP, *Davis*. In a frame-semantic approach, source nouns do not denote roles. Rather, they evoke semantic frames, which are defined as constellations of roles. The syntactic expression of these roles is the job of argument-structure constructions, not "context" in a general sense.

Denominal interpretation and syntactic profile are so tightly connected that a denominal reading is often unavailable except in a single argument-structure configuration. This is so for Agent denominals *nerd out, geek out* and *freak out*, all of which require the particle *out* despite differing in transitivity; the Theme denominals *suit up, gown up* and *mask up*, all of which require the *particle up*, and the Agent denominal *boss*, typically transitive and paired with the particle *around*, e.g., *Our leaders bossed around the world*. These syntactic facts do not follow from criterial features of the source noun denotata, nor does the fact that several of these denominal verbs are exclusively figurative (e.g., a person who bosses someone else around is not a literal boss). Such findings suggest we must combine syntactic, semantic and pragmatic approaches to the interpretation of novel denominal verbs, to capture the interplay of event structure, metaphor and linguistic convention.

TOOLS FOR VERBING ANALYSIS

In this section we will outline the integration-based approach to denominal interpretation by describing a suite of analytic tools developed to model everyday language understanding: Construction Grammar (Michaelis, 2004; Goldberg, 2006; Michaelis, 2011), co-composition (Pustejovsky, 1998; Pustejovsky, 2012), Conceptual Blending Theory (Fauconnier

TABLE 2 | *Argument-structure constructions (adapted from* Goldberg 1995*)*

Construction type	Argument structure	Semantic properties	Denominal example
INTRANSITIVE	<NPx>	X acts in some manner	*Trump bullies.*
DIRECTED MOTION	<NPx, PPy>	X moves toward Y	*A smile ghosted over her face.*
SIMPLE TRANSITIVE	<NPx, NPy>	X acts on Y or X experiences Y	*We pimped our ride.*
DITRANSITIVE	<NPx, NPy, NPz>	X causes Y to receive Z	*I handed them the report.*
CAUSED-MOTION	<NPx, NPy, PPz>	X causes Y to move to Z	*I let Mom guilt me into it.*
RESULTATIVE	<NPx, NPy, XPz [PRD +]>	X causes Y to become Z	*She oiled her hair smooth.*

and Turner, 2004), and Frame Semantics (Fillmore, 2006; Andor, 2010). We believe that these tools help us to describe both novel and entrenched denominal verbs that exhibit certain puzzling properties. The denominal verb *railroad*, as in (10), illustrates these properties. Each property is listed below along with the analytic tool meant to address it:

10. They sort of felt like Steve Jobs had railroaded them into that deal. (COCA)
    - Argument structure: The verb *railroad* is syntactically restricted: it is invariably found in the causative pattern shown in (10), with a PP headed by *into* and a noun or gerund denoting an intentional act.
    - Frame semantics: While *railroad* could be regarded as an Instrument denominal ("transport x by railroad") it is used only figuratively in COCA, to mean "to induce x to act forcibly."
    - Co-composition: Relatedly, the theme argument (direct object) of *railroad* in COCA is always an intentional actor, never, e.g., supplies or other resources that could be transported by railroad.
    - Blending: While causes are commonly viewed as forces,[3] the metaphor underlying the verb *railroad* does not preserve many aspects of source-domain structure: people ride on trains rather than being pushed by trains along a railroad track.

We describe each of these tools in what follows.

Construction Grammar and Constructional Accommodation

In Construction Grammar (CxG; Goldberg 1995; Michaelis 2004), the meaning of a sentence is determined by the combination of the lexical verb's core meaning with the basic event type (constructional meaning) conveyed by the construction with which the verb combines, referred to as an argument-structure construction (ASC). For our purposes, ASCs may be viewed as phrasal templates with verbal heads. **Table 2** shows major English ASCs.

When a verb combines with an ASC, its semantic roles are identified or "fused" with the semantic roles each ASC assigns. Verbs may combine with ASCs to which they are semantically mismatched, resulting in augmentation of the verb's "native" array of semantic roles. A commonly cited case involves the integration of an intransitive verb with the Caused Motion construction:

11. Liberty swam.
12. *Liberty swam the woman.
13. Liberty swam the woman to shore.

Examples (11) and (12) suggest that verbs like *swim* are used only in intransitive environments. How can we square this with examples like (13), in which the verb combines with a direct object and a directional expression? The syntactic flexibility illustrated by (13) is prevalent in English; creating a new lexical entry for each novel verb use (e.g., a trivalent caused-motion version of *swim*) would introduce pointless redundancy, and it would not capture the insight that many novel verb uses are nonce uses: they serve an expressive purpose in a particular context but may never become conventionalized. Using CxG tools, we account for this aspect of linguistic creativity in an intuitive way: ASCs have their own meanings and semantic role arrays, and the kind of event or relation expressed by a verb is ultimately determined by the ASC in which that verb is embedded. The application of this analysis, sometimes referred to as a *constructional accommodation* analysis, to the conversion strategy that produces denominal verbs is straightforward: the language user combines a noun like *oil* with an ASC like the Simple Transitive construction, and the word gains the combinatoric behavior characteristic of the simple transitive verb class. The ASC has a dispositive role in interpretation when the source noun participates in multiple frames. One such case is the noun *water*. When an agent is in the subject, water belongs to the Irrigation frame (e.g., *I watered the roses*). When a source argument is the subject, *water* belongs to the Secretion frame (e.g., *My mouth/eyes watered*). In the accommodation-based view of denominal verb formation, there is no special derivational rule for denominals; denominal verb formations are instead by-products of the ordinary significations of ASCs. This does not mean that the source noun gets its argument array wholly from the ASC with which it combines. As in cases of valence augmentation like (13), those arguments licensed by the input lexeme (whether noun or verb) fuse with arguments of the construction. Sentence (14) shows a case of valence augmentation involving the denominal *door* from (8) above:

[3]See the MetaNet entry at https://metaphor.icsi.berkeley.edu/pub/en/index.php/Metaphor: CAUSES_ARE_FORCES.

14. Taxi passenger didn't see cyclist who was **doored** into path of van (NOW)

Sentence (14) combines the transitive verb *door* with the (passive) Caused Motion construction, from which the verb door *gains* a directional argument. The result of this combination is the fusion of the "victim" participant from *door* with the "theme" participant from the Caused Motion construction.

It is important to note that while the majority of denominal verb types (and tokens) are simple transitives (Rimell, 2012), referring, in Kiparsky's words, to "generically intentional activities" (1997: 476), the referential meaning of the source nominal is attenuated to the point that a participant role of the same type as the source nominal may be expressed as an oblique argument: *She buttered her bread with apple butter*, *She shelved the books on the window sill*. In this connection, it is important to recall from above (What the IDVC Does Not Capture) that source nouns do not denote roles. Rather, they evoke semantic frames, defined as constellations of roles. Each of these roles is expressed by an argument of the denominal verb.

Co-Composition

According to Pustejovsky (1998), Pustejovsky (2012), co-composition is a form of enriched composition in which the operand (argument) contributes information to the operator (verb). Unlike argument selection, co-composition is a semantic two-way street: just as a verb exhibits selectional restrictions (e.g., requiring animacy, volition of the subject argument) so an otherwise inappropriate argument may modulate the meaning of the verb. Formally, co-composition involves a process in which conventional function application from an anchor function (e.g., the governing verb), along with ampliative information supplied by a triggering argument type, co-specifies the functor. Informally, co-composition is defined as the introduction of new information to a verb by the qualia of an argument selected by that verb. A classic example is the modulation of the verb *bake* by its direct object: if *a cake* is the direct object, the verb is interpreted as a verb of creation; if *a potato* is the direct object, the verb is interpreted as a causative change-of-state verb. Our denominal verb *key* illustrates the use of co-composition as an interpretive strategy. As an Instrument denominal whose source nominal denotes a tool used to gain access, *key* is expected to combine with direct objects denoting portals and contained areas, as in, e.g., He keyed the door open and went in (COCA). When combined with direct objects denoting etchable surfaces, however, *key* denotes acts of scoring. It is through conceptual blending that we understand such acts to be acts of vandalism.

Conceptual Blending Theory

Conceptual Blending Theory (CBT; Fauconnier and Turner, 2004) assumes that meaning construction involves the selective mappings of elements across distinct conceptual domains (as in Lakoff's (1993) conceptual metaphor theory), as well as exploitation of inferences that derive from the mapping, and are not valid in any of the domains that are input to the mapping. It represents this construal process through a conceptual integration network that includes two input spaces: a generic space that represents what is common to the two input spaces, and a blended space. Input spaces are mapped to each other and projected selectively onto the blended space, which represents emergent properties and inferences not proper to either of the input spaces. A favorite illustration is metaphoric statement *That surgeon is a butcher*. Clearly there is structure common to each of the input domains of surgery and butchery: both types of entities cut flesh in hygienic settings. This shared structure is captured by the generic space. The blended space represents the properties that make the blend informative but are not attributable to either input space independently: this surgeon has low skill, does not adhere to professional standards, and causes injury. To illustrate the application of the CBT framework to innovative denominal verb formations, let us use it to analyze the innovative denominal formation in (15), from a January 2020 tweet:

15. also, i hate bernie sanders and all the other democratic politicians because i'm a principled black marxist, so none of you silly liberals can **berniebro** me.

While *Berniebro* is a compound noun that typically refers to an ardent male supporter of progressive presidential candidate Sen. Bernie Sanders, these referential properties are overridden in this context, in which *Berniebro* is the complement of a modal verb. Berniebro is not merely a verb in this context, but an agentive transitive verb in particular: the subject of this verb is understood to be an agent acting in line with whatever intentions are consistent with being a *Berniebro*, and the object of the verb (*me*) is understood to refer to a person who might be targeted by a Sanders advocate for online intimidation. Within frame-based semantic analysis, *Berniebro* is a role-designating noun, as it is embedded in a political advocacy frame that includes an organized or grassroots grouping of likeminded voters, openly professed beliefs, pursuit of political influence, favored candidates. The argument structure of the denominal verb *Berniebro* is derived from this (nominal) frame's semantic dependents. In (15), we can imagine two input spaces: the *Berniebro* frame evoked by the input noun (ardent political advocacy for Sanders by young, white, male would-be class warriors) and the coarse-grained event structure associated with the Simple Transitive construction (x acts upon y). The generic space captures the bivalent nature of the events in these two respective input spaces: (1) political supporter intimidates opponent and (2) agent acts on patient. The blended space represents the result of the reconciliation procedure that combines the two spaces: vociferous political advocacy, male posturing and low tolerance for dissent, on the one hand, and online bullying, on the other.

Blending resolves certain denominal puzzles, including the meanings of *door* and *key*, as in (7–8), repeated here as (16–17):

16. In January, someone keyed her car and her husband's truck (NOW)
17. The new laws would increase penalties for drivers who door a cyclist (NOW)

Knowing the meanings of *key* and *door*, one would not necessarily guess that (16) describes an act of vandalism and (17) an act of causing injury in traffic. The FrameNet frame for *key* (called *Key*) includes an agent who gains access *via* an instrument to a location; it does not include a surface scored by a key, but this is what the direct object denotes in (16). Similarly, the FrameNet analysis of *door* is based on the frames Connecting Architecture and Vehicle Subpart, but does not include a victim role, as expressed by the direct object in (17). We assume a conceptual blend in both cases—in the case of *key*, a blend of the Key frame (use of implement) and the Damaging frame, and in the case of *door*, a blend of the Vehicle Subpart and Experience Bodily Injury frame. In each case, the blend is triggered by the use of the Transitive construction, which contributes a direct object, denoting the patient role, to each verb.

Frame Semantics

According to Frame Semantics, word meanings are schematizations of recurrent experiences, packaged as scenes with small arrays of semantic dependents. Fillmore offered the following frame-semantic discovery procedure to his students: imagine that you want to film a movie of a particular lexical unit; how many actors would you have to hire? But in addition to participants, frames may contain relations (e.g., part-whole relations), evaluations (for Fillmore, *stingy*, and *thrifty* as two different frames for reluctance to spend), presuppositions (Fillmore proposed that the "verbs of judging" *praise* and *credit* are distinguished by the fact that praise asserts *goodness* of the prior act while *credit* presupposes it), and perspectives (e.g., *coast* vs. *shore*). The prevalence of metaphorical mappings ensures that many lexical units belong to multiple frames, as when words from the Manual Manipulation frame like *grasp* recur in the Understanding frame. The same can be said of metonymic reference, the basis for eponymous denominal verbs like *FedEx* (e.g., *Can you FedEx it?*). Critical for our purposes is the insight that nouns and verbs have largely isomorphic frame-based representations. As Fillmore puts it (Andor, 2010: 164):

In some cases the lexical unit (or the phrase that it syntactically heads) also stands for a frame element. This is especially true of role-designating nouns: a noun like guard *evokes a frame of someone guarding some object or place, and at the same time it stands for an individual that holds such a role. . .*

In other words, while the argument-structure constructions used to create denominal verbs are verb templates, and realize the source noun's semantic dependents as grammatical relations (subject, object, oblique), a denominal verb, particularly an innovative one, makes sense because we know the story that its source noun tells. Michaelis and Ruppenhofer (2001) make this same point with respect to German applicative (or *be-*) verbs derived from nouns, e.g., *beschildern* (lit. "be-signpost"). Similarly, the English nouns *text, message*, and *signal* (members of the Communication frame) have the frame elements Message, Addressee and Communicator whether noun or a verb, e.g., *I* (Communicator) *texted them* (Addressee) *that I was running late* (Message). But while the noun may only express one of these roles (as in, e.g., *my* (Communicator) *message*, *the message to you* (Addressee), *the message that I was running late* (Message), a noun once embedded in an ASC can express all of the participant roles at once.

Treating denominal verbs requires us to broaden the class of relational nouns to include those that have the semantic dependents they do only by virtue of metonymic reference (Kövecses and Radden, 1998). One such case is the verb *gaslight,* meaning "cause someone (particularly an abuse victim) to doubt their own sanity or perceptions":

18. Most cheaters will lie and gaslight you unless you catch them dead to rights. . . (COCA)

The source noun *gaslight* is a relational noun because it is a metonym: it refers to the major instrument of deception in the 1944 thriller of the same name. In the film, an abusive husband uses various means to deceive the protagonist, Paula, into believing that she is going mad, in order to institutionalize her and gain access to jewels he believes she has hidden. He causes the gaslights in the house to flicker and dim at random times; when Paula reports these events, her abuser claims she is imagining them. While few who now use the verb *gaslight* know of the film, learning of the film provokes an "aha" reaction in many: the verbal coinage makes sense because the film scenario enables us to envision *gaslight* as a relational concept, with a deceiver, a falsehood, some ground truth, and a victim as its semantic dependents, as in (19):

19. My husband *gaslighted* me into believing we were broke (NOW)

Interpreting (19) requires us to envision a scene that combines the Caused Motion construction, metonymic source-noun frame semantics and the mechanism of blending (of film and reality).

APPLICATION

Here we apply the analytic tools developed in the section Tools for Verbing Analysis to a trio of innovative denominal verbs, including two nonce formations from the works of Shakespeare, a prodigious verb coiner (Thierry et al., 2008). We start with a fairly new but relatively entrenched coinage.

Stan

This verb is an agentive denominal formation, illustrated in (20):

20. Maybe if we were supported and stanned like yall stan Drake and Rihanna we would have the money to help (NOW)

Like many denominal person references, this verb refers to characterological figure: an obsessive fan (in this case, the psychotic stalker of Eminem's epistolary 2000 rap song "Stan"). What is striking about the verb *stan* is that it refers to a harmless variety of ardent fan support (especially as expressed in internet Fanboy/Fangirl culture), although one that can turn to online bullying in case of a perceived offense against the celebrity object of adoration. Below is a schematic representation of (20):

- ASC: Transitive
  - Experiencer: Addressee
  - Patient: Drake, Rihanna, etc.
- Conceptual Blend
  - Input space 1: Admiration
  - Input space 2 (Transitive ASC): Ardent support
  - Generic space: Affective state
  - Blended space: Admiration is a sustained (and sustaining) emotional experience
- Source nominal frame: Via metonymy, the Experiencer Focused Emotion frame, with frame elements Experiencer and Content.

Medicine

This instance can be classified as an instrumental denominal. It comes from Iago's description of Othello's plight:

21. Look, where he comes. Not poppy nor mandragora. Nor all the drowsy syrups of the world, Shall ever **medicine** thee to that sweet sleep Which thou owedst yesterday (Othello III, 3).

Below is a schematic representation of the contributors to meaning construction of (21):

- ASC: Caused Motion
  - Agent: opioid syrup
  - Patient: the addressee (Othello)
  - Goal: sleep
- Conceptual Blend
  - Input space 1: Hypnotic drugs/sleep aids
  - Input space 2 (Caused Motion ASC): The metaphorical mappings STATES ARE LOCATIONS and CAUSES ARE FORCES (Lakoff 1993)
  - Generic space: Change of state, causation
  - Blended space: Opioids are the patient's means of transit to a somnolent state; patient unable to achieve transport to somnolent state
- Source nominal frame: The Cure frame (a Healer treating and curing an Affliction of the Patient, sometimes also mentioning the use of a particular Treatment or Medication)

Boy

Like *stan*, this denominal formation is an agentive denominal. It comes from a passage of *Antony and Cleopatra* in which Cleopatra imagines ridicule and humiliation that may await her in Rome:

22. Antony/Shall be brought drunken forth, and I shall see/Some squeaking Cleopatra **boy** *my greatness/I' the posture of a whore* (Antony and Cleopatra V, 2)

- ASC: Simple Transitive
  - Agent: Boy actor who plays Cleopatra
  - Patient: Cleopatra's greatness
- Conceptual Blend
  - Input space 1: Boyhood
  - Input space 2 (Transitive ASC): Parody performance (actors play historic persons)
  - Generic space: Caricature (boy actor maps to female public figure)
  - Blended space: The Elizabethan playing company, impersonation of a public figure, misgendered portrayal in a parody performance, diminution of public figure's stature
- Source nominal frame: The Parody frame (Actor gives caricatured Performance of Public Figure).

This example features referential opacity, which we expect to see in cross-world mappings of the type that feature in conceptual blends. The names *Antony* and *Cleopatra* in the passage refer not to the historic persons as portrayed in the play but instead to the actors who play them. As Fauconnier and Turner (2004) point out, this metonymic reference is of a conventional type [as in, e.g., *Caesar* (actor) *was not bald enough to play Caesar* (historic person)]. An additional observation concerns the semantic dependents of the noun *boy*, which presumably do not include "people or traits that a boy might portray if working as an actor". Where does the direct object of the denominal verb *boy* (*my greatness*) come from? The short answer is: from the blended space rather than from either input space. Even given the then-current understanding of acting troupes, presumably based on the Elizabethan playing company (Kathman, 2005), we would not wish to claim that "acting" belonged to readers' frame-semantic conception of *boy*. But blending can promote the salience of participant roles that are not core members of the source nominal's frame. A case in point is the verb *widow*, which, when transitive typically has a subject referring to a causal event (e.g., *The conflict has widowed 45,000 women*) rather than, say, the spouse who dies. The cause of the spouse's death (e.g., warfare) is at best a peripheral member of the frame of the nominal *widow* (i.e. Personal Relationship) and yet when the verbal construction requires an agent, the nominal frame provides one.

DISCUSSION

Our thick descriptions of innovative denominal verbs demonstrate the application of interpretive strategies based on construction meaning, conceptual blending, co-composition and frame-semantic meaning. We hope to have shown that a combination of these frameworks provides a good tool kit for analysis of denominal formation. The frame-semantic perspective in particular requires us to adopt a broad understanding of what a role-denoting nominal expression is. The essential lesson for scholars of denominal meaning and use is that the nouns that become source nouns for innovative denominal formations are selected for this purpose because they have rich encyclopedic meanings. Thus, denominal verb formation is not so much about creating an argument structure for a noun as it is about exploiting the rich network of semantic connections that the source nominal already has. The argument structure of a novel denominal verb comes from the nominal frame's semantic dependents, with the syntactic realization of those dependents determined by the argument-structure construction (e.g., Caused Motion) with which the noun combines. When we look at nouns and verbs through a frame-semantic lens rather than through a denotational one (according to which nouns refer to entities and verbs to properties and relations), the semantic distance traversed by a

noun in the course of becoming a verb seems small. An important lesson, however, is that in a frame-semantic approach, source nouns do not denote participant roles. Instead, they call forth semantic frames—arrays of semantic dependents. The syntactic expression of these roles is the job of argument-structure constructions, not conversational context. Because argument-structure constructions denote coarse-grained event types like causation of motion, event-structure construals can attach to denominal verbs that are not directly traceable to source-nominal frame semantics, as in the case of *railroading* someone into doing something. Beyond syntactic constructions, there are apparently ineffable interpretations that would seem to make novel denominals an extreme case of context dependence. These novel cases include *door* and *key*—seemingly ordinary denominal verbs that take extraordinary direct objects in our corpus data: a cyclist victim in the case of *door* and a scratchable surface in the case of *key*. We do not define doors as causes of injury or keys as instruments of vandalism. But the relevant denominal interpretations do not come from nowhere. They are products of co-composition and conceptual blending.

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LM performed analyses and drafted the text. AH performed research, including corpus extraction, summarized secondary sources, provided insights and discussion throughout.

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