

# **What is in a morpheme? Theoretical, experimental and computational approaches to the relation of meaning and form in morphology<sup>1</sup>**

Stela Manova, Harald Hammarström, Itamar Kastner, Yining Nie  
Vienna / Uppsala / HU Berlin / NYU

June 2019, to appear in Word Structure

## **1. Introduction**

Speakers use words to communicate. This may seem obvious, but obvious things can also be the most difficult to explain. Because what sets one word (or in sign languages, one sign) apart from another? Words have some kind of internal structure, but this structure can only be discovered by comparing words with one another. And while words and their subparts consist of phonemes, the latter are not associated with meanings themselves. Thus, understanding how exactly meaning and form relate in morphology is a non-trivial task.

In this introductory article to the special issue, we would like to elucidate a specific view of morpheme-based morphology by reconsidering the relationship between form and meaning in morphology. On the view expressed here, there are three possible ways to approach the relation of meaning and form:

- A. Form and meaning emerge simultaneously.
- B. The association is from meaning to form.
- C. The association is from form to meaning.

The most important difference between these scenarios consists in the fact that in scenarios B and C meaning may be assigned at the level of the word, i.e. one may claim that morphemes do not have meanings of their own or even that there are no morphemes at all (as in scenario B).

In what follows, we discuss theoretical, experimental and computational approaches to morphology and how they handle the meaning-form issue. It is shown that morphological theories tend to follow either scenario A or scenario B (or a combination of both), most of them being of type B, while experimental and computational approaches prefer scenario C.

### **1.1. Types of theories**

On Stump's influential typology of morphological theories (Stump 2001; Stewart and Stump 2007:387), with respect to inflectional morphology, theories can be classified as:

- 1) lexical-incremental, e.g. Lieber (1992), Minimalist Morphology (Wunderlich 1996, Stiebels 2011).

<sup>1</sup> We would like to thank the participants in our SLE 2017 workshop, as well as Keren Rice and Jonathan Bobaljik for their support. Thanks also to the reviewers for this special issue, including Edith Aldridge, Mark Aronoff, Olga Borik, Diane Brentari, Elena Koulidobrova, Franc Marušić, Fabio Montermini, Léa Nash and Maria Voeikova. IK was supported by DFG grant AL 554/8-1 (Gottfried-Wilhelm-Leibniz-Preis 2014 to Artemis Alexiadou).

- 2) inferential-incremental, e.g. Articulated Morphology (Steele 1995); Natural Morphology (Dressler et al. 1987) seems to be of this type, too.
- 3) lexical-realizational, e.g. Distributed Morphology (DM; Noyer 1997, Halle and Marantz 1993, Bobaljik 2017).
- 4) inferential-realizational, e.g. the general approach of Word-and-Paradigm morphology (Matthews 1972, 1974, 1991, Zwicky 1985, Blevins 2016), A-morphous Morphology (Anderson 1992), Network Morphology (Corbett and Fraser 1993, Brown and Hippisley 2012, among others), as well as Paradigm Function Morphology (PFM; Stump 1997, 2001). Construction Morphology (CxM; Booij 2010) should also fall under this general view, although its focus is not on inflectional morphology.

Lexical theories follow our scenario B and assume that morphosyntactic properties are associated with inflectional markings just as lexico-semantic properties are associated with lexemes. Incremental theories are of our type A and see the word's morphosyntactic properties as an effect of acquiring the exponents of those properties. Realizational theories are of type B and presume that a word's inflectional markings are determined by that word's morphosyntactic properties. Inferential theories also follow scenario B, in the sense that they see word forms as deduced from more basic forms, such as roots and stems, but by means of rules associating given morphosyntactic properties with given morphological operations.

In theories of the inferential kind, morphology can be said to exist “by itself”, in the words of Aronoff (1994, 2007), as its own branch of linguistics with its own constraints and rules. Words exist along the paradigmatic axis, in relation to other words. Morphology as such does not require morphemes. Inflectional morphemes, for example, are listed as markings (exponents) without meaning in the lexicon. For example, PFM defines form and meaning based on the paradigm function (PF):  $PF(\langle L, \sigma \rangle) = \langle R, \sigma \rangle$  (Stewart and Stump 2007) which states that the PF value of a paradigm cell  $\langle L, \sigma \rangle$  of the lexeme (L) is the pairing of this cell's realization R with the morphosyntactic property set  $\sigma$ .

The empirical focus of different theories has also had natural influences on their development: PFM has explicitly been defined as a theory of inflectional morphology, while CxM is aimed more at derivational morphology (and compounding), broadly put. The distinction between inflection and derivation is captured by others under the so-called split morphology hypothesis, according to which derivation and inflection are distinct and belong to different components of grammar (see Beard 1995). Recently, however, the idea of a paradigmatic organization of morphology has been extended to derivational morphology; for an overview of research on derivational paradigms, see Bonami and Strnadová (2019).

Lexical theories, on the other hand, assume that words are built up of abstract morphemes which get interpreted. Such theories run the conceptual range from Distributed Morphology (DM; Halle and Marantz 1993), through the Exo-Skeletal Model (Borer 2005, 2013), to Lieber (2004). Whether the word itself is a grammatical object which can be defined varies, but all morpheme-based theories subscribe in one way or another to the idea that morphemes carry grammatical information and are combined syntagmatically as concatenated elements (Marantz 2013). DM in particular relies on syntactic structure, whereby the ‘morpheme’ is an abstract unit that refers to a syntactic terminal node and its content, not to the phonological expression of that

terminal. Reducing morphological structure to syntactic structure also means that DM does not subscribe to the split morphology hypothesis. DM furthermore assumes that the phonological forms are exponents, called Vocabulary Items, that relate form and meaning but are inserted “late” (post-syntactically). Morphology is thus distributed between syntax and phonology.

Finally, some analyses operate on what can be seen as individual features, or parts of morphemes. In such “subanalysis”, to borrow a term from Müller (2006), decomposition is even more radical than into morphemes (see also Kubrjakova 2000). Müller (2006) breaks affixes down into parts, such that the German 2nd person singular *-st* and 3rd person singular *-t* are decomposed into [-1] *-t*, [2] *-s-* and [3] *-ø*. And in Nanosyntax (Starke 2009) a syntactic tree is built up not of words as in traditional transformational grammar or of morphemes as in DM but of individual syntactic features.

All theories acknowledge that speakers use words when communicating (however defined, be it as phonological words, morphological words or lexemes), and all acknowledge that there is some kind of internal structure to words. In order to establish what these word parts are, we need to compare whole words. In order to build up words, we need their parts. Where does this leave us?

## 1.2. Positional systems

In this introductory paper to the special issue we wish to unite the two views (cf. Herce, this issue). Just as a building can be seen as one object or as a collection of floors, and just as an organism can be seen as a whole or as a collection of cells, morphology can be observed at different levels. For some, the emphasis is on the parts; for others, the emphasis is on the whole.

We will propose to consider language as a positional system, where morphemes and their forms can be evaluated with respect to meaning in three ways:

- 1) In isolation (as building blocks of morphology, e.g. English *-s*, *-en*, *-ed*, *-er*).
- 2) Based on their position in the word form (i.e. templatically, e.g. inflection is outside derivation; prefixes, suffixes, infixes, interfixes are also established positionally).
- 3) Based on their combination with other morphemes (e.g. English *writ-er-s* but not *\*small-er-s*, points to two different *-er* suffixes, one that derives nouns (agents) and one that expresses comparative degree of adjectives).

As a result, we will see that morphemes associate form and meaning, like in scenario A, but that this association is not trivial and involves scenarios B and C at the different stages of derivation and in comprehension and production.

In order to compare and contrast different approaches to the question of the morpheme and its place in morphology, we solicited contributions to a workshop at the 50th annual meeting of the Societas Linguistica Europaea (SLE) held in Zurich in 2017. The current special issue brings together a number of papers presented at or inspired by the workshop. Our introductory contribution is structured as follows. We first outline the mapping problem between form and meaning in Section 2 and discuss it in the context of positional systems in Section 3. Sections 4 and 5 outline the role of

morphemes in psycholinguistics and computational linguistics, respectively. Section 6 concludes with an overview of the papers in this special issue.

## 2. Relating meaning and form

### 2.1. Terminology

We should first clarify what exactly we mean by “morpheme”. Since different uses of the term are prevalent across the literature, we distinguish the *morpheme*, an abstract grammatical notion, from an *exponent*, its phonological realization. Haspelmath and Sims (2010) give the following definitions in their glossary:

- ***morpheme***: the smallest meaningful part of a linguistic expression that can be identified by segmentation; a frequently occurring subtype of morphological pattern. (p. 335)
- ***exponent***: when a morphological pattern (e.g. *-ed*) expresses an inflectional feature value (e.g. past tense), it is the *exponent* of that feature value. (p. 328)

Similarly, the glossary in Aronoff and Fudeman's (2011) textbook gives the following definitions:

- ***morpheme***: a word or a meaningful piece of a word that cannot be divided into smaller meaningful parts. Examples include *school*, *read*, or the *re-* and *-ing* of *rereading*. (p. 266)
- ***exponent***: the marker of a given morphosyntactic feature. For example, [s] is the exponent of plural in the word *kits*. (p. 263)

In what follows, we adhere to these two definitions and avoid theory-specific terms such as “Vocabulary Item” or general terms such as “lexical item” or “lexeme”. When we wish to remain agnostic about a certain piece of morphology, we will use *form*, as in the different word forms of a paradigm.

### 2.2. The mapping problem

It is well known that the relationship between meaning and form is not a perfect one-to-one mapping. Given a limited number of morphemes and a practically unlimited number of words, the relation could never be perfect to begin with.

To illustrate this point, the exponent *-ta* correlates with a number of morphemes in Bulgarian (1), just as the exponent *-er* does in English (2). It is unclear what Bulgarian *-ta* and English *-er* should mean.

- (1)    Bulgarian -ta:  
      *meče* ‘little bear’  
      *meče-ta* ‘little bear-PLURAL, i.e. little bears’  
      *meče-ta-ta* ‘little bear-plural-DEFINITE, i.e. the little bears’

- (2) English -er:  
*writ-er* (AGENT)  
*(bottle) open-er* (INSTRUMENT)  
*strong-er* (COMPARATIVE)

It is just as difficult to go from meaning to a dedicated exponent. Both the Bulgarian and English plural forms show multiple exponents (3). There is no individual suffix which always spells out the morphosyntactic feature [plural] in these languages.

- (3) Noun plural  
Bulgarian  
*kniga* ‘book’ – PL *knig-i*  
*more* ‘sea’ – PL *more-ta*  
etc.

- English  
*book* – PL *book-s*  
*ox* – PL *ox-en*  
etc.

It appears that we must abandon a naive view in which a certain meaning is always mapped onto a certain form. Nie (this issue) shows that the situation can be even more complex, whereby a certain form maps onto a complex meaning which arises from a combination of morphemes.

The morpheme-based view investigates the mapping from abstract morphemes to exponents. The non-morphemic view studies the mapping between word-level content (content-paradigm cells) and exponents (form-paradigm cells). Consider how PFM treats second-person imperative active forms in Sanskrit; (4) gives the 9th conjugation class (-*nī*) verb KRĪ ‘buy’ (Bonami and Stump 2017, Table 5):

- (4) 2sg    *kṛī-nī-hi*    ‘you (sg) buy!’  
2du    *kṛī-nī-tam*    ‘you two buy!’  
2pl    *kṛī-nī-ta*    ‘you all buy!’

According to Bonami and Stump (2017:463), “the default expression of second person singular subject agreement in active imperatives is *-hi*”. This view of the default gives us the following rules of exponence, where X<sub>V</sub> is the 9th conjugation class:

- (5) Rules of exponence in Sanskrit (Bonami and Stump 2017, ex. (20))  
a. I, X<sub>V</sub>[9th conjugation], {} → X<sub>nī</sub>  
b. II, X<sub>V</sub>, {2sg imp active} → X<sub>hi</sub>

A DM analysis of the same data would not look all that different:

- (6) [2sg] ↔ -*hi* / Imp \_\_ v<sub>9</sub>  
-*nī* / \_\_ v<sub>9</sub>

### 3. Elements, rules and positions

What should we make of the mapping problem in morphology? In this section, we discuss a number of cases outside of linguistics in which form and meaning (broadly construed) do appear in a well-defined correspondence. We highlight the importance of *positional systems* - syntagmatic systems in which the meaning of a basic set of individual *elements* (similar to morphemes in a language) is understood not only in isolation but also based on their position with respect to other elements - and ask whether language counts as such a system. The main thread running through all of these examples is that the rules of the system are established in advance and cannot be changed halfway through the calculation, game or derivation.

#### 3.1. Mathematics

In mathematics we find basic elements such as different types of numbers: natural, rational, irrational, real, and so on.

- Natural numbers: all positive integers (whole numbers) and zero.
- Rational numbers: all numbers that can be expressed as a fraction of two integers.
- Irrational numbers: all real numbers that are not rational.
- Real numbers: all rational and irrational numbers, i.e. any point anywhere on the number line.

These elements are combined in certain ways. Operations such as addition, subtraction, multiplication and so on manipulate the numbers. In other words, certain rules can be applied to these elements. The elements (numbers) and the rules (mathematical operations) are defined axiomatically in the system; they exist from the very beginning and cannot be redefined. For example, the definition of addition in mathematics cannot change from (7) to (8), nor can the order of operations be different in the two equations.

$$(7) \quad (1 + 2) \times 3 + 4$$
$$(8) \quad (2 + 3) \times 4 + 5$$

By analogy with language, numbers correspond to morphemes and operations correspond to morphosyntactic (e.g. Move and Agree in Minimalist syntax) or morphophonological processes (e.g. voicing assimilation).

#### 3.2. Chess and other games

Chess, as well as virtually every other game (be it a board game, card game, or other kind), consists of basic elements: a fixed number of pieces. Fixed rules govern how each piece can move, and again each player knows the pieces and the rules from the very beginning.

Analogizing to morphology, the current situation in the field can be described in the following way: some players assume that rules depend on the chessboard (e.g. PFM), while other players believe that the rules are encoded in the pieces (e.g. DM).

### 3.3. Number systems

Now consider the decimal system, where the basic elements are the ten digits (0-9). It can be argued that the same symbol does not always represent the same value. This is because the value of the symbol depends on its position; the decimal system is thus positional with respect to the meaning of the element.

For example, the number 123 is different from 132, 213, 231, 312 and 321. The meaning of 123 is not  $1+2+3$  but  $100+20+3$ : we need to know that the “1” is multiplied by 100, the “2” by 10 and the “3” by 1. No overt symbols represent this part of the value; instead, this manipulation depends solely on the position of the digit within the number. Some analogies with language might be our understanding of iconicity and semantic compositionality, but we will not expand on this point.

In a positional system the number of elements is not a hindrance to expressing meaning since the system is productive. Complex tasks and large amounts of information can be handled with a very limited number of basic elements, as long as these elements and the rules operating on them are known. For example, the decimal system is base-10. Looking instead toward a binary system, which is base-2, a number such as (9) has the equivalents in (10a-c), all used in programming languages. Here, again, the value of an element depends on its position.

- (9) 110011111010010100
- (10) a. 212628                             (decimal, base-10 using the numbers from 0-9)  
     b. 0637224                             (octal, base-8 using the numbers from 0-7)  
     c. 0x33e94                             (hexadecimal, base-16 using the numbers from 0-9 plus the letters A-F)

Complex computational tasks require large amounts of information and can be handled with a very limited number of basic elements, as long as one knows what these basic elements are and what the rules of the system are.

Machines can, of course, use more than one number system. In order to avoid confusion, programming languages mark different bases in specific ways, e.g. all octal numbers start with “0” (10b) and all hexadecimal ones with “0x” (10c). This would be similar to indexing all homophonous suffixes in the language, e.g. *-er<sub>1</sub>* in *writer* (agent noun), *-er<sub>2</sub>* in *open-er* (instrument noun), and *-er<sub>3</sub>* in *strong-er* (comparative).

### 3.4. Language as a positional system

We now propose that morphology (and language in general) should be considered a positional system in the sense sketched above. This point will be fleshed out using a few examples comparing the decimal system - which as seen above is positional - with basic affixation patterns.

A string of symbols such as “12” changes its meaning when another layer is added, (11a)-(12a). Similarly, the meaning of a morphological form changes when another (affixal) layer is added, (11b)-(12b).

- (11) a. 12 → 123

- (12) b. Bulgarian *žen-a* ‘woman’ → *žen-a-ta* ‘woman-DEFINITE’  
 a. 45 → 456 → 4566  
 b. *mor-e* ‘sea’ → *mor-e-ta* ‘sea-PL, i.e. seas’ → *mor-e-ta-ta* ‘sea-PL-DEF, i.e. the seas’

The meaning of “12” also changes due to substitution in an existing layer.

- (13) a. 12 → 13  
 b. *žen-a* ‘woman’ → *žen-i* ‘woman-PLURAL’

Other arguments from morphology and syntax can be adduced in support of the conclusion that language is a positional system. These include:

1. The differentiation between roots / affixes is positional.
2. Stratal affixes: Level 1 and Level 2 affixes are defined positionally.
3. Templetic morphology is entirely positionally defined (Stump 1997, 2001).
4. Layered morphology (and its relation to semantic scope, e.g. Rice 2000) is positionally defined.
5. Position classes in morphology (Inkelas 1993).
6. There are positional restrictions on the placement of an affix in a word (affix ordering constraints, see Manova and Aronoff 2010, Manova 2015).
7. Selection for specific affixes, whether as subcategorization frames (Lieber 1992), mobile affixes (Kim 2015) or sublexicons (Gouskova et al 2015).
8. Movement in syntax.
9. Word order in syntax.

Phonology also deals with positional systems, of course, although there no meaning is represented as such. See also Franzon et al (this issue) for a psycholinguistic example of how the meaning of Number is constant even when interacting with other factors such as animacy.

Positional systems give us a way of thinking about the question we started off with, namely why there are no morphemes that relate meaning and form uniquely. All theories mentioned above have a similar approach to this issue: the relationship between meaning and form is not one-to-one. And now we see why: If language is a positional system, its form-meaning mappings cannot always be one-to-one because the meaning of an element in a positional system depends on the position of the element.<sup>2</sup>

2 This view might be related to the discussion on whether natural language is context-free or not, an issue we will not broach here. See e.g. Pullum and Gazdar (1982).

## 4. Morphemes in psycholinguistics

Given that we have reason to posit morphemes which mediate between form and meaning in specific ways, we would also like to know whether there is psycholinguistic support for this idea, how such elements are processed, and how their behavior can be modeled computationally. Here we briefly survey some relevant contributions from the psycholinguistic and neurolinguistic literature (for contrasting views see Marantz 2013; Plag and Balling 2016). Computational learning and modeling of morphology is addressed in the next section.

The most common experimental paradigm probing the mental lexicon is the lexical decision task (Meyer and Schvaneveldt 1971): a participant sees a string of characters (scenario C) and is asked to decide whether that string constitutes a word in their language. The basic setup thus involves decisions at the level of the orthographic word, that is, in terms of words versus non-words. Under the “affix stripping model” of Taft and colleagues (Taft and Forster 1975, 1976; Taft 1979), this is a task that involves implicit decomposition of the word into its constituent parts, i.e. morphemes. Taft’s experiments manipulated the frequency of different words, stems and affixes, arguing that a prefixed word is accessed via its stem even when this stem is not a word in its own right. For example, *unhook* is related to *hook* in the same way as *persuade* is to *suade*. The findings indicate that the prefixes are stored in the mental lexicon, as are the stems, even though *suade* itself is not a word, (14).

- (14) a. *unhook* → *un-*, *hook*  
b. *persuade*, *dissuade* → *per-*, *dis-*, *suade*

Contemporary neurolinguistic work corroborating this model (Fruchter et al. 2013; Fruchter and Marantz 2015) demonstrates that speakers obligatorily decompose the (visual) stimulus into morphemes, look these up in the mental lexicon, and recombine them. All three steps can be individually observed and manipulated (showing sensitivity to frequency, family density and so on).

Related studies have investigated the extent to which parts of words are identified and obligatorily decomposed considering a range of factors and manipulations, including masked vs overt priming, different writing systems, and whether the written forms contain real affixes or merely orthographically identical parts (Rastle et al. 2004; Stockall and Marantz 2006; Crepaldi et al. 2010, 2013; Lewis et al. 2011; Marelli et al. 2013; Gwilliams and Marantz 2015, 2018; Deutsch and Kuperman 2018; Kastner et al. 2018; Neophytou et al 2018). Affixes can be identified and processed even in isolation, that is, without having a contentful stem to attach to (Crepaldi et al. 2016; Lázaro et al. 2016; Beyersmann et al. 2016). Manova and Brzoza (2018) and Manova (2019) provide evidence that native speakers of English, Italian, Polish and Slovene can differentiate between attested and unattested suffix combinations in isolation: native speakers do not need to see bases such as roots or stems in an experimental trial in order to correctly judge a suffix combination as attested or non-attested. This finding indicates that not only affixes but also subparts of words such as affix combinations are listed in the mental lexicon; a similar conclusion is implied by the results of de Lint (this issue).

Must we make reference to morphemes in order to explain these findings? Some models of processing argue that this is not the case. In particular, Naïve

Discriminative Learning (NDL: Baayen et al. 2011; Plag and Balling 2016) links up form and meaning without a mediating morphological representation. This kind of approach follows earlier connectionist approaches (Seidenberg and McClelland, 1989; Plaut et al., 1996) and can be found in other works as well (Marelli et al. 2015; Amenta et al., 2017). Marantz (2013) discusses this family of models with particular reference to NDL, arguing in detail that they do incorporate a wealth of syntactic and morphological information and thus do not form a good argument for removing morphemes from lexical processing. Bondarenko et al. (2019) similarly claim that abandoning morphemes would render these models unable to explain some processing reflexes of allomorphy. We now move on to describing other computational approaches in some more depth.

## 5. Morphemes in computational linguistics

Much work in computational linguistics has been directed towards encoding the outcome of classic morphological analysis in a suitable computational formalism. This allows efficient data analysis and generation (e.g. Hulden 2009) which serve great practical purposes for various downstream tasks in Natural Language Processing (Machine Translation, Information Retrieval, etc). Since hand-crafting a computational morphology involves a significant amount of manual labour, a common solution has been to use Machine Learning methods to extract rules from (hand-annotated) form-analysis pairs (e.g. <"books", book-PL>, see Kann and Schütze 2016 and Chrupala 2008, Ch. 6), with the advantage that the rules can also make guesses at the analysis of previously unseen words. Such rules typically recognize morphemes, but as neural network approaches have entered the field, far more “emergent” representations are gaining popularity (see e.g. Heinzerling and Strube 2018). These representations resemble Naïve Discriminative Learning (NDL) in that clear and specific morphemes are not realized.

The next step from generalization over form-analysis pairs is to generalize from forms only. To computationally induce morphological rules from (unannotated) raw text is known as Unsupervised Learning of Morphology (ULM). ULM takes large amounts of raw text data as its input and attempts to induce the morphology of the input language. The reason why this might be possible at all is due to the great difference in substring frequencies reflected in recurrent morphological formations. For example, the frequency of the final substring *-ing* in English will be much greater than that of a random substring of the same length, and words that end in *-ing* will also appear with the terminal segment *-ed* much more often than chance. There have been many dozens of concrete proposals on exactly how to exploit frequency asymmetries (see the overview in Hammarström and Borin 2011).

Most work in ULM is motivated by the potential to save human labour in annotating or rule-writing towards a computational morphological analyzer. Another form of motivation, however, predating any practical computational work, is the idea of formalizing the process of linguistic description, into so-called linguistic discovery procedures (Harris 1955). Since most subsequent work in the area has been practically oriented, the theory has not made significant progress beyond its initial insights.

Nearly all work in ULM has targeted concatenative morphology, but there are a few approaches that address non-concatenative templatic morphology,

morphophonological changes and suprasegmental morphology (see Hammarström and Borin 2011). Similarly, nearly all work in ULM focuses exclusively on the form side of morphology, postponing the mapping to meaning to future work. The few approaches that do address semantics are aided by the fact that representations can also be extracted in an unsupervised manner through standard techniques of context-occurrence analysis (e.g. Deerwester et al. 1990, Mikolov et al. 2013).

There have been practical achievements in ULM, wherein the results of ULM resemble manual linguistic analysis and are useful for downstream NLP tasks. But it is also fair to say that the ULM problem has not been “solved”; there is no system that can be applied off the shelf to any language and yield near-human-like results without additional manual tuning or engineering work. There is no single system which can be heralded as the “best” (see Hammarström and Borin 2011) and used faithfully as a representative for comparison with non-computational approaches.

## 6. The papers in the special issue

The four contributions in this special issue approach the question of morphemes and positions, i.e. of the relation of meaning and form in a morpheme, from different angles and diverse empirical domains. Two of the papers are experimental and two are theoretical.

The first paper, *Effects of animacy on the processing of morphological Number: a cognitive inheritance?*, by **Chiara Zanini, Rosa Rugani, Dunia Giomo, Francesca Peressotti & Francesca Franzon** is experimental and sees morphemes (specifically those encoding Number) as relating meaning and form in a classical way (scenario A in the introduction). However, some Number morphemes appear to contain more meaning than other Number morphemes, for example, when part of animate nouns in a language that does not encode animacy morphologically. In their experiment, the authors tested the processing of morphological Number in relation to animacy. The experiment consisted of a phrase-completion task: Noun phrases of a demonstrative and a noun appeared on the screen one at a time and the demonstrative or the noun lacked an inflectional morpheme. The authors found out that it was easier to inflect nouns for Number when the inflectional morpheme was interpretable with respect to a semantic feature related to animacy. Since in the real world animacy appears important for counting, the paper also concludes that morphology is designed to easily express information that is salient from a cognitive point of view.

From the perspective of positions in morphology, one can describe the findings of this paper in terms of the ability of the Number morpheme to combine with different types of bases, namely those that denote animate and inanimate nouns. Such an approach relates animacy to the semantics of the morphological base and allows the meaning associated with the Number morpheme to remain constant.

The second paper, *On morphemes and morphomes: exploring the distinction*, by **Borja Herce** is a theoretical paper that argues that there is no principled difference between morphemes and morphomes. Since Aronoff (1994), morphomes (purely morphological forms that cannot be defined in terms of meaning) have been seen as the strongest evidence for the existence of morphology proper. Herce makes the following claims about morphemes and morphomes: 1) they can have the same

sources; 2) they can exhibit the same diachronic resilience; and 3) they can both be stems or affixes. For assessment of morphomicity, the author relied on quantitative measures “applied to **forms which recur within a single lexeme's paradigm**” (author's emphasis); these measures capture the positioning of a morphological form (be it a morpheme or a morphome) in a paradigm and the morphosyntactic information associated with the paradigm cells occupied by that form. Herce finds that no property, besides the defining one, systematically differentiates morphemes from morphemes and concludes that the distinction between the two types of morphological form is not one of kind but of degree.

It has to be mentioned here that morphemes and morphomes, at least their prototypical instances, differ positionally, in the sense that a prototypical morpheme is a stem and as such is the equivalent of two morpheme positions, one for a root and another for an affix.

In the third paper, *From meaning to form and back in American Sign Language verbal classifier morphemes*, **Vanja de Lint** reports on an experiment designed to test a hypothesis about a class of markers in American Sign Language, commonly known as *classifiers*. These signed formatives, which can be used to depict an object, individual or instrument iconically, have been argued to differ with respect to the arguments entailed by their use: one type encodes the external argument, one type encodes the internal argument, and one type encodes both external and internal arguments. Previous theoretical work has analyzed these elements as morphemes spelling out specific parts of the syntactic tree, with one explicit proposal being that three different types of classifiers spell out different instantiations of two functional morphemes. The different types are claimed to have different internal structure which also correlates directly with their form. The paper uses a novel experimental paradigm in order to investigate what entailments native signers have about the use of the three types of classifiers, corroborating some of the existing claims while discovering a new contrast between causative verbs and manner verbs.

This case comes perhaps closest to a direct relationship between form and meaning, and it is unsurprising that this kind of correlation can be found in iconic constructions used by sign languages (see Sandler and Lillo-Martin 2006 for general discussion and additional references). In our own terminology above, the analysis makes reference to both rules and positions.

The last paper, a theoretical contribution titled *Morphological causatives are Voice over Voice* by **Yining Nie**, discusses what are commonly referred to as “causative” constructions in languages such as Halkomelem, Japanese and Tagalog. Much research has tackled the question of how complex causative events are and what kind of elements are involved: does one verb embed another, or a larger phrase, or perhaps two smaller units combine? Nie argues that rather than having one morpheme be spelled out as causative morphology, what looks like an exponent of one morphemic affix is in essence a configuration: two morphemes (the syntactic head Voice) attached recursively.

This strongly positional analysis assumes very general rules of semantic composition, which certain languages can utilize by making specific positional arrangements. An analysis such as this one makes a strong case for form and meaning emerging simultaneously, here from shared syntactic structure.

Taken together, these papers emphasize the positional nature of various morphological phenomena, allowing us to further probe the question of how morphemes relate form and meaning in word structure.

Summing up, we started with the observation that there are three possible scenarios how to approach the relation of meaning and form in morphology:

- A. Form and meaning emerge simultaneously.
- B. The association is from meaning to form.
- C. The association is from form to meaning.

We then showed that morphemes and their forms can be evaluated with respect to meaning in three ways:

- 1) In isolation (as building blocks of morphology).
- 2) Based on their position in the word form (i.e. templatically).
- 3) Based on their combination with other morphemes (morpheme combinations).

Word structure of various kinds seems relevant to morphology (in order of increasing size): (phonemes and) submorphemes > morphemes (i.e. roots and affixes) > stems, morphemes and affix combinations > words. However, structurally all of these depend on the morpheme in some way, in the sense that they are defined as either building parts of the morpheme or as containing a number of morphemes, i.e. having one or more morpheme positions that are related. Thus, the morpheme appears to have a central role with respect to word structure and to accommodate not only grammatical information (meanings relevant to grammar) but also positional information.

## References

- Amenta, S., Marelli, M., & S. Sulpizio (2017). From sound to meaning: phonology-to-semantics mapping in visual word recognition. *Psychonomic Bulletin and Review* 24:887–893.
- Anderson, Stephen R. (1992). *A-Morphous Morphology*. Cambridge: CUP.
- Aronoff, Mark (1994). *Morphology by Itself*. Cambridge, MA: MIT Press.
- Aronoff, Mark (2007).. In the beginning was the word. *Language* 83(4): 803-830.
- Aronoff, Mark and Kirsten Fudeman (2011). *What is morphology?* 2nd edition. Wiley-Blackwell.
- Baayen, R. H., P. Milin, D.F. Durdevic, P. Hendrix & M. Marelli (2011). An amorphous model for morphological processing in visual comprehension based on naive discriminative learning. *Psychological Review* 118:438–481.
- Baroni, M., J. Matiasek & H. Trost (2002). Unsupervised discovery of morphologically related words based on orthographic and semantic similarity. In Mike Maxwell (ed.), *Proceedings of the Workshop on Morphological and Phonological Learning of ACL/SIGPHON-2002*, 48-57. East Stroudsburg PA: ACL.
- Beard, R. (1995). *Lexeme-Morpheme Base Morphology*. Albany, NY: SUNY Press.
- Berg, Kristian & Mark Aronoff (2017). Self-organization in the spelling of English suffixes: The emergence of culture out of anarchy. *Language* 93: 37-64.
- Beyersmann, E., J. C. Ziegler, A. Castles, M. Coltheart, Y. Kezilas & J. Grainger (2016). Morpho-orthographic segmentation without semantics. *Psychon Bull Rev* 23(2): 533-9.
- Bobaljik, J. (2017). Distributed Morphology. *Oxford Research Encyclopedia of*

- Linguistics*. Retrieved 16 Jun. 2019, from <https://oxfordre.com/linguistics/view/10.1093/acrefore/9780199384655.001.0001/acrefore-9780199384655-e-131>.
- Blevins, J. (2016). *Word and paradigm morphology*. Oxford University Press.
- Bonami, O. & J. Strnadová (2019). Paradigm structure and predictability in derivational morphology. *Morphology* 29 (2): 167-197. <https://doi.org/10.1007/s11525-018-9322-6>.
- Bonami, O. & G. T. Stump (2017). Paradigm Function Morphology. In Andrew Hippisley & Gregory Stump (eds.), *The Cambridge handbook of morphology*, 449–481. Cambridge: Cambridge University Press.
- Bondarenko, D., Özsoy, O., & I. Kastner (2019). Grammatical factors in morphological processing: evidence from allomorphy. Presentation at the 32nd CUNY Conference on Human Sentence Processing. [osf.io/gqj37](https://osf.io/gqj37)
- Booij, G. (2007). Construction Morphology and the Lexicon, In *Decembrettes 5*, available at: <http://www.lingref.com/cpp/decemb/5/>
- Booij, G. (2010). *Construction Morphology*. Oxford University Press.
- Borer, H. (2005). *Structuring Sense*: Volumes I-II. Oxford University Press.
- Borer, H. (2013) *Structuring Sense*: Volume III. Oxford University Press.
- Brown, D. and A. Hippisley. (2012). Network morphology. Cambridge: CUP.
- Chrupala, G. (2008). *Towards a Machine-Learning Architecture for Lexical Functional Grammar Parsing*. PhD thesis, Dublin City University.
- Corbett, G. G. and N. M. Fraser (1993). Network Morphology: A DATR account of Russian nominal inflection. *Journal of Linguistics* 29:113-142.
- Crepaldi D., L. Hemsworth, C. J. Davis & K. Rastle (2016). Masked suffix priming and morpheme positional constraints. *Q J Exp Psychol (Hove)* 69(1): 113-28.
- Crepaldi, Davide, Kathleen Rastle, Colin J. Davis & Stephen J. Lupker (2013). Seeing Stems Everywhere: Position-Independent Identification of Stem Morphemes. *Journal of Experimental Psychology: Human Perception and Performance* 39:510–525.
- Crepaldi, Davide, Kathleen Rastle, Max Coltheart & LyndseyNickels (2010). ‘Fell’ primes‘fall’, but does ‘bell’ prime ‘ball’? Masked priming with irregularly-inflected primes. *Journal of Memory and Language* 63:83–99.
- Deerwester, S., Dumais, S. T., Furnas, G. W., Landauer, T. K., and Harshman, R. (1990). Indexing by latent semantic analysis. *Journal of the American Society for Information Science*, 41(6):391–407.
- Deutsch, A., & V. Kuperman (2018). Formal and semantic effects of morphological families on word recognition in Hebrew. *Language, Cognition and Neuroscience*.
- Dressler, W., Mayerthaler, W., Panagl, O., & Wurzel, W. (1987). *Leitmotive in Natural Morphology*. Amsterdam: Benjamins.
- Fruchter, Joseph & Alec Marantz (2015). Decomposition, lookup, and recombination: MEG evidence for the Full Decomposition model of complex visual word recognition. *Brain and Language* 143:81–96.
- Fruchter, Joseph, Linnaea Stockall & Alec Marantz (2013). MEG masked priming evidence for form-based decomposition of irregular verbs. *Frontiers in Human Neuroscience* 7:1–16.
- Gouskova, Maria, Luiza Newlin-Łukowicz, and Sofya Kasyanenko (2015). Selectional restrictions as phonotactics over sublexicons. *Lingua* 167:41-81.
- Greenberg, J. H. (ed.) (1963). *Universals of Human Language*. Cambridge, Mass: MIT Press.
- Gwilliams, L. & A. Marantz (2015). Non-linear processing of a linear speech stream: The influence of morphological structure on the recognition of spoken Arabic words. *Brain and Language* 147:1-13.
- Gwilliams, L. & A. Marantz (2018). Morphological representations are extrapolated from

- morpho-syntactic rules. *Neuropsychologia*.
- Halle, M. & A. Marantz (1993). Distributed morphology and the pieces of inflection. In Hale K. and S. J. Keyser (eds.), *The view from building 20*, 111-176. Cambridge, MA: MIT Press.
- Hammarström, H. & L. Borin (2011). Unsupervised Learning of Morphology. *Computational Linguistics* 37(2): 309-350.
- Harris, Z. S. (1955). From phoneme to morpheme. *Language*, 31(2):190–222.
- Haspelmath, Martin and Andrea D. Sims (2010). *Understanding morphology*. 2nd edition. London: Hodder.
- Heinzerling, B. and Strube, M. (2018). BPEmb: Tokenization-free Pre-trained Subword Embeddings in 275 Languages. In *Proceedings of the Eleventh International Conference on Language Resources and Evaluation (LREC 2018)*, Miyazaki, Japan. European Language Resources Association (ELRA).
- Hulden, M. (2009). Foma: a finite-state compiler and library. In *Proceedings of the 12th Conference of the European Chapter of the Association for Computational Linguistics*, pages 29–32. Association for Computational Linguistics.
- Inkelas, S. (1993). Nimboran position class morphology. *Natural Language and Linguistic Theory*, 11: 559–624.
- Kann, K. and Schütze, H. (2016). MED: The LMU system for the SIGMORPHON 2016 shared task on morphological reinflection. In *Proceedings of the 14th SIGMORPHON Workshop on Computational Research in Phonetics, Phonology, and Morphology*, pages 62–70. Association for Computational Linguistics.
- Kastner, I., L. Pylkkänen, & A. Marantz (2018). The form of morphemes: MEG evidence from masked priming of two Hebrew templates. *Frontiers in Psychology* 9:2163. doi: 10.3389/fpsyg.2018.02163
- Kim, Yuni. (2015). Mobile affixation within a modular approach to the morphology-phonology interface. In Manova, Stela (ed), *Affix Ordering Across Languages and Frameworks*. Oxford University Press, 111-123.
- Kiparsky, P. (1982). Lexical morphology and phonology. In The Linguistic Society of Korea (Ed.), *Linguistics in the morning calm* (pp. 1–91). Seoul: Hanshin Publishing Co.
- Kubrjakova, Elena S. (2000). Submorphemic Einheiten. In Booij, G., Lehmann, C., and Mugdan, J. (eds), *Morphology. An international handbook on inflection and word-formation*, Volume 1, 417-426. Berlin/New York: de Gruyter.
- Lázaro, M, V. Illera & J. Sainz (2016). The suffix priming effect: Further evidence for an early morpho-orthographic segmentation process independent of its semantic content. *Q J Exp Psychol (Hove)* 69(1): 197-208.
- Lewis, Gwyneth, Olla Solomyak & Alec Marantz (2011). The neural basis of obligatory decomposition of suffixed words. *Brain and Language* 118:118–127.
- Lieber, R. (1992). *Deconstructing morphology: Word formation in syntactic theory*. Chicago: University of Chicago Press,
- Lieber, R. (2004). *Morphology and lexical semantics*. Cambridge University Press.
- Manova, S. (2015) (ed.). *Affix ordering across languages and frameworks*. New York: Oxford University Press.
- Manova, S. (2019). Suffix combinations in English, Italian, Polish and Slovene: Theory and processing. Ms. University of Vienna.
- Manova, S. & M. Aronoff (2010). Modeling affix order. *Morphology* 20: 109-131.
- Manova, S. & B. Brzoza (2018). Suffix ordering in Polish: Implications for foreign language learning. Ms. University of Vienna & University of Poznań.
- Marantz, Alec (2013). No escape from morphemes in morphological processing. *Language and Cognitive Processes* 28:905–916.
- Marelli, M., Amenta, S., Morone, E. A., & Crepaldi, D. (2013). Meaning is in the

- beholder's eye: Morpho-semantic effects in masked priming. *Psychonomic Bulletin and Review* 20:534-541.
- Marelli, M., Amenta, S., & D. Crepaldi (2015). Semantic transparency in free stems: the effect of orthography-semantics consistency on word recognition. *Quarterly Journal of Experimental Psychology* 68:1571–1583.
- Matthews, P. H. (1972). *Inflectional morphology*. Cambridge University Press.
- Matthews, P. H. (1974). *Morphology: An introduction to the theory of word structure*. Cambridge University Press.
- Matthews, P. H. (1991). *Morphology*. Cambridge University Press.
- Meyer, David and Roger Schvaneveldt (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology* 90: 227-234.
- Mikolov, T., Sutskever, I., Chen, K., Corrado, G. S., and Dean, J. (2013). Distributed representations of words and phrases and their compositionality. In Burges, C. J. C., Bottou, L., Ghahramani, Z., and Weinberger, K. Q., editors, *Advances in Neural Information Processing Systems 26 (NIPS 2013)*, pages 3111–3119. Neural Information Processing Systems.
- Mithun, M. (1999). *The languages of native North America*. Cambridge: Cambridge University Press.
- Müller, Gereon (2006). Subanalyse verbaler Flexionsmarker. In Grammatische untersuchungen:Analysen und reflexionen: Gisela Zifonun zum 60. Geburtstag. Edited by Eva Breindl, Lutz Gunkel, and Bruno Strecker, 183–203. Tübingen, Germany: Narr.
- Neophytou, K., Manouilidou, C., Stockall, L., & A. Marantz (2018). Syntactic and semantic restrictions on morphological recomposition: MEG evidence from Greek. *Brain and Language* 183:11-20.
- Noyer, R. (1997). *Features, positions and affixes in autonomous morphological structure*. New York, NY: Garland.
- Plag, Ingo & Laura Winther Balling (2016). Derivational morphology: An integrative perspective on some fundamental questions. In Pirelli, V., I. Plag & W. U. Dressler (eds.). *Word knowledge and word usage: A cross-disciplinary guide to the mental lexicon*. Berlin: De Gryuter.
- Plaut, D. C., McClelland, J. L., Seidenberg, M. S., & K. Patterson (1996). Understanding normal and impaired word reading: computational principles in quasi-regular domains. *Psychological Review* 103:56–115.
- Pullum, G. K., and Gazdar, G. (1982). Natural languages and context-free languages. *Linguistics and Philosophy* 30(2):471-504.
- Rastle, Kathleen, Matthew H. Davis, and Boris New (2004). The broth in my brother's brothel: morpho-orthographic segmentation in visual word recognition. *Psychonomic Bulletin and Review* 11:1090– 1098.
- Rice, K. (2000). *Morpheme order and semantic scope*. Cambridge: CUP.
- Sandler, W. & D. Lillo-Martin. (2006). *Sign language and linguistic universals*. Cambridge: Cambridge University Press.
- Seidenberg, M. S., & J.L. McClelland. (1989). A distributed, developmental model of word recognition and naming. *Psychological Review* 96:523–568.
- Starke, M. (2009). Nanosyntax - A short primer to a new approach to language. *Nordlyd*. DOI: <https://doi.org/10.7557/12.213>.
- Steele, S. (1995). Towards a theory of morphological information. *Language* 71:260-309.
- Stewart, T. & G. Stump (2007). Paradigm Function Morphology and the Morphology– Syntax Interface. In G. Ramchand & C. Reiss (eds.), *The Oxford handbook of linguistic interfaces*, 383-421. Oxford: Oxford University Press.
- Stiebels, B. (2011). Minimalist Morphology. Ms. University of Leipzig. Available at:

[http://home.uni-leipzig.de/stiebels/papers/handbook\\_morphology\\_stiebels\\_mm-2011.pdf](http://home.uni-leipzig.de/stiebels/papers/handbook_morphology_stiebels_mm-2011.pdf)

- Stockall, Linnaea & Alec Marantz (2006). A single route, full decomposition model of morphological complexity: MEG evidence. *The Mental Lexicon* 1:85–123.
- Stump, G. T. (1997). Template morphology and inflectional morphology. In G. Booij & J. van Marle (Eds.), *Yearbook of morphology 1996* (pp. 217–241). Dordrecht: Kluwer.
- Stump, G. T. (2001). *Inflectional morphology*. Cambridge: Cambridge University Press.
- Taft, Markus & Kenneth Forster (1975). Lexical storage and the retrieval of prefixed words. *Journal of Verbal Learning and Verbal Behavior* 14: 630-647.
- Taft, Markus & Kenneth Forster (1976): Lexical storage and retrieval of polymorphemic and polysyllabic words. *Journal of Verbal Learning and Verbal Behavior* 15: 607-620.
- Taft, Markus (1979). Recognition of affixed words and the word frequency effect. *Memory & Cognition* 7 (4): 263-272.
- Wunderlich, Dieter (1996). Minimalist morphology: the role of paradigms. In G. Booij & J. van Marle (eds.), *Yearbook of Morphology 1995*, 93–114. Dordrecht: Kluwer.
- Zwicky, A. (1985). Clitics and particles? *Language* 61:283-305.

Chiara Zanini<sup>1,2</sup>, Rosa Rugani<sup>3</sup>, Dunia Giomo<sup>4</sup>, Francesca Peressotti<sup>5</sup>, \*Francesca Franzon<sup>2,4</sup>

<sup>1</sup>Romanisches Seminar (RoSe), Universität Zürich; <sup>2</sup>Department of Neuroscience (DNS), University of Padova

<sup>3</sup>Department of General Psychology (DPG), University of Padova; <sup>4</sup>Neuroscience Area, International School for Advanced Studies (SISSA); <sup>5</sup>Department of Developmental Psychology and Socialization (DPSS), University of Padova

\*address for correspondence: ffranzon@sissa.it

Francesca Franzon, Ph.D.,

Neuroscience Area - International School for Advanced Studies (SISSA)

Via Bonomea 265 - 34136, Trieste, Italy

# **Effects of animacy on the processing of morphological Number: a cognitive inheritance?**

## **Abstract**

Language encodes into morphology part of the information present in the referential world. Some features are marked in the great majority of languages, such as the numerosity of the referents that is encoded in morphological Number. Other features do not surface as frequently in morphological markings, yet they are pervasive in natural languages. This is the case of animacy, that can ground Gender systems as well as constrain the surfacing of Number. The diffusion of numerosity and animacy could mirror their biological salience at the extra-linguistic cognitive level. Human extra-linguistic numerical abilities are phylogenetically ancient and are observed in non-human animal species, especially when counting salient animate entities such as social companions. Does the saliency of animacy influence the morphological encoding of Number in language processing?

We designed an experiment to test the encoding of morphological Number in language processing in relation to animacy. In Italian, Gender and Number are mandatorily expressed in a fusional morpheme. In some nouns denoting animate referents, Gender encodes the sex of referents and is semantically interpretable. In some other animate nouns and in inanimate nouns, Gender is uninterpretable at the semantic level. We found that it is easier to inflect for Number nouns when the inflectional morpheme is interpretable with respect to a semantic feature related to animacy. We discuss the possibility that the primacy of animacy in counting is mirrored in morphological processing and that morphology is designed to easily express information that is salient from a cognitive point of view.

**Keywords:** animacy, gender, morphological Number, numerical cognition.

## 1 Introduction

Natural languages communicate information about entities of the referential world most evidently by conveying it through lexical words. Potentially, any meaning can be encoded at the lexical level, and new signs can be added when needed. However, the possibility to convey information about the reference is not confined to the lexicon: also grammaticalised elements, such as morphological values, can bear semantic content. Crucially, the semantic features that can be conveyed through morphology form a finite set and are cross-linguistically very consistent. For example, the great majority of the languages have verbal tense, aspect and mood paradigms to encode properties of events (156 out of 160 considered languages in the WALS map 21B, by Bickel & Nichols 2013) or number paradigms to encode plurality (968 out of 1066 reported languages in the WALS map 33A by Dryer 2013). Yet, at least to our knowledge, no language shows dedicated morphological values to encode properties like colour or olfactory information. Why does morphology encode prevalently some meanings and not others? Is there something special about the information on which morphological paradigms are built? In the framework of the inexhaustible debate on the link between language and thought (among others: Chomsky 1988; Greenberg 1948; Hurford 1987; Hymes 1964; Lucy 1992; Sapir 1921; Whorf 1956), it has been proposed that the core structure of the natural languages would stem from processing mechanisms rather than the other way round (Christiansen & Chater 2008) and recent literature has highlighted the role of languages as advanced communicative systems that allow speakers to share information coming from mental experiences, and from the core knowledge systems in particular (e.g. Corballis 2017). The core knowledge systems are a tool-kit of non-verbal cognitive skills that allow humans and animals to represent the most salient aspects of the environment, and to behave accordingly (Cantlon & Brannon 2007; Dehaene 2011; Rugani et al. 2015; Spelke 2000; Starr, Libertus & Brannon,

2013). These skills seem to have played a crucial role in evolutionary success: they seem to be present soon after birth in humans and to have a phylogenetically ancient origin, as they are mostly shared with non-human animal species. World aspects they represent encompass object representation, numerical abilities, as well as abilities concerning naïve physics, time, space, and motion (Carey 2009; Spelke 2000). Recently, a link has been outlined between this information and information encoded in morphology and morpho-syntax, suggesting that information processed by these systems would be so salient to have shaped the grammatical structure of language. In other words, information encoded in a core linguistic level, such as morphology, would stem from information coming from core knowledge processes (Bickel et al. 2015; Franzon, Zanini & Rugani 2018; Strickland 2017; Zanini et al. 2017).

Among the elements that could allow us to explore a hypothetical link between core grammar and core cognition, Number morphology could offer an especially suitable testbed for several reasons. First, the grammatical encoding of information about numerosity is widespread throughout natural languages (Corbett 2000). The WALS reports that 90.8% of the considered languages have a grammatical device to convey nominal plurality (Dryer 2013). The author points out that the remaining about 10% of the languages is difficult to interpret and could as well display some markings for Number. Moreover, this estimate increases when considering that Number can be marked not only on nouns and pronouns but also on verbs, referring to the numerosity of participants in an action, or to the number of times, or places in which an action is performed (Veselinova 2013). The fact that Number morphology is so pervasive across languages may consistently mirror the salience of the information about numerosity at the extra-linguistic cognitive level. A further noteworthy contact point between core grammar and numerical cognition can be traced back to some similarities between the information encoded into morphological systems and the one processed in extra-linguistic numerical cognition: the values of

morphological Number systems observed in typology closely resemble the information processed by the non-verbal systems dedicated to number and quantity processing (Franzon, Zanini & Rugani 2018). Most literature agrees on the fact that numerical reasoning is handled by two non-verbal numerical cognitive mechanisms: the Object File System (OFS) and the Analogue Magnitude System (AMS) (Feigenson, Dehaene & Spelke 2004). The OFS is founded on the capability of individuating each new object entering into a scene, to which a new file (object file) is assigned and stored in the working memory; its signature is a limit to the number (usually 3 or 4) of object-files that can be simultaneously tracked and stored (among others: Trick & Pylyshyn 1994). The AMS can deal with larger numerosities and its functioning would be ratio-dependent according to Weber's law: it is easier to discriminate between quantities or numerosities when the ratio between them is bigger (among others: Gallistel & Gelman 1992).

Crucially, these core numerical abilities can be observed independently from linguistic abilities, such as in educated adult humans when, under specific experimental conditions, language use is prevented (Cordes et al. 2001) or in adult speakers having no number words (Butterworth et al. 2008; Pica et al. 2004); in preverbal infants (deHevia 2011; McCrink & Wynn 2007); and in non-human animals, especially when counting salient animate entities (Agrillo et al. 2014; Rugani et al. 2010, 2015; Vallortigara 2012; Cantlon & Brannon 2006). In this regard, it is worth noticing that numerical abilities are not implemented in an indiscriminate way, but are carried out relatively to some life aspects which are salient from a biological point of view like counting animate beings, especially if these latter are social companions (Rugani et al. 2010). Interestingly enough, also the surfacing of Number in morphological paradigms can be constrained by many features among which we find the ones related to a hierarchy of animacy (Dixon 1979; Smith-Stark 1974). Animacy has been mostly described as a

lexical feature; in fact, it does not surface as diffusely as numerosity in morphological markings. Yet, animacy is pervasive in natural languages (Dahl 2000) and can play a transparent role in shaping morphological paradigms (Corbett 1991). Generally, nouns are more likely to be inflected for Number when the corresponding referents are higher in the animacy hierarchy; according to Corbett (2000) “the singular - plural distinction in a given language must affect a top segment of the Animacy Hierarchy” (Corbett 2000: 56). Scholars have proposed different animacy hierarchies, either grammar-based or semantic-based, all of these placing pronouns and kinship terms on the top and nouns denoting inanimate referents on the lower steps (Dixon 1979; Matasović 2004; Smith-Stark 1974; for a critical discussion, see Corbett 1996 and Brown et al. 2013). These generalizations formalise consistencies observed across natural languages and are to some extent captured in the WALS maps 34A (Haspelmath 2013) and 35A (Daniel 2013). For example, Malay marks Number on personal pronouns but not on nouns, Sarsi marks Number only for kinship terms, Manchu on pronouns and nouns denoting human beings, Comanche marks Number for animate referents, but rarely for inanimate ones (Haspelmath 2013; Daniel 2013).

Could the diffusion of numerosity and the pervasiveness of animacy in morphological paradigms mirror their biological salience and phylogenetic ancestry at the extra-linguistic cognitive level? Does the saliency of animacy influence the morphological encoding of Number in language processing? Unfortunately, up to now the link between numerical cognition and its encoding into language has been mainly investigated by focusing on the lexicon and on words expressing quantities and number such as quantifiers, ordinal and cardinal numbers (e.g. Butterworth et al. 1999; Carey 2004; Clark & Grossman 2007; Gelman & Gallistel 2004; Gordon 2004; Lipton & Spelke 2003; Ochtrup et al. 2013; Pica et al. 2004; Rath et al. 2015; Salillas, Barraza & Carreiras 2015; Semenza 2008; Troiani et al.

2009), while fewer studies have taken into account morphology. However, preliminary results seem promising as they point to the fact that quantity representation is accessed while processing morphological Number. For example, children who speak languages displaying morphological Number values (e.g., singular, plural, dual) have been shown to acquire the relevant number words (such as ‘one’ or ‘two’) earlier than children who speak languages without morphological Number values (Almoammer et al. 2013; Marušič et al. 2016; Sarnecka et al. 2007). A study conducted on German by Roettger & Domahs (2015) reported an effect similar to SNARC (spatial-numerical association of response codes) related to morphological Number in performing a series of behavioural tasks. The authors found that words inflected in the singular had a relative left-hand advantage and words in the plural a relative right-hand advantage.

## 1.1 The study

For the first time, we designed an experiment to test the encoding of morphological Number in language processing and its interaction with animacy. In Italian, Gender and Number are mandatorily expressed in a fusional morpheme (e.g., *gatto* ‘cat-Masc.Sg’). Yet, while Number is semantically interpretable in almost every noun, the semantic interpretability of Gender is restricted to some lexemes denoting animate referents (1a). More precisely, in some animate nouns, the semantic opposition of the sex of the referents corresponds to a morphological opposition of Gender<sup>1</sup>. However, in some other animate

---

<sup>1</sup>A clarification is needed here. In general, in Italian, Gender is inherent to nouns (e.g. the noun *sedia* ‘chair’ is inherently feminine and it cannot take masculine Gender in other contexts). Instead, Gender is contextually assigned in the case of adjectives (e.g. the Gender of an adjective depends on the Gender of its controller: *la sedia nuova* ‘the.Fem.Sg chair-Fem.Sg new-Fem.Sg’ vs. *il divano nuovo* ‘the.Masc.Sg sofa-Masc.Sg new-Masc.Sg’). However, some animate nouns seem to behave like the adjectives as they alternatively bear masculine Gender with male referents and feminine Gender with female referents (e.g. *il sarto* ‘the.Masc.Sg tailor-Masc.Sg’ vs. *la sarta* ‘the.Fem.Sg tailor-Fem.Sg’). Some scholars argue that Gender is inherently assigned to these nouns as well. According to this view, the two nouns will be derivationally and not inflectionally related (Matthews 1974; Thornton 2005; Zamparelli 2008). Conversely, other scholars claim that Gender is contextually assigned to these nouns that can thus be alternatively inflected in the masculine or in the feminine (Di Domenico 1997; Franzon et

nouns, Gender does not encode such opposition and thus is not interpretable with respect to the sex of the referent (1b). Lastly, in inanimate nouns, Gender is not related to any semantic feature<sup>2</sup> and thus is not interpretable (1c).

- (1) a. *gatto* vs. *gatta*  
           cat-Masc.Sg              cat-Fem.Sg  
     b. *topo*      vs.      ∅  
           mouse-Masc.Sg  
     c. *sasso*      vs.      ∅  
           stone-Masc.Sg

Henceforth, nouns such as the one exemplified in (1a) are referred to as ANIM\_G. For example, animate nouns with semantically interpretable Gender; nouns of the same type of the one illustrated in (1b) are called ANIM\_I, e.g. animate nouns with inherent Gender; type (1c) nouns are labelled INANIM, e.g. inanimate nouns. Based on literature mentioned in our introduction (§1), we hypothesised a cognitive advantage for animate nouns over inanimate nouns whenever speakers inflect them for Number. Two scenarios can be supposed. In the first case, it may be easier to inflect for Number all animate nouns,

---

al. 2013). It is beyond the aims of the present study to take a position in this debate. Rather, we just aimed to verify whether animate nouns showing a masculine/feminine alternation are processed differently from animate nouns which, instead, do not show this possibility.

<sup>2</sup> According to some scholars, Gender does encode semantic features even in the case of nouns denoting inanimate referents. For example, a set of Italian inanimate nouns can appear in oppositions as *buco* ‘hole-Masc.Sg’ vs. *buca* ‘large hole-Fem.Sg’. These Gender oppositions would concern the feature of dimension and the morphological value of feminine would be linked to an interpretation of [+ large]. Even if this kind of opposition is widely attested in Standard Italian as well as in many Italo-Romance dialects, it seems not to be productive (on this and related points see, among others, Acquaviva 2013). It must be noticed that this type of oppositions was avoided in our experimental design.

irrespective of interpretability of their Gender. Then, we would expect that both ANIM\_G and ANIM\_I nouns will be inflected more accurately than INANIM ones. In the second case, it may be that only animate nouns whose Gender is interpretable at the semantic level are inflected more easily and thus more accurately than both ANIM\_I and INANIM in the experimental task. Our working hypotheses are summarised in (2):

- (2) a. ANIM\_G (*gatto*), ANIM\_I (*topo*) > INANIM (*sasso*)  
 b. ANIM\_G (*gatto*) > ANIM\_I (*topo*), INANIM (*sasso*)

Before illustrating the experimental methodologies, it must be clarified that, in Italian, the Gender of a noun is unambiguously detectable only in phrasal contexts. For example, both *tavolo* ‘table’ and *mano* ‘hand’ share the same feminine final inflectional suffixes: *-o* for the singular and *-i* for the plural (*tavoli* ‘tables’, *mani* ‘hands’). In other words, these two nouns share the same declensional class characterised by a two cell paradigm (singular: *-o*; plural: *-i*). Nevertheless, the first noun triggers masculine agreement (*il tavolo bello* ‘the.Masc.Sg table-Masc.Sg nice-Masc.Sg’) whereas the second noun triggers feminine agreement (*la mano bella* ‘the.Fem.Sg hand-Fem.Sg nice-Fem.Sg’). Traditionally, six declensional classes have been recognised for Italian (for a more extensive description and discussion see, among others: Acquaviva 2009; Aronoff 1994; Corbett 1991). Class I is characterised by a two cell paradigm (singular: *-a*; plural: *-e*) and includes feminine nouns only (e.g. *sedia* - *sedie* ‘chair - chairs’). Class II is the class to which the above mentioned nouns *tavolo* and *mano* belong; this class includes masculine nouns except for *mano* that is instead feminine. Even if there is no one-to-one correspondence between declensional classes and Gender in Italian, it is worth noticing that Class I and Class II are the

most productive classes as well as the most transparent with respect to Gender (again, with the sole exception of *mano*).

Further, it must be noticed that Gender and biological sex do not necessarily coincide; for example, some animate nouns trigger masculine agreement, but denote female referents (e.g. *il soprano* ‘the.Masc.Sg soprano-Masc.Sg’). Yet, even if Italian inflectional suffixes are not iconic with respect to animacy and there is no one-to-one correspondence between declensional classes, grammatical Gender and biological sex, a strong trend is still observable. Prototypically, animate nouns belonging to the declension Class I (*-a/-e*) and bearing feminine Gender tend to denote female beings, whereas animate nouns belonging to the declension Class II (*-o/-i*) and bearing masculine Gender tend to denote male beings (this and related topics have been extensively discussed in Loporcaro 2018 taking into account the diversity found in the Romance varieties).

## 2 Method

### 2.1 Participants

Thirty-six young adult native speakers of Italian took part in the study as volunteers (females = 31; mean age = 21.86; min age = 19; max age = 36; SD = 3.29; mean education = 13.55; min education = 13; max education = 18; SD = 1.29). All participants were right-handed, had normal or corrected-to-normal vision, and had no reported history of neurological or psychiatric impairments, and no reading or learning disorders. All participants signed a written informed consent before taking part in the study.

### 2.2 Procedure

Participants were tested in a dimly lit, quiet room. They performed a phrase-completion task on a computer screen. The task was delivered with PsychoPy software (Peirce 2007). Each trial consisted of the following sequence: first, a fixation cross appeared in the centre of the screen; afterwards, a noun phrase made up of two words showed up. One or the other word lacked the inflectional morpheme. The participants were asked to complete the word at issue as accurately and quickly as possible by pressing a button to insert *-o* or another one to insert *-i*. The response keys were counterbalanced across participants. The sentence remained visible until the participant gave a response. After 250 ms a new sentence was presented. For each trial, response times (RTs) and accuracy were recorded. Eight practice trials were administered before beginning an experiment, to familiarise participants with the task. Trials were randomly presented for each participant. The overall task lasted about 30 minutes. The task included two breaks, thus the participants had an opportunity to rest every 10 minutes. The participants were instructed to take a break and resume when they preferred.

### **2.3 Materials**

We created 158 experimental trials. For each of the three *Types* illustrated in (1), we selected: 20 animate nouns with interpretable Gender (ANIM\_G, *gatto* ‘cat’), 19 animate nouns with semantically uninterpretable Gender (ANIM\_I, *topo* ‘mouse’) and 20 inanimate nouns (INANIM, *sasso* ‘stone’). Each experimental noun was presented in two conditions of *Number*, namely masculine singular and masculine plural. To keep semantic variability at minimum across conditions, we chose two semantic classes for nouns with animate referents (animals and human roles) and two for nouns with inanimate referents (food and materials). Twenty INANIM nouns with an infrequent plural form were added to

prevent participants from focussing on the experimental manipulations. Experimental types of noun are summarised in Table (1).

**Table 1: Types of experimental nouns**

Type	Num	Semantic classes	Gender	Number
ANIM_G	20	humans and animals	masculine and feminine	singular and plural
ANIM_I	19		only masculine	
INANIM 1	20	food and materials		
INANIM 2	20			only singular

Only non-compounded and non-derived nouns with a regular inflection and belonging to declensional classes I and II were included in the experimental items. Since the experiment was a (reading) task administered visually, nouns whose singular form presents a different number of graphemes with respect to the corresponding plural one were discarded (e.g. *uomo – uomini* ‘man – men’; *sacco – sacchi* ‘bag – bags’). Frequency as collected from the itWaC corpus (Baroni et al. 2009), orthographic length and orthographic neighbourhood of the experimental nouns were controlled and matched across conditions as far as possible. Indeed, effects due to frequency are well-known to affect visual presentation of visual stimuli at least from Forster & Chambers (1973). In particular, the four experimental categories (ANIM\_G, ANIM\_I, INANIM 1, INANIM 2) did not significantly differ from each other as for masculine singular forms (all  $p > 0.05$ ).

Further, also the experimental categories were assigned on the basis of quantitative methods by considering the distribution of masculine forms and of feminine forms on the total occurrences. Potentially, it is possible to derive both masculine and feminine forms of all nouns denoting an animate referent, given Italian word formation rules (on this point see also §5). This observation may lead to the conclusion that any categorization of Italian nouns as ANIM\_G or ANIM\_I is inconsistent. To prevent

arbitrary classifications, we performed corpus analysis to disentangle well attested forms from hapaxes, jokey saying and innovative/not yet established forms. We considered as ANIM\_G only those nouns significantly occurring with a similar frequency (as collected from the itWaC corpus) in the masculine singular and in the feminine singular (mean Masc = 13718.25, mean Fem = 10029.95, t (19) = 1.51, p > 0.05); whereas, we considered as ANIM\_I only those nouns occurring significantly more in the masculine singular than in the feminine singular (mean Masc = 14356.84, mean Fem = 46.894, t (18) = 0.04, p < 0.05). In other words, the mean ratio of the distribution of ANIM\_G masculine forms on the total occurrences is 0.559 (SD = 0.199) and that of the corresponding feminine forms is 0.44 (SD = 0.199); conversely, the mean ratio of the distribution of ANIM\_I masculine forms on the total occurrences is 0.986 (SD = 0.024) and that of the corresponding feminine forms is 0.013 (SD = 0.024). Similarly, we did not assign any noun to the category of INANIM 2 (implausible plural) on the basis of their reference to mass entities. In fact, it is well known from the literature that even if the so called mass nouns are inflected in the singular, it is not uncommon for some of them to occur in the plural as well (for Italian see: Acquaviva 2013; Marcantonio & Pretto 2001; for quantitative studies tackling the distribution of mass and count nouns in Italian see: Franzon, Arcara & Zanini 2016; Katz & Zamparelli 2012; Kulkarni, Rothstein & Treves 2013). Instead, we labelled as INANIM 2 those nouns occurring significantly more in the singular than in the plural (as collected from the itWaC corpus; mean Sg = 12638.7, mean Pl = 279.25, t (19) = 3.01, p < 0.05); whereas nouns of the other three categories are evenly distributed between singular and plural occurrences (ANIM\_G: mean Sg = 13718.25, mean Pl = 16152.4, t (19) = 0.36, p > 0.05; ANIM\_I: mean Sg = 14356.84, mean Pl = 12393.89, t (18) = 0.32, p > 0.5; INANIM 1: mean Sg = 13278.15, mean Pl = 11858.489, t (19) = 0.18, p > 0.05). Given all

these constraints and observations, we selected the nouns that best fit the experimental purposes<sup>3</sup>.

Experimental nouns are listed in Appendix.

Each experimental trial consists of a phrase in which the content noun lacking the final inflectional morpheme (e.g. *-o* for masculine singular and *-i* for masculine plural) was preceded by the demonstrative *questo* ‘this’ to constrain agreement in the masculine singular and *questi* ‘these’ to constrain agreement in the masculine plural. 220 filler trials were added to avoid perseveration strategies in the participants’ performance. 110 filler trials required completion on the demonstrative instead and, among these, 60 nouns did not belong to declensional classes I and II, but to classes less transparent with respect to Gender (e.g. *fantasma* ‘ghost’ which ends in *-a* but triggers masculine agreement or *cane* ‘dog’ which ends in the opaque suffix *-e*). The other 110 filler trials required completion on the content nouns but these latter, differently from the experimental trials, trigger feminine agreement although not belonging to declension Class I (e.g., *mano - mani* ‘hand - hands’ belonging to Class II *-o/-i*; *l'ipotesi – le ipotesi* ‘the.Fem.Sg hypothesis - the.Fem.Pl hypotheses’, invariable). Experimental and filler trials are summarised in Table (2).

**Table 2: Experimental and filler trials**

Trials			Key to press
Experimental	<i>Questo gatt-</i> _	‘This cat-’	O for Masc.Sg
Experimental	<i>Questi gatt-</i> _	‘These cat-’	I for Masc.Pl
Filler	<i>Quest- fantasma</i>	‘This- ghost’	O for Masc.Sg
Filler	<i>Quest- cane</i>	‘This- dog’	O for Masc.Sg
Filler	<i>Questa ipotes-</i> _	‘This hypothesis-’	I for Fem.Sg
Filler	<i>Queste nav-</i> _	‘These ship-’	I for Fem.Pl

<sup>3</sup> It must be noted that nouns of the category ANIM\_G vary semantically less than those of the category ANIM\_I since the former mainly refer to humans while the latter refer both to humans and animals. We applied quantitative methodologies to trace the best possible categorisation for the experimental purposes, as explained in §2.3. It is not surprising that there is a high probability that a noun occurring equally in the masculine and in the feminine (and thus having interpretable gender) denotes a human referent. Indeed, features linked to human references are set in the top segments of the animacy hierarchy and are the more prone to constrain Gender (and Number) systems (Corbett 1991; Matasović 2004). In this sense, we think that our selection of the experimental nouns is genuine and reflects a general language property. Such a distribution, though, was taken into account when discussing experimental results (see §3).

## 2.4 Data analysis

Data were analysed by means of the R software for statistical analysis (R core team 2014). We used generalised linear mixed models (Baayen, Davidson & Bates 2008) to investigate the influence of the type of the stimuli as well as other variables (such as frequency) on the response times and on the accuracy with which participants completed the task. We fitted two models, one for RTs (Model 1) and one for accuracy (Model 2; see §3 for more details on the two models), in which *Absolute frequency*, *Type* (ANIM\_G, ANIM\_I, INANIM), *Animacy* (animate, inanimate), *Number* (singular, plural) and the interactions *Type x Number* and *Animacy x Number* were added as fixed effects.

## 3 Results

As a convention, response times shorter than 200 ms and longer than 2000 ms were discarded. Trials involving inanimate nouns with implausible plurals (e.g. mass nouns) were not considered in the analysis. Rough means on response times (RTs) are reported in Table (3) and the results of the corresponding model are summarised in Table (4). The analysis revealed a main effects of *Frequency* (the more frequent a noun the faster it was completed), *Number* (singulars were completed faster than plurals) and *Animacy* (animates were completed faster than inanimates). We observed also the interaction *Number x Animacy* (inanimate plural nouns were completed slower), but no *Type* effect.

**Table 3: Mean response times (RTs)**

The standard deviations (SDs) are given in brackets.

	Singular	Plural
<b>Animate</b>	1054.939 (387.334)	1093.049 (394.009)
<b>Inanimate</b>	1078.532 (402.985)	1210.722 (474.919)

**Table 4: Summary of Model 1 (RTs)**

	<b>Value</b>	<b>Std.Error</b>	<b>DF</b>	<b>t-value</b>	<b>p-value</b>
<b>(Intercept)</b>	1105.5470	32.54351	2623	33.97135	0.0000
<b>Frequency</b>	-0.0011	0.00022	2262	-4.97362	0.0000*
<b>Animacy_inanimate</b>	108.9177	15.36830	2623	7.08717	0.0000*
<b>Number_Sg</b>	-42.8439	14.65413	2262	-2.92368	0.0035*
<b>Animacy_inanimate x Number_Sg</b>	-84.1292	20.70054	2262	-4.06411	0.0000*

Rough means on accuracy<sup>4</sup> are reported in Table (5) and the results of the corresponding model are summarised in Table (6) and plotted in Figure (1). The analysis revealed no effect of *Frequency*, but a main effect of *Type*: ANIM\_G trials were completed more accurately than both ANIM\_I and INANIM ones. No main effect of *Number* was found, nevertheless the interaction *Type x Number* reached significance: singular ANIM\_I trials were completed more accurately than plural ANIM\_I ones and the same trend was observed for INANIM trials. Conversely, no difference between singular and plural trials was found in the ANIM\_G condition.

**Table 5: Mean accuracy**

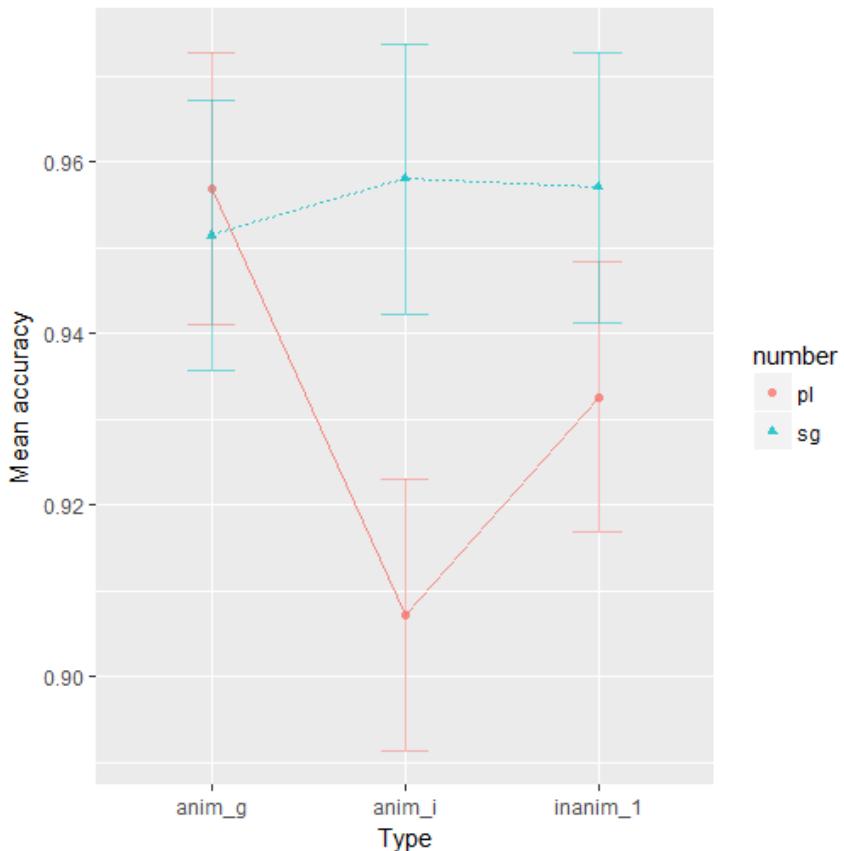
The standard deviations (SDs) are given in brackets.

	<b>Singular</b>	<b>Plural</b>
<b>ANIM_G</b>	0.952 (0.213)	0.957 (0.202)
<b>ANIM_I</b>	0.958 (0.2)	0.908 (0.289)
<b>INANIM</b>	0.958 (0.199)	0.933 (0.249)

<sup>4</sup> Given the task explained in §2.3, accuracy errors consisted in pressing the wrong key to insert the final inflectional morpheme. They were made every time the O key (instead of the I key) was pressed to complete phrases such as *questi gatt-* ‘these cats’ and every time the I key (instead of the O key) was pressed to complete phrases such as *questo gatt-* ‘this cat’.

**Table 6: Summary of Model 2 (accuracy)**

	Value	Std.Error	DF	t-value	p-value
(Intercept)	0.9552212	0.012132315	1968	78.73363	0.0000
TypeAnim_i	-0.0488176	0.012341895	1968	-3.95544	0.0001*
TypeInanim	-0.0241507	0.012146503	1968	-1.98828	0.0469*
TypeAnim_i x NumberSg	0.0556736	0.017424384	1957	3.19515	0.0014*
TypeInanim x NumberSg	0.0304845	0.017188911	1957	1.77350	0.0763

**Figure 1: Accuracy in the completion of ANIM\_G, ANIM\_I and INANIM trials**

#### 4 Discussion

We designed an experimental task to observe whether it was easier to inflect for Number nouns denoting animate referents than nouns denoting inanimate referents. To this purpose, young adult Italian speakers were asked to complete as fast and as accurately as possible a set of nouns lacking the inflectional morpheme. Our working hypotheses, summarised in (2, §1.1) and repeated here in (3), concerned not

only the interaction between Number and animacy (3a), but also the interaction between Number and the semantic interpretability of Gender as related to animacy (3b). We predicted that the primacy of animacy in Number inflection could involve either all nouns denoting animate referents irrespective of the semantic interpretability of their Gender (3a) or only those nouns denoting animate referents and with an interpretable Gender (3b).

- (3) a. ANIM\_G (*gatto*), ANIM\_I (*topo*) > INANIM (*sasso*)  
b. ANIM\_G (*gatto*) > ANIM\_I (*topo*), INANIM (*sasso*)

Results show two different patterns with respect to the type of the investigated dependent variable: RTs or accuracy. First of all, in both cases, we did observe an effect of animacy, thus providing evidence in favour of the idea that assign the Number value on nouns denoting animate referents is an easier task (at least for young adult Italian speakers). However, while an overall effect of animacy matching the scenario in (3a) emerged when considering the RTs, an effect related to the interpretability of animacy in accordance with scenario in (3b) better explained participants' performance on accuracy. Moreover, frequency and Number significantly predicted the RTs, consistently with findings across the psycholinguistic literature. Intriguingly, though, these predictors lacked significance when examining accuracy.

On the one hand it is not surprising that different effects can be traced back to different variables, on the other hand such differences need an explanation. Here, we tentatively suggest that the pattern exemplified in (3a) may resemble a general inter-linguistic effect. In other words, the results obtained for the RTs can be explained assuming some primacy of animacy in assigning morphological Number

values, irrespective of the interpretability of Gender values and, thus, irrespective of whether the inflectional paradigm is semantically transparent in relation to Gender. Taking this reasoning to the extreme, it may be hypothesised that it is easier (e.g. faster) to assign the Number value on nouns denoting animate referents regardless of how morphological Gender shapes or does not shape a Number paradigm and thus independently from the language at issue. Conversely, results on accuracy seem to be more sensitive to the way a Number paradigm is shaped. In this latter case, the performance cannot be explained as an effect of animacy alone since it seems easier (e.g. more effortless in terms of precision) to assign the Number value on nouns when the inflectional morpheme is interpretable with respect to a semantic feature related to animacy, as sketched in (3b). This effect depends on how a particular paradigm is built and on the interpretability of the morphological values; thus, it may be a Gender-related and language-specific effect.

It could be objected that the semantic interpretability of Gender is not accountable for the pattern we found as nouns of the category ANIM\_G vary semantically less than those of the category ANIM\_I (see Note 3, §2.3). Since the former mainly refer to humans while the latter refer both to humans and animals, it could be that our results reflect more a human vs. non-human distinction rather than a more general interpretable vs. uninterpretable Gender difference. First of all, since nouns denoting human referents are included in both categories, a difference between these latter should be unexpected. Yet, since a significant difference between the two categories both including human referents is observed, it can be argued that this pattern is more likely to reflect an interpretable vs. uninterpretable Gender distinction. Secondly, it must be remarked that our experimental stimuli categorisation was conducted using quantitative methodologies and thus may genuinely reflect a general language property, namely the fact that nouns occurring equally in the masculine and in the feminine (and thus having interpretable

Gender) are more likely to denote human referents. Indeed, features linked to human references are set in the top segments of the animacy hierarchy and are the more liable to shape morphological systems (Corbett 1991; Matasović 2004). Since Gender interpretability and human reference seem to covary, arguing that our results reflect a human vs. non-human distinction is not challenging with respect to the tentative interpretation we gave. In fact, semantic interpretability of morphemes may speed up linguistic processing – and thus verbal communication – especially when morphological paradigms encode cognitively salient information (such as numerosity, animacy, and relatedness to humans).

If we are on the right track in interpreting our findings, new light can be shed on the relationship between numerical cognition, morphological Number and linguistic diversity. On the one hand, our results suggest that numerical cognition is mirrored in the morphological processing of Number by highlighting some parallelism between the primacy of animacy in counting and the primacy of animacy in inflecting nouns for morphological Number. This interpretation is in accordance with those hypotheses claiming that the foundations of language lay on core cognition rather than the other way round, along the lines explored by recent frameworks on biology and language evolution (for a review see Corballis 2017; for a different perspective see also Everaert et al. 2017; Everett 2017; Overmann 2015). Here, we suggest that cognition seems to design morphology, Number morphology in particular, in order to make information that is salient from a biological point of view quickly communicable. In this regard, it is trivial recalling here that, by definition, a morphological paradigm entails an opposition of at least two values; in other words, Number morphology systematically encodes different numerosities onto different values. Precisely, as the exponents of these values are mostly phonologically short and are mostly mandatorily expressed (Dressler 1989), they can convey information about numerosity systematically and thus efficiently. In addition, since number as a real-world category is inherently

structured, learning theory predicts that morphological Number hierarchy as reported in linguistic typology should emerge naturally and universally in language, as a consequence of reflecting these real-life contingencies (Malouf, Ackerman & Seyfarth 2015).

On the other hand, it is undeniable that, to some extent, natural languages are different from each other and that differences are related also to grammar and (Number) morphology and not only to the lexicon. What are the sources of linguistic diversity if cognitive constraints are the same for every language and every speaker? While linguistic typology traditionally had a main focus on language universals (Greenberg 1963; Comrie 1981), the emphasis has been now shifted on linguistic diversity as a basic property of human language (Evans & Levinson 2009). Tracing the origins of language variation and change transcends the purposes of this paper; yet, our results suggest that cross-linguistic divergences may lie at the root of genuinely linguistic, paradigmatic issues rather than in core cognition issues dealing with how speakers conceive the surrounding world. Ultimately, if it is true that core cognition seems to cross-linguistically constrain which information can be encoded onto morphological values, it is also true that morphology works autonomously as for the way such information can be encoded and structured in different paradigms.

## 5 Conclusions and future directions

In this paper we explored the idea that morphological processing mirrors core cognitive processing, by addressing the relationship between numerical cognition, Number morphology, and animacy. Indeed, we found that the primacy of animacy in counting seems to have a counterpart in morphological processing, suggesting that (Number) morphology is designed to easily express information that is salient from a biological point of view. Our results consistently pointed to some primacy of animacy in

assigning Number values; however, they must be partially traced back to language-specific effects. In particular, the following questions must be tackled by testing other languages with different Number paradigms: can animacy effects be replicated in other Number paradigms either with transparent or non-transparent Gender inflection? Can similar effects be found for other features that are encoded in morphology? Are those features salient from a cognitive point of view?

For example, in Bulgarian, animacy does not affect the declensional system. However, semantic features related to sex do: in the masculine plural, the nouns that do not denote male human referents have a special Number form (count plural). Similarly, in the complex declension system of Polish, masculine plural nouns denoting male humans are inflected differently from all other masculine plural nouns. These observations may lead to a broader question that has not been addressed directly in this study, i.e. the “gender fairness” of language, and that can however benefit from some observations about the effects of the structural properties of languages. Natural languages, and especially morphology, do not encode all information related to a referential entity, but just a part of it. This reduction of information may be very drastic, to the point of encoding into binary oppositions some referential features that are far more complex or fuzzy. For example, Number morphology most frequently surfaces as the binary opposition ‘one’ (singular) vs. ‘different from one’ (plural), but the numerosities that can be perceived and conceived are more varied, as shown in the introduction (§1). The reduction of complexity can result in a more economic communication of some types of information, namely the ones that have likely been salient at some point of our evolutionary life. However, the role of morphology, and especially of inflection, is also functional, because it provides the agreement features that are required to build relations between words. As a consequence of this, inflectional morphemes can be available to perform functional operations and thus their value cannot

be always linked to referential or semantic properties. When a morpheme is used as a default, it is, in principle, not interpretable at the semantic level. Number morphology is not an exception in this regard: the singular is generally the default value for uncountable references (whereas other Number values are more likely to be semantically interpretable; Franzon, Zanini & Rugani 2018; Arcara et al. 2018).

In languages like Italian, the default value for animate nouns with interpretable gender is the masculine, which is also the value used to encode a male referent. The clash of interpretability between the formal value and its semantic content is behind the idea that some linguistic systems do not meet the requirements called for male and female equality, as emerged from the current debate about the “gender fairness” of language. On the one hand, grammatical Gender and declensional classes are abstract formalisations, and their role in the sentence is functional. On the other hand, these grammatical features encode meanings that speakers are still able to lead back to the referential world so far as to force the interpretability of the morpheme at the semantic level. In this sense, potentially, the grammatical Gender of every Italian animate noun could be interpretable and, potentially, the masculine and the feminine form of every Italian animate noun could be derived. Nevertheless, while some possibilities are established, others are not attested at all, and few others may lead to change of the Italian system. In fact, declension systems can, to a certain extent, reflect cultural aspects of the community of speakers (social gender in the sense of Aikhenvald 2012; see also Corbett 1991). Even if, in our opinion, the linguistic choice of a default value is mostly explainable by principles of information optimization, the issue has a practical side which is more pertinent to the domain of sociolinguistics, though. Debate on the non-sexist usage of language is very heated in present-day Italy. The guidelines for non-sexist usage of the Italian language insist on respecting a one-to-one correspondence between the grammatical Gender and the sex of the human referent by encouraging the use of innovative forms such as *sindaca*

‘mayor-Fem.Sg’ (compared to the corresponding well attested *sindaco* ‘mayor-Masc.Sg’) on the basis of established pairs such as *maestro – maestra* ‘teacher-Masc.Sg – teacher-Fem.Sg’ (Cancelleria Federale 2012; Robustelli 2014; Sabatini 1987; Thornton 2004; 2016).

The fact that issues like the one illustrated above inflame the current debates and may lead to language change reflects the salience of some features over others in shaping morphological paradigms. Since Saussure (1916) it is out of question that linguistic signs are arbitrary functions between forms and meanings. Yet, morphology allows to explore a slightly different perspective: some meanings tend to find their way to be encoded more than others. Further studies on this topic can help us in figuring out whether *some* among these functions are less arbitrary and more salient than others and the role of the core cognition in mapping them.

### Acknowledgments

This study is supported by H2020-MSCA-IF-2017 SNAeB, Project No: 795242, to RR. European Research Council Grant 679010 (ERC STATLEARN to Davide Crepaldi) supported FF while this manuscript was under review.

We thank two anonymous reviewers for helpful comments on an earlier version of this manuscript.

## Appendix

### Properties of the experimental nouns

English translation is given in brackets for the corresponding Italian nouns in the masculine singular.

<b>ANIM_G</b>	<b>English translation</b>	<b>Freq Masc.Sg (-o)</b>	<b>Freq Masc.Pl (-i)</b>	<b>Freq Fem.Sg (-a)</b>	<b>Ort.Length</b>	<b>Neighbour.</b>
<i>bidell-o</i>	(janitor)	1067	997	338	6	3
<i>cognat-o</i>	(brother-in-law)	3851	621	1875	6	4
<i>div-o</i>	(movie star)	1991	2165	2616	4	10
<i>maestr-o</i>	(teacher)	56949	25974	12683	6	3
<i>cugin-o</i>	(cousin)	8997	5919	4098	5	6
<i>ragazz-o</i>	(boy)	91821	219653	87236	6	3
<i>suocer-o</i>	(father-in-law)	2613	1030	3764	6	3
<i>nonn-o</i>	(grandfather)	19082	11472	18601	4	5
<i>sart-o</i>	(tailor)	2376	766	815	4	9
<i>serv-o</i>	(servant)	12677	10158	11434	4	9
<i>zi-o</i>	(uncle)	19313	2841	11365	2	3
<i>orfan-o</i>	(orphan)	3507	1685	9758	5	6
<i>gatt-o</i>	(cat)	22226	20884	3726	4	11
<i>sovran-o</i>	(sovereign)	8925	1192	2475	5	4
<i>ballerin-o</i>	(dancer)	2514	2691	4246	8	3
<i>fanciull-o</i>	(child)	6357	5270	7317	8	3
<i>fidanzat-o</i>	(fiancé)	7382	491	10372	8	4
<i>gemell-o</i>	(twin)	1220	4834	541	6	3
<i>vedov-o</i>	(widower)	564	221	6611	5	5
<i>zingar-o</i>	(gypsy)	933	4184	728	6	3
<b>mean</b>		13718.25	16152.4	10029.95	5.4	5
<b>sd</b>		22491.521	48398.716	18842.667	1.535	2.655
<b>ANIM_I</b>	<b>English translation</b>	<b>Freq Masc.Sg (-o)</b>	<b>Freq Masc.Pl (-i)</b>	<b>Freq Fem.Sg (-a)</b>	<b>Ort.Length</b>	<b>Neighbour.</b>
<i>sindac-o</i>	(mayor)	124955	24933	42	6	1
<i>magistrat-o</i>	(magistrate)	31395	53157	33	9	1
<i>soldat-o</i>	(soldier)	18884	59860	16	6	6
<i>angel-o</i>	(angel)	17499	15243	60	5	2
<i>parroc-o</i>	(parson)	13649	2481	0	6	1
<i>uccell-o</i>	(bird)	7838	27855	0	6	2
<i>grill-o</i>	(cricket)	5554	1472	0	5	4
<i>squal-o</i>	(shark)	3645	3585	2	5	1
<i>insett-o</i>	(bug)	3448	12161	5	6	4
<i>corv-o</i>	(crow)	2261	1876	54	4	11
<i>cign-o</i>	(swan)	2176	1500	2	4	2
<i>fabbr-o</i>	(blacksmith)	2137	998	0	5	3
<i>leopard-o</i>	(leopard)	2189	544	7	7	2
<i>architett-o</i>	(architect)	23371	12828	24	9	4
<i>cangur-o</i>	(kangaroo)	891	823	14	6	1
<i>camell-o</i>	(camel)	2532	2318	136	7	2
<i>struzz-o</i>	(ostrich)	1656	1087	11	6	3
<i>merl-o</i>	(blackbird)	1397	1098	146	4	4
<i>top-o</i>	(mouse)	7303	11665	339	3	11

<b>mean</b>	14356.84	12393.89	46.894	5.736	3.421
<b>sd</b>	28166.52	17646.88	82.848	1.557	3.005

<b>INANIM 1</b>	<b>English translation</b>	<b>Freq Masc.Sg (-o)</b>	<b>Freq Masc.Pl (-i)</b>	<b>Freq Fem.Sg (-a)</b>	<b>Ort. Length</b>	<b>Neighbour.</b>
<i>vetr-o</i>	(glass)	30587	10435	NA	4	6
<i>nastr-o</i>	(ribbon)	14008	6834	NA	5	4
<i>cavol-o</i>	(cabbage)	11140	3509	NA	5	2
<i>sass-o</i>	(stone)	7691	8378	NA	4	9
<i>muscol-o</i>	(muscle)	5386	16694	NA	6	1
<i>tartuf-o</i>	(truffle)	4497	2774	NA	6	1
<i>rubin-o</i>	(ruby)	4188	526	NA	5	3
<i>sciropp-o</i>	(syrup)	2667	648	NA	7	1
<i>smerald-o</i>	(emerald)	1796	597	NA	7	1
<i>cedr-o</i>	(citron)	1472	879	NA	4	3
<i>biscott-o</i>	(biscuit)	1410	6228	NA	7	1
<i>carciof-o</i>	(artichoke)	1257	3152	NA	7	1
<i>cib-o</i>	(food)	58426	22444	NA	3	8
<i>cuscin-o</i>	(pillow)	4652	2.798	NA	6	1
<i>gelat-o</i>	(ice-cream)	9630	3725	NA	5	10
<i>pel-o</i>	(hair)	15521	5512	NA	3	15
<i>sold-o</i>	(coin)	5316	122470	NA	4	5
<i>tappet-o</i>	(carpet)	12658	4971	NA	6	2
<i>tub-o</i>	(tube)	13831	8822	NA	3	7
<i>tesor-o</i>	(treasure)	59430	8569	NA	5	2

<b>mean</b>	13278.15	11858.489	5.1	4.15
<b>sd</b>	17094.601	26641.294	1.372	3.897

<b>INANIM 2</b>	<b>English translation</b>	<b>Freq Masc.Sg (-o)</b>	<b>Freq Masc.Pl (-i)</b>	<b>Freq Fem.Sg (-a)</b>	<b>Ort. Length</b>	<b>Neighbour.</b>
<i>burr-o</i>	(butter)	22036	32	NA	4	3
<i>amiant-o</i>	(asbestos)	18707	63	NA	6	0
<i>ossigen-o</i>	(oxygen)	16392	31	NA	7	1
<i>metan-o</i>	(methane)	11523	3	NA	5	3
<i>asfalt-o</i>	(asphalt)	11007	280	NA	6	2
<i>brod-o</i>	(soup)	10803	225	NA	4	6
<i>azot-o</i>	(nitrogen)	7919	4	NA	4	1
<i>acet-o</i>	(vinegar)	7309	324	NA	4	3
<i>ozon-o</i>	(ozone)	6658	3	NA	4	1
<i>zolf-o</i>	(sulphur)	5321	41	NA	4	3
<i>or-o</i>	(gold)	86433	2522	NA	2	11
<i>fien-o</i>	(hay)	3587	66	NA	4	3
<i>orz-o</i>	(barley)	3380	19	NA	3	7
<i>lard-o</i>	(lard)	3180	20	NA	4	9
<i>clor-o</i>	(chlorine)	2838	8	NA	4	2
<i>tim-o</i>	(thyme)	2517	55	NA	3	10
<i>argent-o</i>	(silver)	28102	1321	NA	6	3
<i>zenzer-o</i>	(ginger)	1811	1	NA	6	0

<i>origan-o</i>	(oregano)	1646	1	NA	6	1
<i>amid-o</i>	(starch)	1605	566	NA	4	7
<b>mean</b>		12638.7	279.25		4.5	3.8
<b>sd</b>		18899.535	611.991		1.277	3.349

## References

- Acquaviva, P. 2009. The Structure of the Italian Declension System. In Montermini,F., Boyé, G., & Tseng, J. (eds.), *Selected Proceedings of the 6th Décembrettes*, 50-62. Somerville, MA: Cascadilla Proceedings Project.
- Acquaviva, P. 2013. *Il nome*. Roma: Carocci.
- Agrillo, C., Miletto Petrazzini, M.E. & Bisazza, A. 2014. Numerical acuity of fish is improved in the presence of moving targets, but only in the subitizing range. *Animal Cognition* 17(2). 307–316.
- Aikhenvald, A. Y. 2012. Round women and long men: shape, size, and the meanings of gender in New Guinea and beyond. *Anthropological Linguistics*. 33-86.
- Almoammer, A., Sullivan, J., Donlan, C., Marušić, F., Žaucer, R., O'Donnell, T. & Barner, D. 2013. Grammatical morphology as a source of early number word meanings. *Proceedings of the National Academy of Sciences* 110(46). 18448–18453.
- Arcara, G., Franzon, F., Gastaldon S., Brotto, S., Peressotti, F., Semenza, C. & Zanini, C. 2018. One can be some but some cannot be one: ERP correlates of incongruence are different for singular and plural. *Cortex*. 1-18. <https://doi.org/10.1016/j.cortex.2018.10.022>
- Aronoff, M. 1994. *Morphology by Itself*. Cambridge, Ma.: MIT Press.
- Baayen, R. H., Davidson, D. J. & Bates, D. M. 2008. Mixed-effects modeling with crossed random effects for subjects and items. *Journal of memory and language* 59(4). 390-412.

- Baroni, M., Bernardini, S., Ferraresi, A. & Zanchetta, E. 2009. The WaCky Wide Web: A collection of very large linguistically processed web-crawled corpora. *Language Resources and Evaluation*, 43(3). 209–226.
- Bickel, B. & Nichols, J. 2013. Exponence of Selected Inflectional Formatives. In Dryer, M. S. & Haspelmath, M. (eds.), *The World Atlas of Language Structures Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology. (Available online at <http://wals.info/chapter/21>)
- Bickel, B., Witzlack-Makarevich, A., Zakharko, T. & Iemmolo, G. 2015. Exploring diachronic universals of agreement: alignment patterns and zero marking across person categories. *Agreement from a diachronic perspective*. 2952.
- Brown, D., Corbett, G. G., Fedden, S., Hippisley, A. R. & Marriott, P. 2013. Grammatical typology and frequency analysis: number availability and number use. *Journal of Language Modelling* 1(2). 227.
- Butterworth, B., Granà, A., Piazza, M., Girelli, L., Price, C. & Skuse, D. 1999. Language and the origins of number skills: Karyotypic differences in Turner's syndrome. *Brain and Language* 69. 486–488.
- Butterworth, B., Reeve, R., Reynolds, F. & Lloyd, D. 2008. Numerical thought with and without words: Evidence from indigenous Australian children. *Proceedings of the National Academy of Sciences* 105(35). 13179–13184.
- Cancelleria federale. 2012. *Guida al pari trattamento linguistico di donna e uomo nei testi ufficiali della Confederazione*. Cancelleria federale, Berna.
- Cantlon, J. F. & Brannon, E. M. 2006. Shared system for ordering small and large numbers in monkeys and humans. *Psychological Science* 17(5). 401–406.

- Cantlon, J.F. & Brannon, E.M. 2007. Basic math in monkeys and college students. *PLoS Biology* 5(12). 2912–2919.
- Carey, S. 2004. Bootstrapping & the origin of concepts. *Daedalus* 133(1). 59–68.
- Carey, S. 2009. *The origin of concepts*. Oxford University Press.
- Chomsky, N. 1988. *Language and problems of knowledge: The Managua lectures* (Vol. 16). MIT press.
- Christiansen, M. H. & Chater, N. 2008. Language as shaped by the brain. *Behavioral and brain sciences* 31(05). 489–509.
- Clark, R. & Grossman, M. 2007. Number sense and quantifier interpretation. *Topoi* 26. 51–62.
- Comrie, B. 1981. *Language universals and linguistic typology*. Chicago: Chicago University Press.
- Corballis, M. C. 2017. Language evolution: a changing perspective. *Trends in cognitive sciences* 21(4). 229-236.
- Corbett, G. G. 1991. *Gender*. Cambridge: CUP.
- Corbett, G. G. 1996. Minor number and the plurality split. *Rivista di linguistica* 8. 101-122.
- Corbett, G. G. 2000. *Number*. Cambridge: CUP.
- Cordes, S., Gelman, R., Gallistel, C.R. & Whalen, J. 2001. Variability signatures distinguish verbal from nonverbal counting for both large and small numbers. *Psychonomic Bulletin & Review* 8(4). 698–707.
- Dahl, Ö. 2008. An exercise in a posteriori language sampling. *Language Typology and Universals Sprachtypologie und Universalienforschung* 61(3). 208–220.
- Daniel., M. 2013. Plurality in Independent Personal Pronouns. In Dryer, M.S. & Haspelmath, M. (eds.), *The World Atlas of Language Structures Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology. Available online at <http://wals.info/chapter/35>.

- Dehaene, S. 2011. *The number sense: How the mind creates mathematic*. New York: OUP.
- de Hevia, M. D. 2011. Sensitivity to number: Reply to Gebuis and Gevers. *Cognition* 121(2). 253–255.
- Di Domenico, E. 1997. *Per una teoria del genere grammaticale*. Padova: Unipress.
- Dixon, R. M. W. 1979. Ergativity. *Language* 55. 59–138.
- Dryer, M.S. 2013. Coding of Nominal Plurality. In Dryer, M. S. & Haspelmath, M. (eds.), *The World Atlas of Language Structures Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology. (Available online at <http://wals.info/chapter/33>)
- Evans, N. & Levinson, S. C. 2009. The myth of language universals: Language diversity and its importance for cognitive science. *Behavioral and brain sciences* 32(5). 429–492.
- Everaert, M. B., Huybregts, M. A., Berwick, R. C., Chomsky, N., Tattersall, I., Moro, A. & Bolhuis, J. J. 2017. What is language and how could it have evolved? *Trends in cognitive sciences* 21(8). 569-571.
- Everett, C. 2017. *Numbers and the making of us: counting and the course of human cultures*. Harvard University Press.
- Feigenson, L., Dehaene, S. & Spelke, E. 2004. Core systems of number. *Trends in cognitive sciences* 8(7). 307–314.
- Franzon, F., Bertocci, D. & Semenza, C. 2013. Exploring Gender Inflection: an insight from errors in aphasia. *Stem-, Spraak-en Taalpathologie* 18(Suppl. 1). 171-173.
- Franzon, F., Arcara, G. & Zanini, C. 2016. Lexical categories or frequency effects? A feedback from quantitative methods applied to psycholinguistic models in two studies on Italian. In Corazza, A., Montemagni, S. & Semeraro, G. (eds.), *Proceedings of the Third Italian Conference on Computational Linguistics CLiC-it 2016*, 152-156. Accademia University Press.

Franzon, F., Zanini, C. & Rugani, R. 2018. Do non-verbal number systems shape grammar? Numerical cognition and Number morphology compared. *Mind and Language*. 1-22.  
<https://doi.org/10.1111/mila.12183>

Forster, K. I. & Chambers, S. M. 1973. Lexical access and naming time. *Journal of verbal learning and verbal behaviour* 12(6). 627-635.

Gallistel, C. R. & Gelman, R. 1992. Preverbal and verbal counting and computation. *Cognition* 44(1). 43–74.

Gelman, R. & Gallistel, C. R. 2004. Language and the origin of numerical concepts. *Science* 306(5695). 441–443.

Gordon, P. 2004. Numerical cognition without words: Evidence from Amazonia. *Science* 306(5695). 496–499.

Greenberg, J. H. 1948. The classification of African languages. *American Anthropologist* 50(1). 24-30.

Greenberg, J.H. 1963. Some universals of grammar with particular reference to the order of meaningful elements. In Greenberg, J.H. (ed.), *Universals of Language*, 73–113.

Haspelmath, M. 2013. Occurrence of Nominal Plurality. In Dryer, M.S. & Haspelmath, M. (eds.), *The World Atlas of Language Structures Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology. Available online at <http://wals.info/chapter/34>.

Hurford, J. R. 1987. *Language and number: The emergence of a cognitive system*. Blackwells.

Hymes, D. 1964. Two types of linguistic relativity. *Sociolinguistics: proceedings of the UCLA Sociolinguistics Conference*. 114-67.

- Katz, G. & Zamparelli, R. 2012. Quantifying Count/Mass Elasticity. In J. Choi et al. (eds.), *Proceedings of the 29th West Coast Conference on Formal Linguistics*, 371-379. Somerville, MA: Cascadilla Proceedings Project.
- Kulkarni, R., Rothstein S. & Treves, A. 2013. A Statistical Investigation into the Cross-Linguistic Distribution of Mass and Count Nouns: Morphosyntactic and Semantic Perspectives. *Biolinguistics* 7. 132-168.
- Lipton, J. S. & Spelke, E. S. 2003. Origins of number sense large-number discrimination in human infants. *Psychological Science* 14(5). 396–401.
- Loporcaro, M. (2018). *Gender from Latin to Romance: History, Geography, Typology* (Vol. 27). Oxford University Press.
- Lucy, J. A. 1992. *Language diversity and thought: A reformulation of the linguistic relativity hypothesis* (Vol. 12). Cambridge University Press.
- Malouf, R., Ackerman, F. & Seyfarth, S. 2015. Explaining the number hierarchy. *Proceedings of the 37th Annual Cognitive Science Society Meeting*. 1500–1506.
- Marcantonio, A. & Pretto, A. M. 2001. Il nome. In Renzi, L., Salvi, G., & Cardinaletti, A. (eds.), *Grande grammatica italiana di consultazione*, 329-346. Bologna: Il Mulino.
- Marušič, F., Plesničar, V., Razboršek, T., Sullivan, J. & Barner, D. 2016. Does Grammatical Structure Accelerate Number Word Learning? Evidence from Learners of Dual and Non-Dual Dialects of Slovenian. *PLoS One* 11(8). e0159208.
- Matasović, R. 2004. *Gender in Indo-European*. Universitaetsverlag Winter.
- Matthews P. H. 1974. *Morphology*. Cambridge: CUP.

- McCrink, K. & Wynn, K. 2007. Ratio abstraction by 6-month-old infants. *Psychological science* 18(8). 740–745.
- Ochtrup, M. T., Rath, D., Klein, E., Krinzinger, H., Willmes, K. & Domahs, F. 2013. Are number words fundamentally different? A qualitative analysis of aphasic errors in word and number word production. *International Journal of Speech & Language Pathology and Audiology* 1(1). 12–28.
- Overmann, K. 2015. Numerosity Structures the Expression of Quantity in Lexical Numbers and Grammatical Number. *Current Anthropology* 56(5). 638-653.
- Peirce, J. W. 2007. PsychoPy—psychophysics software in Python. *Journal of neuroscience methods* 162(1-2). 8-13.
- Pica, P., Lemer, C., Izard, V. & Dehaene, S. 2004. Exact and approximate arithmetic in an Amazonian indigene group. *Science* 306(5695). 499–503.
- Rath, D., Domahs, F., Dressel, K., Claros-Salinas, D., Klein, E., Willmes, K. & Krinzinger, H. 2015. Patterns of linguistic and numerical performance in aphasia. *Behavioral and Brain Functions* 11(1). 2.
- Robustelli, C. 2014. *Donne, grammatica e media. Suggerimenti per l'uso dell'italiano*. GiULiA giornaliste, Roma.
- Roettger, T. B. & Domahs, F. 2015. Grammatical number elicits SNARC and MARC effects as a function of task demands. *The Quarterly Journal of Experimental Psychology* 68(6). 1231-1248.
- Rugani, R., Regolin, L. & Vallortigara, G. 2010. Imprinted numbers: newborn chicks' sensitivity to number vs. continuous extent of objects they have been reared with. *Developmental science* 13(5). 790–797.

- Rugani, R., Vallortigara, G., Priftis, K. & Regolin, L. 2015. Number-space mapping in the newborn chick resembles humans' mental number line. *Science* 347(6221). 534–536.
- Sabatini, A. 1987. *Il sessismo nella lingua italiana*. Roma: Presidenza del Consiglio dei Ministri.
- Salillas, E., Barraza, P. & Carreiras, M. 2015. Oscillatory Brain Activity Reveals Linguistic Prints in the Quantity Code. *PLoS One* 10(4). e0121434.
- Sapir, E. 1921. *An introduction to the study of speech*. New York: Harcourt, Brace.
- Spelke, E.S. 2000. Core knowledge. *American Psychologist* 55. 1233-1243.
- Sarnecka, B., Kamenskaya, V., Yamana, Y., Ogura, T., & Yudovina, Y. 2007. From grammatical number to exact numbers: Early meanings of ‘one’, ‘two’, and ‘three’ in English, Russian, and Japanese. *Cognitive Psychology* 55(2). 136–168.
- De Saussure, F. 1916. *Cours de linguistique generale*.
- Semenza, C. 2008. Number processing. In Stemmer, B. & Withaker, H. (eds.), *Handbook of the Neuroscience of Language*, 219–227. Oxford: Elsevier.
- Starr, A., Libertus, M. E. & Brannon, E. M. 2013. Number sense in infancy predicts mathematical abilities in childhood. *Proceedings of the National Academy of Sciences* 110(45). 18116-18120.
- Strickland, B. 2017. Language Reflects “Core” Cognition: A New Theory About the Origin of Cross-Linguistic Regularities. *Cognitive science* 41(1). 70-101.
- Thornton, A. M. 2004. Mozione. In Grossmann, M. & Rainer, F. (eds.), *La formazione delle parole in italiano*, 218-227. Niemeyer, Tübingen.
- Thornton, A. M. 2005. *Morfologia*. Roma: Carocci.

- Thornton, A. M. 2016. Designare le donne: preferenze, raccomandazioni e grammatica. In Corbisiero, F., Maturi, P. & Rusconi, E. (eds.), *Genere e linguaggio. I segni dell'uguaglianza e della diversità*, 15-33. Milano, Franco Angeli.
- Trick, L. M. & Pylyshyn, Z. W. 1994. Why are small and large numbers enumerated differently? A limited-capacity preattentive stage in vision. *Psychological Review* 101. 80 –102.
- Troiani, V., Peelle, J. E., Clark, R. & Grossman, M. 2009. Is it logical to count on quantifiers? Dissociable neural networks underlying numerical and logical quantifiers. *Neuropsychologia* 47(1). 104–111.
- Vallortigara, G. 2012. Core knowledge of object, number, and geometry: A comparative and neural approach. *Cognitive Neuropsychology* 29. 213-236.
- Veselinova, L. N. 2013. Verbal Number and Suppletion. In Dryer, M. S. & Haspelmath, M. (eds.), *The World Atlas of Language Structures Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology. (Available online at <http://wals.info/chapter/80>)
- Whorf, B. L. & Chase, S. 1956. *Language, Thought and Reality, Selected Writings of Benjamin Lee Whorf*. MIT Press.
- Zamparelli, R. 2008. On the interpretability of φ-features. In De Cat, C. & Demuth, K. (eds.), *The Bantu-romance connection: a comparative investigation of verbal agreement, DPs, and information structure*, 167-199 (Vol. 131). John Benjamins Publishing.
- Zanini, C., Benavides, S., Lorusso, D., & Franzon, F. 2017. Mass is more. The conceiving of (un)countability and its encoding into language in five-year-old-children. *Psychonomic Bulletin & Review* 24(4). 1330-1340.

# On morphemes and morphemes: exploring the distinction

Borja Herce

[borjaherce@gmail.com](mailto:borjaherce@gmail.com)

University of the Basque Country (UPV/EHU)  
University of Surrey (SMG)

**Abstract:** The concept of the morpheme (i.e. a morphological unit at odds with syntax and semantics) is notoriously uncomfortable for many formal models of morphology. Many discussions have thus centred on whether morphemes exist and whether individual cases are morphemic or not. When one gets rid of theoretically-driven assumptions, however, there is little evidence for a dichotomic taxonomization of the morphological minimal signs into morphemes and morphemes. Cross-linguistic variation suggests that morphological units can be arranged on a scale from the most simple to the most complex morpho-syntactic distributions. The properties of ones vs the others are, however, not substantially different. I argue, therefore, that we should avoid this arbitrary taxonomy and explore instead the diversity of form-meaning mappings objectively by developing adequate and cross-linguistically applicable quantitative measures.

## 1 Introduction

Even though it may not be a logical necessity, decompositional models of morphology (morphemic, realizational etc.) usually start from the assumption that morphological objects realize single morphosyntactic properties (i.e. a particular feature value like 'first person' or a conjunction of values like 'first person'+'plural'). In Spanish, for example, the formative /mos/ appears at the end of many verb forms in various tenses: *tuvimos*, *somos*, *estemos*, *damos* etc. Every verb form ending in -mos is a 1PL form and, conversely, every 1PL form ends in -mos. This is the one-to-one biunique correspondence that guides most formal models.

The paradigmatic distribution of morphological objects, however, is not always so straightforward. A distribution which appears systematic (e.g. because it is repeated across various formatives) but which does not correspond to any conceivable morphosyntactic category is usually labelled 'morphemic', after Aronoff (1994). These many-to-many mappings constitute the opposite pole of what form-meaning relations 'ought' to look like and yet they do not appear to be especially vulnerable to change and may even be extended analogically (see e.g. Maiden 2011). Purely morphological stipulation seems to be called for in these cases (e.g. Table 1) whereas for morphemic phenomena (e.g. Spanish -mos) morphosyntactic explanations are usually preferred. It is usually not stressed enough, however, that between 'natural class' distributions<sup>1</sup> and paradigmatically unrestricted ones (A vs D in Figure 1), there are various intermediate configurations.

---

<sup>1</sup> Natural classes are those that correspond to a morphosyntactic value (e.g. [PL], [3], [FUT]) or to a conjunction of values (e.g. [3PL], [FUT.IND], [1PL.FUT.IND]).

	SG	PL
1EX	seð	sieti
1INC		seð
2	sieti	sieti
3FEM	sieti	seð
3MASC	seð	seð

Table 1: Subject agreement of 'walk' in Dhaasanac  
(Baerman et al. 2005:106 after Tosco 2001)

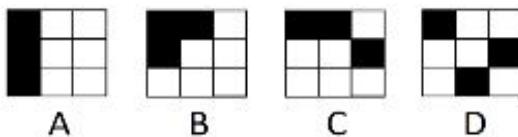


Figure 1: possible distributions of a 3-cell exponent in a 3x3 paradigm

The literature on the morpheme has most often focused on whether specific entities (e.g. the Latin 'third stem' [Steriade 2016], the Romansch N-morpheme [Maiden 2017] etc.) are morphemic or not. Different researchers and models may draw the border at different points in the continuum, depending on the feature structure they assume, the status of mechanisms like blocking and of other assumed properties of morphosyntactic architecture. However, the artificial imposition of dichotomy to variables which are not so is not a scientifically desirable practice (MacCallum et al. 2002). My purpose here, therefore, is to improve our knowledge of form-meaning mappings, avoiding arbitrary taxonomies by identifying instead the relevant scales of variation at work (in the vein of Canonical Typology [Corbett 2005] or Multivariate Typology [Bickel 2010]), and to develop more objective measures of the relative degree of morphemicity (or morphemicity) of formatives. This will increase our understanding of the morpheme-morpheme continuum and of the possible relations between form and function in grammar. Section 2 presents some evidence against an aprioristic distinction between morphemes and morphemes based on their properties. Section 3 presents evidence for the continuum between the simplest and the most complex morphosyntactic distributions. Section 4 introduces some quantitative measures that could be used to assess a formative's place in this continuum. Finally, Section 5 states conclusions and future avenues for research.

## 2 On the properties of morphemes and morphemes

One of the main preoccupations of those studying morphemes is how to identify them in a language and, of course, whether they exist in the first place (Bermúdez-Otero & Luís 2016). Sometimes, concern is voiced over the fact that morphemes are identified negatively (i.e. they are forms which are not describable as direct exponents of morphosyntactic properties) or over the fact that the morphemic status of an exponent does not allow for any further empirical predictions (Koonts-Garboden 2016.). These concerns are natural if one regards morphemes and morphemes as natural kinds; as discrete categories in the Aristotelian sense to which a particular element can either belong or not. An axiom which is usually tacitly assumed in most approaches is that morphemes and morphemes are inherently different phenomena. They do differ, obviously, in the way they relate to morphosyntactic values, but this is only because this is the very criterion used to define one vs the other. The question to ask is whether morphemes and morphemes show

or not reasonably different properties as would be expected if they are different phenomena in a deep sense. This section will analyze some of the available evidence.

## 2.1 Resilience and learnability

One of the properties which according to some (e.g. Pertsova 2011) should distinguish morphemic and morphomic patterns is that the latter are more difficult to acquire. A systematic learning bias against morphemes would be responsible, according to these authors, of the comparative scarcity of morphomic structures across languages. We could therefore expect that, once they emerge, morphemes have a strong tendency to be lost or rearranged into natural-class distributions. We do find, of course, cases where this is the case, but morphemes are obviously not immune to change or disappearance either. What is important is that, once a morpheme is in place, no systematic bias has been observed against them in most cases.

Martin Maiden has been at the forefront of research on Romance morphemes and has provided abundant evidence supporting the diachronic stability of those structures (see e.g. Maiden 2011). Research on morphomic patterns in other language families is, unfortunately, in its infancy due to the scarcity of synchronic and diachronic data. However, the available evidence suggests that resilience is not a parochial feature of Romance morphemes. Morphomic structures in Sami, for example, which are of a similar time depth, also seem to be very stable diachronically. Stem alternants in the family are often the result of the phenomenon known as consonant gradation. This is usually agreed to have started as a productive phonological process in the earliest stages (see e.g. Gordon 2009). The phonetic basis for the phenomenon is reasonably clear: consonants at the beginning of open syllables could be pronounced with greater articulatory effort than those at the beginning of closed syllables. Consequently, in different positions, some stem consonants were pronounced in a 'stronger' or 'weaker' way (compare, for example, Finnish *o-tan* 'I take' to *o-tta-vat* 'they take'). This would have been originally an allomorphic automatic process whose (predictable) distribution must have been originally this one in the proto-language (phonological contexts requiring a weak consonant have been shaded):

	PRES			PAST		
	SG	DU	PL	SG	DU	PL
1	mene-m	mene-ja-n	mene-pa(-k)	mene-j-e-m	mene-j-me-n	mene-j-ma-k
2	mene-k	mene-pa-ta-n	mene-pa-ta-k	mene-j-e-k	mene-j-te-n	mene-j-ta-k
3	mene-jä	mene-pa-n	mene-ja-k	mene-j	mene-j-ne-n	mene-j-e-n

Table 2: Reconstructed Proto-Sami Indicative agreement forms of 'go' (Sammallahti 1998: 212)

At this stage, some sound changes took place, most notably the elision of intervocalic /j/, that disrupted the original conditioning environment. For example, a form like 1DU *mene-ja-n*, which had a strong grade by virtue of the open syllable status of /ne/ became *mene-n*. This left the weak-strong alternation as a synchronically unmotivated phenomenon. Its distribution from that moment onwards did not correlate with any unitary morphosyntactic or phonological context and should thus be considered purely morphomic, i.e. an instance of pure morphology.

One could hypothesize that, given the lack of synchronic motivation for the pattern, language users might be unable to learn and replicate it and would have consequently changed it, for example by aligning the distinction to some difference in morphosyntactic value like present vs

past, or by getting rid of the alternation altogether. This second scenario is, indeed, not unattested. Modern South Sami has lost consonant gradation as a morphological process. Every other Sami variety, however, has preserved consonant alternation. Furthermore, the distribution of the variants has been left intact in these cases. Below I present illustrative verbal paradigms showing the paradigmatic distribution of consonant gradation in four Sami varieties, from west to east.

	PRES			PAST		
	SG	DU	PL	SG	DU	PL
1	bas-áv	biss-in	bass-ep	biss-iv	bis-ijmen	bis-ijmä
2	bas-á	bass-ebähnten	bass-ebähitet	biss-e	bis-ijden	bis-ijdä
3	bass-a	bass-eba	biss-e	bis-ij	bis-ijga	biss-in

Table 3: Pite Sami *basset* 'fry' (Wilbur 2014: 174)

	PRES			PAST		
	SG	DU	PL	SG	DU	PL
1	boađán	bohte	boahtit	bohten	bodjime	bodjimet
2	boađát	boahtibeahtti	boahtibehtet	bohtet	bodjide	bodjidet
3	boahtá	boahtiba	bohtet	bodji	bodjiga	bohte

Table 4: North Sami *boahtit* 'come' (Kahn & Valijärvi 2017: 117, 121)

As illustrated by the above paradigms of Pite Sami and North Sami, the distribution of consonant gradation in the verbal paradigm has been preserved unchanged in these western Sami varieties. Furthermore, this has been so despite the emergence of unnatural whole-word syncretisms like 1.DU.PRES/3.PL.PAST and 3.PL.PRES/2.SG.PAST. These identities could have been easily erased, for example by generalizing the weak consonant grade in the past. However, we do not find any tendency for speakers to align formal (i.e. consonant grade) and functional (i.e. tense, person, number) categories. The same situation obtains in the eastern varieties of Sami.

	PRES		PAST	
	SG	PL	SG	PL
1	kuul-am	kuull-âp	ku'll-em	kuul-im
2	kuul-ak	kuull-ve'ted	ku'll-ič	kuul-id
3	kooll	ko'll-e	kuul-i	ku'll-e

Table 5: Skolt Sami *kuullâd* 'hear' (Feist 2011: 115)

	PRES		PAST	
	SG	PL	SG	PL
1	jāl-a	jēll'-ep'	jTII'-e	jTII'-em'
2	jāl-al	jēll'-bedt'e	jTII'-ek'	jTII'-et'
3	jāll	jēll'-ev	jTII'-e	jTII'-en'

Table 6: Kildin Saami *jēll'-e* 'live' (Rießler to appear: 4)

As the paradigms above show, the dual has been lost in Skolt and Kildin Sami. Substantial changes have been, therefore, taking place in the paradigms, and yet, these have not affected the inherited distribution of weak and strong grades, which shows the great resilience that morphemic distributions may attain. This diachronic stability would be difficult to explain if morphemes, unlike morphemes had no synchronic function whatsoever or were even counterproductive in language acquisition or communication.

## 2.2 Origin

It is usually assumed (e.g. Wurzel 1989: 190-193) that inflectional morphology can emerge either from syntax (via grammaticalization) or from phonology (via morphologization of sound changes). The first path usually gives rise to 'well-behaved' formatives (i.e. agglutinative morphemes, with a natural morphosyntactic distribution etc.) whereas the second is more likely to result in non-concatenative and morphemic patterns like the ones of Sami. This is, however, not a property unexceptionally distinguishing forms with natural-class distributions from morphemic ones. Sound change can also give rise to natural-class distributions. The paradigmatic distribution of gradation shown in Table 7 is morphosyntactically natural (1/2 vs 3) yet it emerged in a completely accidental way because of the different syllable structure of some forms and the others in Finnish:

	PRES		IMP	
	SG	PL	SG	PL
1	annan	annamme	annoim	annoimme
2	annat	annatte	annoit	annoitte
3	antaa	antavat	antoi	antoivat

Table 7: Finnish *antaa* 'give'

Morphological forms, whether stem alternants or formatives, whether morphemes or morphemes, owe their distribution either to their original source construction or to analogical developments that subsequently modify the original distributions. Morphosyntactic features are generally assumed to be an important factor to account for the distribution of forms precisely because they seem to have a role in analogical change:

	Old Norse		Old Swedish		Modern Swedish	
	SG	PL	SG	PL	SG	PL
1	brenn	brennum	brenner	brennom	bränner	bränner
2	brennr	brennið	brenner	brennin	bränner	bränner
3	brennr	brenna	brenner	brenna	bränner	bränner

Table 8: Rask 1976:121

Noreen 1904:471-473

Holmes & Hinchliffe 2003:264

The above present tense paradigms of 'burn' in several stages of Scandinavian show that in analogical extension, morphosyntactic feature values (e.g. SG.PRES in Old Swedish or PRES in Modern Swedish) often act as niches (Gause 1934, Aronoff 2016) where a single form may come to predominate while also constraining its expansion to other environments. Features are usually

assumed to be important precisely because they are (as far as this is possible) good predictors for morphological change. The paradigmatic extension of the suffix -(e)r from Old Norse to Old Swedish is 'expected' over hypothetical extensions to any other paradigm cell. It must be stressed, however, that formal affinities can have the exact same role in grammar. Morphemic distributions, therefore, may also arise analogically in language change:

Gloss	2PL.IMP (conservative )	2PL.IMP (innovative)	INF
'know'	sabed	saber	saber
'put'	poned	poner	poner
'tell'	decid	decir	decir
'want'	quered	querer	querer
'make'	haced	hacer	hacer

Table 9: Spanish analogical change in 2PL.IMP

GER (conservative)	GER (innovative)	3PL.PAST
sabiendo	supiendo	supieron
poniendo	pusiendo	pusieron
diciendo	dijendo	dijeron
queriendo	quisiendo	quisieron
haciendo	hiciendo	hicieron

Table 10: Spanish analogical change in GER

In Table 9, stem identity gives rise to affixal identity. The shared stem of the 2PL imperative and the infinitive, which holds across every single Spanish verb,<sup>2</sup> facilitates the substitution of etymological *sabe-d* by the innovative *sabe-r* in substandard varieties of Spanish. Conversely, in Table 10, affixal formal similarity (stressed -ie-) of the gerund and other paradigm cells (exemplified here by the 3PL past) induces stem identity when e.g. *sab-ie-ndo* becomes *sup-ie-ndo* in some local Peninsular varieties (see Pato & O'Neill 2013). The result of these analogical changes is that formatives like -r or stem alternants like sup- have extended in a way that they no longer correlate to single morphosyntactic values and should be regarded as morphemic. Because formal similarity generates more similarity, forms, the same as morphosyntactic features, can also act as important structurers of grammar, i.e. as the source of morphological 'niches' that favour internal homogeneity and external heterogeneity. Whether this is labeled 'gradient attraction' (Burzio 2001:664), 'similarity-based syncretism' (Steriade 2016) or 'morpheme', the phenomenon should not be dismissed as superficial or unimportant. As argued by Hockett (1987:88), sometimes "it is the resonances that induce the grammatical structure."

## 2.3 Morphological object

The literature on the morpheme has tended to focus overwhelmingly on stem alternants like the latin third stem (e.g. Aronoff 1994), the Romance L- and N-morphemes (e.g. Maiden 2011) etc. while little attention has been devoted to affixes. It could therefore seem that the stem is crosslinguistically a possible locus for morphomicity while affixes are always morphemic. Because of the way in which stem and affix are usually defined, morphologists expect (only) lexical information to occur in the stem and expect affixes to express grammatical information. Because this is what we find across languages most frequently, theoretical analyses have tended to adopt this as the underlying situation in all cases. Formal differences in the stem are regarded as meaningless and are said to be triggered by the affixes because, theoretically, "[s]tems do not serve as realizations of properties" (Spencer 2016: 226). The following passage is representative of this theoretical impulse:

<sup>2</sup> Infinitive and 2PL imperative constitute a "stem space" in Spanish (see Boyé & Cabredo Hofherr 2006), which amounts to saying that these two cells (and only these two cells) always share stem.

*In German, for example, some verbs show characteristic ABLAUT or UMLAUT patterns, where person and tense-indicating formatives trigger different vocalisms. From tragen 'carry', we get first person singular present trage, second person singular presentträgst, and first person singular past trug, each with different stem vowels.* (Bickel & Nichols 2007: 186)

Contrast this with the *modus operandi* of morphologists with other morphological objects. Even when the distribution of affixes does not correspond to well-defined morphosyntactic values, analysts resort to positing covert operations (e.g. blocking, rules of referral etc.) or to homophony to maintain the 'meaningfulness' hypothesis. As a result, even the more deviant patterns can be derived from the canonical morphemic ideal.

From an exclusively empirical point of view, however, there is no reason to assume, *a priori*, that grammatical meaning or morphosyntactic functions must be realized exclusively by means of segmentable inflectional formatives. In the particular case advanced by Bickel & Nichols, for example, it seems more illuminating to say that the locus for the present/past distinction is to be found, at least partially, in the difference in stem vocalism (i.e. trag- vs trug-) rather than in the affixal material, since the present and past affixes are often the same:

	PRESENT		PAST	
	SG	PL	SG	PL
1	trag-(e)	trag-en	trug	trug-en
2	träg-st	trag-t	trug-st	trug-t
3	träg-t	trag-en	trug	trug-en

Table 11: German verb *tragen* 'carry'

Looking at cross-linguistic data without aprioristic assumptions reveals that, in fact, both stem alternants and formatives can systematically map onto natural or unnatural class distributions:

	SG	DU	PL
1	-ve	'-ve	-pe
2	-pe	'-ve	-ve
3	-ve	'-ve	-ve

Table 12: Subject agreement in Hua verbs, (Stump 2015: 128 after Haiman 1980)

The distribution of the affixes -ve and -pe above is morphosyntactically unnatural, not reducible to blocking and yet completely systematic. Table 12 above presents the forms of the interrogative mood but the same distribution appears in other TAMs in Hua with completely different formatives (e.g. -e vs -ne, -ma' vs -pa', -ga vs -na, -hine vs -sine). This shows that stem or affixal status is also not a property distinguishing morphemes and morphemes.

### 3 A distributional continuum

If we want to remain as close to the empirical data as possible we should avoid classifying

morphological objects on the basis of theoretical assumptions (like the absence of grammatical import of stem alternants) or alleged underlying distributions which we supposedly cannot see in surface because of blocking or other mechanisms. I will therefore remain agnostic as for the virtues of these analyses here and will just look at distributions at face value.

I have shown in the preceding section that a look at the properties of morphemic and morphomic forms does not reveal substantial differences. If we look at the different morphosyntactic distributions that morphological objects may adopt across languages we find that there is a continuum rather than a sharp divide between more simple and more complex distributions:

	SG	PL
M	rabotal	rabotali
F	rabotala	
N	rabotalo	

Table 13: Russian past tense forms of the verb 'work'

The distribution of the form *rabotali* in the above Table 13 corresponds to what are different values in the singular. In morphosyntactic terms, however, its description is as simple as it gets (PL) and decidedly natural. Syncretisms, however, are not always so straightforward:

	Object suffixes	Subject suffixes	
		Realis	Irrealis
2SG	-o	-lu	-le
1SG		-ie	-fe
3SG	-fo	-lee	-be
2PL	-mo	-mo	-bule
1PL		-ne	-bile
3PL	-te		

Table 14: Kwomtari personal agreement suffixes (Spencer 2008: 107)

Forms like *-mo* or *-bile* also correspond to what is more than one value in other morphosyntactic contexts. Furthermore, the mapping seems systematic: First and second person syncretize both in the singular and in the plural of object suffixes with different formatives. First and third person are also syncretic twice (in both realis and irrealis) with different suffixes. Despite their systematicity, the syncretisms are contradictory. Naturalness is not straightforward in this case but rather dependant on the assumed feature structure and on our theory of morphological architecture. Given the 'right' feature structure it is usually possible to construe any one-dimensional syncretism as natural. This is not the case, however, in bidimensional syncretisms:

	SG	DU	PL
1	fecemin	fecohul	fecomun
2	fecem	fecebil	

3	feceb	
---	-------	--

Table 15: Amele verb 'see' perfect switch reference (Roberts 1987)

A form like *fecebil* has a natural distribution in that it occupies a morphosyntactically well-defined region of the paradigm (non-speaker, non-singular). More complex distributions, however, can also be systematic:

<i>ibili</i> 'walk' past			<i>egon</i> 'be' present	
	SG	PL	SG	PL
1	nenbilen	genbil-tza-n	nago	gau-de
2	zenbil-tza-n	zenbil-tza-ten	zau-de	zau-de-te
3	zebilen	zebil-tza-n	dago	dau-de

Table 16: Basque *ibili* 'walk' past and *egon* 'be' present

As Table 16 illustrates, the morphosyntactic distribution of suffixes like *-tza* or *-de* in Basque cannot be defined as a traditional natural class, although it can be captured as second person and/or plural. Whether these are coherent semantics is debatable (see Jackendoff's 1985). The complexity of the distribution, however, can always be stretched to a point where any appeal to morphosyntactic or semantic affinity will be impossible. This was the case of Dhaasanac (Table 1), Hua (Table 12) or of Wojokeso below:

	SG	DU	PL
1	-onji	-ontae	-ontone
2	-onji	-onji	-ontifi
3	-i	-onji	-ontifi

Table 17: Same-subject non-future medial verb agreement in Wojokeso (West 1973:10)

The morphosyntactic distribution of the suffix *-onji* must necessarily be stated as a disjunction of values, which has tended to be regarded in the literature as the defining property of a morpheme. Because we are clearly dealing with a continuum, rather than a dichotomous dimension 'natural vs unnatural', one of our main goals should be to develop measures to quantify the place of specific morphological forms in this continuum. Providing quantitative measures of morphomicity is an objective that morphologists should have in mind if they are to overcome subjectivity and reach higher levels of cross-linguistic comparability.

#### 4 Measuring distributional variation

The morphosyntactic distribution of a form or its distance to its closest natural class are properties which can in principle be reduced to numerical values. However, there is hardly any precedent of any such attempts in the literature. One of the reasons for this is, undoubtedly, the fact that, of all components of grammar, morphology is probably the one subject to most variation as it can be completely absent from one language and exuberant and baroque in another. Even when present, the number of features and values that a given language distinguishes can be so starkly different that it is very difficult to arrive to meaningful crosslinguistic generalizations. It is my intention to take the first steps in this direction by developing measures that can be applied consistently to

morphological signs in different languages.

#### 4.1 Some preliminary considerations in connection to quantitative measurement

Because feature structure (i.e. whether first and third person or dative and ablative form a natural class or not) is disputed, an executive decision needs to be taken in this respect. In order to be as conservative as possible I will set the highest possible bar for unnaturalness. This involves using a **maximally non-restrictive feature structure** so that only unmistakably morphemic patterns are classified as such. I will base the subsequent quantitative measures here upon a feature structure in which any combination of values of a feature (e.g. nominative and ablative, first person and third person etc.) can be considered a natural class. The first person plural and third person plural *-en* in German conjugation can, for example, be described as [-2.PL], or [1/3.PL] and will be considered a natural class for the purposes of this paper. This highly unrestrictive feature structure means that no distribution can be identified as unnatural without the orthogonality of at least two features in the paradigm. Therefore, one needs at least a bidimensional 2x2 paradigm to calculate any of these measures.

A consequence of this high prerequisite is that focus here will be on forms appearing on tabular inflectional paradigms, leaving aside those forms for which no such orthogonality exists (e.g. derivational families, lexicalization patterns etc.). This is not to be understood as a claim, on my part, that morphemicity is to be found only in these cases but simply as a narrowing of the phenomenon analyzed. Adopting the most permissive feature structure imaginable will also render the phenomena and results of later research relevant to a greater audience, including those favouring more restrictive feature structures.

Another related decision that needs to be adopted beforehand concerns the absolute maximal domain within which morphological identities will be explored and considered relevant. This could well be the whole language. Round (2013), for example, regards identical suffixes in the verbal and nominal paradigms of Kayardild as constituting a morpheme. Another possibility would be to strategically restrict attention to those forms within a smaller linguistic sub-domain, such as a certain part of speech, an inflection class or a lexeme.

Even if the right amount of evidence can probably 'convince' language users to the contrary, it is likely that the cognitive significance of a formal identity is dependent, among other things, on the perceived morphosyntactic affinity of the contexts where the form can appear. Consequently, it is my contention that a formal identity between a verbal and a nominal affix with different semantics (e.g. *leb-e* ['live' 1SG present] vs *Bericht-e* ['report' plural]) is likely to be regarded as grammatically less relevant, or irrelevant, compared to a formal identity between two word forms of the same lexeme (e.g. *leb-t* ['live' 3SG] vs *leb-t* ['live' 2PL]). Therefore, in order to delimit the object of study of the present paper, and also to be on a 'safer' ground in general, these measures will be applied to **forms which recur within a single lexeme's paradigm**.<sup>3</sup> This, of course, is a strategic decision and should not be taken to imply that formal identities which stride the borders of the lexeme, like those of Kayardild, are considered always irrelevant.

---

<sup>3</sup> It has sometimes been argued that even this may not be enough to grant cognitive reality. Nevins et al. (2015), for example, argue that patterns like the one in Table 18 are not learned (i.e. interiorized as grammatical objects) by language users of Portuguese. Regardless of the virtues of their particular experiment and their conclusions regarding this concrete morpheme, it must be acknowledged that this is, indeed, a possibility. This problem also applies to forms with morphemic distributions of course (see Zanini et al. 2020 in this volume). However, because, at present, there is no consensual way to "weed out" these cases, the most I can do is to avoid most of them by restricting attention to cases where identical forms recur within a single lexeme.

With these preliminary issues settled, I will in the following sections present some of the ways in which the morphosyntactic (un)naturalness of a morphological object can be quantified.

## 4.2 Internal Morphosyntactic Coherence (IMC)

The sole exception I am aware of of a proposal to measure morphomicity is Esher (2014). She briefly sketched a measure of what she labeled 'morphosyntactic coherence' which she defined as the average proportion of feature values which are shared by every possible pair of cells within a morpheme. For example, when applying this measure to the so-called L-morpheme, she argues:

*for Romance, one might assume (...) the morphosyntactic feature set {IND, SBJV, SG, PL, PERS1, PERS2, PERS3}. In this system, the cells comprising the Ibero-Romance L-pattern would be defined as {1.SG.IND, 1.SG.SBJV, 2.SG.SBJV, 3.SG.SBJV, 1.PL.SBJV, 2.PL.SBJV, 3.PL.SBJV}. There are 21 possible pairs of cells within this morpheme: 6 pairings of 1.SG.IND with each of the SBJV cells, and 15 pairings of each SBJV cell with each other SBJV cell. Similarity between the pair 1.SG.IND and 1.SG.SBJV is 66.7 %, since they share two out of three possible features, while similarity between 1.SG.IND and 2.SG.SBJV is 33.3 % (one shared feature), and similarity between 1.SG.IND and 3.PL.SBJV is 0 % (no shared features). Of the 21 possible pairings, 10 have 66.7 % similarity, 9 have 33.3 % similarity, and 2 have 0 % similarity; the mean similarity of cells within this metamorpheme is 46.0 %. (Esher 2014:344)*

This is a good starting point. However, some clarifications are necessary if this measure and others are to be calculated consistently. The proposed solution to many of the points which are raised next is not always due to any inherent superiority of that solution over others but often just a convention, i.e. a largely unmotivated decision whose only purpose is to ensure a consistent calculation of the measure in different cases.

a) First of all, I believe that for the sake of simplicity, only evidence internal to the morphemic distribution should be used in this measure. If that is the case, there should be no room here for a distinction between 2<sup>nd</sup> and 3<sup>rd</sup> person in the L-morpheme. When these situations arise, the values will be conflated into a single cell, which can be labelled -1 in this case:

	PRES.IND		PRES.SUBJ			PRES.IND		PRES.SUBJ	
	SG	PL	SG	PL		1	pong-	pon-	pong-
1	pong-	pon-	pong-	pong-		1	pong-	pon-	pong-
2	pon-	pon-	pong-	pong-		-1	pon-	pon-	pong-
3	pon-	pon-	pong-	pong-					pong-

Table 18: Stem of the Spanish verb *poner* 'put' in different morphosyntactic contexts

As was mentioned before, for the purposes of this calculation I will presume that any set of values (e.g. nominative, genitive and allative; first and third person etc.) can constitute a natural class. This refinement of the measure streamlines the description of the distribution and simplifies the calculation of the average cell similarity. There are now just 5 relevant cells {1.SG.IND, 1.SG.SBJV, -1.SG.SBJV, 1.PL.SBJV, -1.PL.SBJV} and just ten pairings, whose average cell similarity is also 46%. The modification does not have any impact in the final result in this particular case (i.e. it just simplifies the calculus), although it may in other distributions.

b) There is another related circumstance, concerning the number of cells, about which one may

potentially have doubts. If minimality of description is aimed at, as could be understood from the previous modification, the distribution of the Spanish L-morpheme could potentially be captured as just (1.SG.IND) & (SUBJ). This is, indeed, the minimal morphosyntactic description but it is not suitable for our present purposes. The measure resulting from this description would be 0 and thus identical to that of other clearly different and more complex patterns. This, evidently, does not capture the properties of the distribution. Therefore, the rule will be that, if to capture a distribution we need to do reference to a particular feature (e.g. person or number), reference to that feature will be compulsory in every morphosyntactic context. In other words, all the cells will need to include in their description the same number of feature value specifications.

c) Another clarification is necessary if we want to apply this measure to all paradigmatic distributions consistently. This refers to those cases where all the cells of a morphemic distribution share one value. For example, all the cells within the Romance L-morpheme share a tense value 'present'. If we included that value in the cell descriptions, the figure for the coherence would increase. That is, if we described the cells as {1.SG.PRES.IND, 1.SG.PRES.SBJV, -1.SG.PRES.SBJV, 1.PL.PRES.SBJV, -1.PL.PRES.SBJV}, then the average cell similarity would be 57%. However, I believe that, in those cases, as Esher did, the shared value should be left out of the cell description, because, as it happened before with the 2 vs 3 person distinction, the morpheme's distribution does not give evidence for the existence of that feature in the first place.

Because Esher's (2014) measure, as refined here, deals exclusively with the morphosyntactic coherence internal to the morpheme, it is referred to as 'internal morphosyntactic coherence'. Being internal, there are some aspects of paradigmatic distributions that this measure does not capture. As stated before and acknowledged by Esher (2014: 344), its limitations are that it "will not signal (...) cases in which a given feature value is shared by all cells (...) and cases in which a given feature value is *uniquely* shared by all cells". The answer to the second problem noted by Esher is simple. If a given value is uniquely shared by all cells in the morphemes, i.e. to the exclusion of all other cells, we are no longer dealing with a morpheme but with a morphemic, natural class distribution. Consider these examples:

	German <i>fragen</i> 'ask' present		Amele verb 'see' perfect switch reference (Roberts 1987)		
	SG	PL	SG	DU	PL
1	frag-e	frag-en	fecemin	fecohul	fecomun
2	frag-st	frag-t	fecem	fecebil	
3	frag-t	frag-en	feceb		

Table 19: Two non-morphemic patterns

If we proceeded, for the calculus of this measure, as established above, we would not be able to reach any number whatsoever because we are dealing with a single morphosyntactic domain. Amele *fecebil*, for example, can be described as (-1.-SG), whereas the distribution of German *-en* in the above paradigm can be captured as (-2.PL). Cases like these will count as morphemic, natural class distributions, for the purposes of this measure.

As specified here, the measure for the internal morphosyntactic coherence of the L-morpheme (46%) is close to its logical maximum because an IMC of 50% would imply that the two cells can be reduced to a single morphosyntactic context (see e.g. *-en* in Table 19 above). Typical IMC values will therefore be in the order of 0% (e.g. Hua suffix *-pe* in Table 12), 25% (Wojokeso *-onji* in Table 17), 33% (Basque *-tza* in Table 16) etc.

### 4.3 Morphosyntactic Constrainedness (MC)

The other limitation of the measure of internal morphosyntactic coherence pointed out by Esher (2014:344), that it “will not signal (...) cases in which a given feature value is shared by all cells”, can only be dealt with by recognizing this as a separate circumstance to note in the description of particular distributions. For example, if we consider the overall Spanish verbal paradigm, all the cells of the L-morpheme share a value ‘present’. The same as morphemes, morphemes may be confined to particular morphosyntactic contexts or subparadigms. We may call this measure ‘morphosyntactic constrainedness’ and define it informally as the extent to which the distribution of a formative is confined to a morphosyntactically coherent subset of the total paradigm.

The distribution of forms within a paradigm may be constrained negatively (a form does not appear with some particular value(s)) or positively (e.g. it can only appear with some value). The second is, evidently, more restrictive than the first. To calculate the measure of paradigmatic constrainedness I propose to assign a value of 1 to positively defined (strong) constraints and 0.4 to negatively defined (weak) constraints.<sup>4</sup> A form may be subject to more than one constraint simultaneously and when that is the case the numbers will be simply added:

	PRES			PAST		
	SG	DU	PL	SG	DU	PL
1	boadán	bohte	boahtit	bohten	boðiime	boðiimet
2	boadát	boahtibeahti	boahtibehtet	bohtet	boðiide	boðiidet
3	boahtá	boahtiba	bohtet	bodii	boðiiga	bohte

Table 20: North Sami *boahtit* ‘come’ (Kahn & Valijärvi 2017: 117, 121)

The stem alternant with a weak consonant can appear in North Sami in both past and present, in singular, dual and plural numbers, and in first, second and third person. It is, therefore, morphosyntactically completely unrestricted and its morphosyntactic constrainedness is thus 0.

	SG	PL
ILL	maddja	maddjid
LOC	maddjest	maddjin
COM	maddjin	maddjuvui’m
ABE	madditää	maddjitää

Table 21: Skolt Saami *maadd* ‘base’, partial paradigm (Feist 2010:146)

The formative *-jin* in Skolt Sami appears in either number but does not appear in all grammatical cases. We can therefore say that the suffix has a weak constraint because it does not appear in some cases like illative or abessive. Its morphosyntactic constrainedness is therefore 0.4.

---

<sup>4</sup> This relative weight to one kind constraint relative to the other is arbitrary to some extent. The advantage of 0.4 over e.g. 0.5 is that two weak constraints can be distinguished from a strong one.

	PRES		PAST	
	SG	PL	SG	PL
1	am	are	was	were
2	are	are	were	were
3	is	are	was	were

Table 22: English 'be'

The form 'are' in English is subject to a strong morphosyntactic restriction, namely, that it is limited to appearing in the present tense. Its paradigmatic constrainedness is thus 1.

	Interrogative			Indicative			Counterfactual		
	SG	DU	PL	SG	DU	PL	SG	DU	PL
1	-ve	'-ve	-pe	-e	'-e	-ne	-hine	'-hine	-sine
2	-pe	'-ve	-ve	-ne	'-e	-e	-sine	'-hine	-hine
3	-ve	'-ve	-ve	-e	'-e	-e	-hine	'-hine	-hine

Table 23: Subject agreement in Hua verbs, partial paradigm  
(Stump 2015: 128 after Haiman 1980)

A form, even when morphemic, can be subject to several constraints simultaneously. The suffix *-pe*, for example, is limited to the interrogative mood (strong constraint) to non-dual numbers (weak constraint) and to non-third person (another weak constraint). Its paradigmatic constrainedness, thus, is  $1 + 0.4 + 0.4 = 1.8$ .

#### 4.4 External Morphosyntactic Coherence

Another distributional dimension which is not captured fully by either of the former measures refers to the 'distance' between a morphemic distribution and morphosyntactic naturalness. An inspiration for such a measure is to be found in issues like the so-called 'meaning assignment problem' and the 'imperfect distribution problem' (Trommer & Bank 2017). For these and many other morphologists, formatives must express grammatical meaning. From this perspective, it is, indeed, problematic, when formatives have a distribution which does not align perfectly with some feature value, however abstract. For this reason, Trommer & Bank (2017) devote their efforts to quantifying the extent to which the actual distribution of a formative deviates or not from that which would be expected from a given hypothesized morphosyntactically coherent meaning. In this vein, they introduce the measures of 'recall' and 'precision'. Informally, the first measures the number of times a meaning is expressed by the "right" form whereas the second refers to the number of times a form has the "right" meaning. Let us illustrate the notions with an example:

	SG	PL
1	sin	sin

2	bas	sid
3	as	sin

Table 24: Luxembourgish *sin* 'be', present. (Wunderlich 2012 after Nübling 2000)

As shown in Table 24, the form *sin* appears in the first person (in both singular and plural) and in the third person plural. If we propose its meaning to be non-addressee/[-2], then we have a precision of 3/4 (note the false negative of 3SG) but a recall of 1, since every instance of *sin* has the value [-2]. If we posit, instead, that the meaning of *sin* is just speaker/[1], then precision would be 1 (all first person forms are, indeed, *sin*) but recall would be 2/3 (note the false positive of 3PL). As Trommer & Bank (2017) state, precision is optimized by minimizing false positives, whereas recall is optimized by minimizing false negatives.

Capitalizing from these notions 'recall', 'precision', 'false positives' and 'false negatives', we can devise a measure for the 'external morphosyntactic coherence' of a distribution. We can define this as the minimum number of false positives and false negatives that a given distribution would give rise to under the most efficient meaning hypothesis. Consequently, the lower the number, the higher the external morphosyntactic coherence of a form. In the case of Luxembourgish *sin*, the meanings non-addressee and speaker both give rise to the same number of mismatches (one). This would be its external morphosyntactic coherence.

In other cases (e.g. Wojokeso -onji, presented again below for convenience) no meaning hypothesis gives rise to less than two false positives or false negatives. The morphosyntactic distribution of the suffix, therefore, is minimally two steps away from naturalness.

	SG	DU	PL
1	-onji	-ontae	-ontone
2	-onji	-onji	-ontifi
3	-i	-onji	-ontifi

Table 25: Same-subject non-future medial verb agreement in Wojokeso (West 1973:10)

If we hypothesize -onji to mean [-PL], we do not account for the absence of the form from the 1DU and the 3SG. If we argue that it means [2.-PL] we don't cover the appearance of -onji in the 1SG and 3DU. As a result, the external morphosyntactic coherence of the suffix will be two.

Contrast this to the case of morphemes, where the most efficient meaning hypothesis should describe all its morphosyntactic uses and only those of that form. This is the case, for instance, of the form *fecebil* in Amele or -en in German conjugation, as was mentioned before. These forms have a perfect correlation to particular morphosyntactic values and couldn't, therefore, be classified, under the present high requirements, as morphemes in the usual sense of the term.

#### 4.5 Other possible measures

The measures which have been proposed here do not exhaust, of course, the variety of measures that could be devised in relation to morphosyntactic distribution. Other measures of morphomicty could, for example, be sought in probability theory. It is sometimes assumed that morphemic patterns, if they are truly independent from any feature values, must have a

distribution which is “morphosyntactically random” (Carstairs-McCarthy 2014: 75). The background idea is, of course, that, depending on the size of the paradigm, it is unlikely for a given formative to correlate perfectly with a certain morphosyntactic value unless its distribution is not random. The argument is not unlike that of Sauerland & Bobaljik (2013) when they try to separate the formal identities due to morphosyntactic affinity (more frequent) from other (accidental) homophonies which would constitute, in their view, simply background noise in their quest for systematic morphosyntactic affinities.

From a purely random perspective, for example, taking as a reference the distribution of an exponent spanning 2 cells within a 4-cell paradigm, 67% (4/6) of the possible distributions are natural. The likelihood of natural distributions decreases fast with increasingly bigger paradigms. For example, only 7% (6/84) of the possible configurations of a 3-cell exponent within a 3x3 paradigm will constitute a natural class (Figure 2). It must be stressed, however, that distributions which are furthest away from morphosyntactic naturalness are actually as infrequent as natural distributions and much more infrequent than distributions which are intermediate between the two extremes:

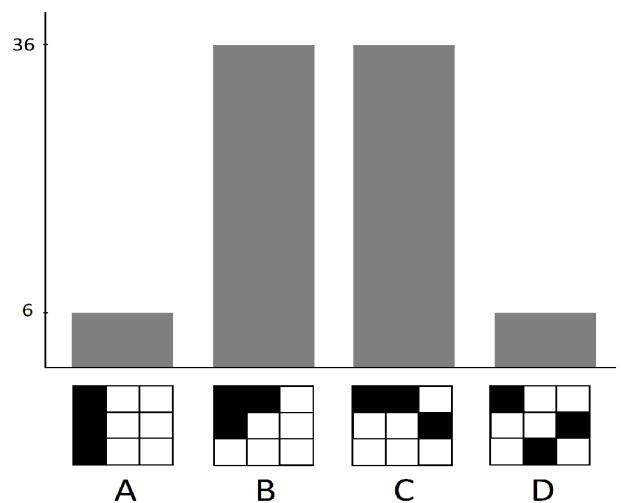


Figure 2: Number of distributions of different kinds

As Figure 2 illustrates, a 3-cell formative within a 3x3 paradigm can adopt 84 different configurations. Six of them (A) will be completely natural (i.e. describable as a single morphosyntactic context) and another six (D) will be in the exact opposite pole, which we may call 'anti-naturalness' (internal morphosyntactic coherence = 0). The majority of the possible configurations, however, are intermediate between these two extremes. 36 configurations (B) are such that the formative does not appear in a whole row and a whole column, so that even if not natural, its distribution is still somewhat restricted (internal morphosyntactic coherence = 33%). Another 36 of the possible configurations (C) are those which leave 'free' only one row or column in the paradigm and are therefore more unrestricted, even if not completely so.

There are two different ways in which these concerns could be relevant for the measurement of morphomicity. One could use the continuum of Figure 2 as a yardstick to measure the degree of orthogonality of the domain of a given morphological object to morphosyntactic features. Under this approach, exponents which adopt configurations farther removed from 'naturalness' would be more 'morphic'. Therefore, an exponent with a distribution D would be 'more morphic' than one which adopts a distribution C, which would be in turn more morphic than one which adopts a distribution B. This is the *raison d'être* of the measure of internal morphosyntactic coherence which was presented before.

An alternative way to employ these considerations in relationship with morphomicity suggests itself if we understand (much like Carstairs-McCarthy 2014: 75) that a morpheme is a morphological object whose distribution is random. Under this perspective, distributions B and C would be the most morphemic, whereas A and D would be the least morphemic. It must be acknowledged that, in some cases of morphological polarity (e.g. conjunct/disjunct systems) there may be an available motivation (i.e. an alternative feature system) for D-type configurations so that they may not constitute the best examples of morphemes. However, when there is no semantic explanation for the pattern I see no reason why these patterns should not be regarded as morphemic in the most usual sense of the word.

Considerations like the ones in this section have been usually brought about in theoretical discussions in order to highlight the extreme unlikelihood of morphosyntactically natural distributions arising by chance (e.g. Pertsova 2008). This is sometimes argued to support the paramount importance of morphosyntactic features and natural classes for morphological organization since, unlike could be expected on purely probabilistic grounds, morphosyntactically natural distributions are much more frequent than unnatural ones. Although I sympathize with the idea that features and natural classes are indeed important structurers of grammar, I consider this reasoning to be clearly flawed since it disregards completely any diachronic considerations. We know that morphological patterns originate most often (maybe always ultimately) from free words in syntactic constructions. These words do have a meaning, and, if we exclude pronouns, which often cumulate the values of person and number into an indivisible item, most often a 'minimal' meaning such as [future] or [plural]. There is no reason whatsoever why, once these words grammaticalize and become part of a bigger paradigm, they would not keep their former distributions, in which case they could well align by mere inertia with the morphosyntactic value they expressed originally. Only chance formal resemblances between originally distinct objects or a long history of sound or semantic changes in the language can increase the chances for unnatural configurations. Because of the diachronic origin of bound formatives, even if unnatural morphological patterns were not actually dispreferred in language learning and change, it might still be unrealistic to expect a predominance of unnatural distributions.

## 5 Conclusion

I have shown in this paper how the facts of language suggest that the distinction between morphemes and morphemes, or between so-called 'natural' and 'unnatural' morphosyntactic distributions, is one of degree rather than one of kind. Besides the defining one, no single property can be identified that consistently distinguishes morphemes from morphemes. Morphemes can have the same sources as morphemes and the same diachronic resilience, and they can also be stems or affixes. This may lead us to question the motivation and usefulness of the distinction as a whole.

The obvious solution is to measure rather than to taxonomize the distributions of morphological signs. Various quantitative measures have been proposed here that enable us to objectively describe the place of particular forms in the morpheme-morpheme continuum. Although the vast variability of the morphological component from one language to another poses formidable challenges, developing measures of this kind is the way to progress toward inter- and intralinguistic comparability.

Future research should be aimed at refining these measures and scaling them up. Throughout this paper, these measures have been applied to concrete forms (e.g. Sp. *pong*- Eng. 'are', Hua -*pe*) in concrete inflectional paradigms. There is no reason, however, why they should not apply to bigger

objects like whole paradigms (averaging across the measures for the different formatives) or even whole inflectional systems. The application of these measures to more complex objects of course would necessarily bring about new decisions on how factors like type and token frequency or the Zipfian nature of linguistic input (e.g. Blevins et al. 2017) are taken into account.

It seems a fruitful avenue for future research to apply these and other measures in larger cross-linguistic analyses to spot statistical tendencies and co-dependencies. Larger empirical datasets should provide a definitive answer to the question of whether or to what extent theoretically-driven distinctions like ‘natural’ vs ‘unnatural’ or ‘morphemic’ vs ‘morphomic’ matter in language.

### Acknowledgements:

Thanks are due to Matthew Baerman, Oliver Bond and Iván Igartua for their comments on earlier versions of this paper. The comments of two anonymous reviewers of Word Structure have also helped to improve this manuscript. The financial support of the Basque government (PRE\_2015\_1\_0175) and Techne are also gratefully acknowledged.

### References:

- Aronoff, Mark. 1994. *Morphology by itself: Stems and inflectional classes*. Cambridge (MA): MIT press.
- Aronoff, Mark. 2016. Competition and the lexicon. In Annibale Elia, Claudio Iacobini & Miriam Voghera (Eds.). *Livelli di Analisi e fenomeni di interfaccia. Atti del XLVII congresso internazionale della società di linguistica italiana*. 39-52. Roma: Bulzoni Editore.
- Baerman, Matthew, Dunstan Brown, and Greville G. Corbett. 2005. *The syntax-morphology interface: A study of syncretism*. Cambridge: Cambridge University Press.
- Bermúdez-Otero, Ricardo & Luís, Ana R. 2016. A view of the morpheme debate. In Ana R. Luis & Ricardo Bermudez-Otero (Eds.) *The morpheme debate*: 309-40. Oxford: Oxford University Press.
- Blevins, James P; Petar Milin & Michael Ramscar. 2017. The Zipfian Paradigm Cell Filling Problem. In F. Kiefer, J. P. Blevins & H. Bartos (Eds.), *Perspectives on Morphological Structure: Data and Analyses*. Leiden: Brill.
- Bickel, Balthasar & Johanna Nichols. 2007. Inflectional morphology. In Timothy Shopen (Ed.) *Language typology and syntactic description 3*, 2: 169-240. Cambridge: Cambridge University Press.
- Bickel, Balthasar. 2010. Capturing particulars and universals in clause linkage. In Isabelle Bril (Ed.) *Clause-hierarchy and clause-linking: the syntax and pragmatics interface*: 51-101. Amsterdam: John Benjamins.
- Boyé, Gilles & Patricia Cabredo Hofherr. 2006. The structure of allomorphy in Spanish verbal

- inflection. *Cuadernos de Lingüística del Instituto Universitario Ortega y Gasset* 13: 9-24.
- Burzio, Luigi. 2001. Zero derivations. *Linguistic Inquiry* 32.4: 658-677.
- Carstairs-McCarthy, Andrew. 2014. Affixes and stem alternants in Latvian nouns: implications for inflectional theory. *Baltic Linguistics* 5: 59-80.
- Corbett, Greville G. 2005. The canonical approach in typology. In Zygmunt Frajzyngier, Adam Hodges & David S. Rood (Eds.) *Linguistic diversity and language theories*: 25-49. Amsterdam: John Benjamins.
- Esher, Louise. 2014. Autonomous morphology and extramorphological coherence. *Morphology* 24, 4: 325-350.
- Feist, Timothy Richard. 2011. *A grammar of Skolt Saami*. PhD Dissertation.
- Gause, Georgij F. 1934. *The struggle for existence*. Baltimore: Williams and Wilkins.
- Gordon, Matthew K. 2009. A fortition-based approach to balto-fennic-sámi consonant gradation. *Folia Linguistica Historica* 18, 1-2: 49-79.
- Haiman, John. 1980. *Hua, a Papuan language of the eastern highlands of New Guinea*. Amsterdam: John Benjamins.
- Hockett, Charles F. 1987. Refurbishing our foundations. Amsterdam: John Benjamins.
- Holmes, Philip, and Ian Hinchliffe. 2003. *Swedish: A comprehensive grammar*. London: Routledge.
- Jackendoff, Ray S. 1985. Multiple Subcategorization and the Theta-Criterion: The Case of Climb. *Natural Language and Linguistic Theory* 3: 271-295.
- Kahn, Lily & Riitta-Liisa Valijärvi. 2017 *North Sámi: An Essential Grammar*. London: Routledge.
- Koonts-Garboden, Andrew. 2016. Thoughts on diagnosing morphomicty: A case study from Ulwa. In Ana R. Luis & Ricardo Bermudez-Otero (Eds.) *The morpheme debate*: 309-40. Oxford: Oxford University Press.
- Maiden, Martin. 2011. Morphological persistence. In Martin Maiden, John Charles Smith & Adam Ledgeway (Eds.), *Cambridge history of the romance languages*: 155-215. Cambridge: Cambridge University Press.
- Maiden, Martin. 2017. Romansh allomorphy (Again!). In Claire Bowern, Laurence Horn & Raffaella Zanuttini (Eds.), *On looking into words (and beyond): Structures, Relations, Analyses*: 189-210.
- MacCallum, Robert C., Shaobo Zhang, Kristopher J. Preacher & Derek D. Rucker. 2002. On the practice of dichotomization of quantitative variables. *Psychological Methods* 7: 19-40.
- Montermini, Fabio, and Olivier Bonami. 2013. Stem spaces and predictability in verbal inflection. *Lingue e linguaggio* 12, 2: 171-190.
- Nevins, Andrew, Cilene Rodrigues & Kevin Tang. 2015. The rise and fall of the L-shaped morphome: diachronic and experimental studies. *Probus* 27.1: 101-155.

- Noreen, Adolf. 1904. *Altschwedische grammatischen*. Halle: Niemeyer.
- Nübling, Damaris. 2000. *Prinzipien der Irregularisierung. Eine kontrastive Analyse von zehn Verben in zehn germanischen Sprachen*. Tübingen: Niemeyer.
- Pato, Enrique & Paul O'Neill. 2013. Los gerundios analógicos en la historia del español (e iberorromance). *Nueva Revista de Filología Hispánica* 61, 1: 1-27.
- Pertsova, Katya. 2011. Grounding systematic syncretism in learning. *Linguistic Inquiry* 42, 2: 225-266.
- Rask, Rasmus. 1976. *A grammar of the Icelandic or Old Norse tongue*. Amsterdam: John Benjamins.
- Rießler, Michael. To appear. Kildin Saami. In Marianne Bakró-Nagy, Johanna Laakso & Elena Skribnik (Eds.), *Oxford Guide to the Uralic Languages*. Oxford: Oxford University Press.
- Roberts, John R. 1987. *Amele*. London: Croom Helm.
- Round, Erich R. 2013. Rhizomorphomes, meromorphomes, and metamorphomes. In Matthew Baerman, Dunstan Brown & Greville Corbett (Eds.), *Understanding and Measuring Morphological Complexity*. 29-52. Oxford: Oxford University Press.
- Sammallahti, Pekka. 1998. The Saami languages: An introduction. Karasjok, Norway: Davvi Girji.
- Sauerland, Uli & Jonathan Bobaljik. 2013. Syncretism distribution modeling: Accidental homophony as a random event. *Proceedings of GLOW in Asia IX 2012*.
- Spencer, Katharine. 2008. Kwomtari grammar essentials. In Murray Honsberger, Carol Honsberger & Ian Tupper (Eds.) *Kwomtari phonology and grammar essentials*: 53-183. Ukarumpa: SIL-PNG Academic Publications.
- Spencer, Andrew. 2016. Stems, the morpheme and meaning-bearing inflection. Luís, Ana R. & Ricardo Bermúdez-Otero. (Eds.) 2016. *The Morpheme Debate*. Oxford: Oxford University Press.
- Steriade, Donca. 2016. The morpheme vs. similarity-based syncretism: Latin *t*-stem derivatives. In Ana R. Luís & Ricardo Bermúdez-Otero. (Eds.). *The Morpheme Debate*. Oxford: Oxford University Press.
- Stump, Gregory. 2015. Inflectional Paradigms: Content and Form at the Syntax-Morphology Interface. Cambridge: Cambridge University Press.
- Tosco, Mauro. 2011. *The Dhaasanac Language*. Cologne: Rüdiger Köppe.
- Trommer, Jochen & Sebastian Bank. 2017. Inflectional learning as local optimization. *Morphology* 27, 3: 383-422.
- West, Dorothy. 1973. *Wojokeso sentence, paragraph, and discourse analysis*. Canberra: The

Australian National University.

Wilbur, Joshua. 2014. *A grammar of Pite Saami*. Berlin: Language Science Press.

Wunderlich, Dieter. 2012. Polarity and constraints on paradigmatic distinctness. In Jochen Trommer (Ed.) *The morphology and phonology of exponence*: 121-159. Oxford: Oxford University Press.

Wurzel, Wolfgang Ullrich. 1989. *Inflectional morphology and naturalness*. Dordrecht: Kluwer Academic Publishers.

Zanini, Chiara; Rosa Rugani; Dunia Giomo; Francesca Peressotti; Francesca Franzon. 2020. Effects of animacy on the processing of morphological Number: a cognitive inheritance? Word Structure.

# **From meaning to form and back in American Sign Language verbal classifier morphemes**

**Vanja de Lint**

**University of Amsterdam**

V.deLint@uva.nl

## **Abstract**

In a seminal paper, Benedicto & Brentari (2004) present a theoretical proposal in which they analyze American Sign Language (ASL) classifier morphemes as instantiations of functional heads F1 and F2 that determine the external or internal position of the argument that lands in their specifier through a structural agreement relation. It has served as a ground for several follow-up studies investigating argument structure in sign language classifier constructions. However, their proposal requires both theoretical amendment and empirical corroboration. In this paper, I will critically assess the proposal by Benedicto & Brentari (2004) and provide empirical support for its modified version.

## **1. Sign language classifiers**

### **1.1 Sign linguistics**

Half a century of research in sign linguistics has established that, like spoken languages, sign languages are naturally acquired, rich languages with autonomic, modular grammars and complex structures (Stokoe 1960; Klima & Bellugi 1979; Sandler & Lillo-Martin 2006). The sub field of sign language morphology, too, has exposed many similarities between the spoken and signed modality (Meir 2012). Both modalities use conventions of form-meaning correspondences (spoken languages use words, sign languages use signs) and both display duality of patterning: a limited set of formation units making up a limitless set of meaningful utterances (Stokoe 1960). In spoken languages, the formation units – phonemes- can be said to be arbitrary and mostly devoid of meaning. In sign languages, on the other hand, many basic, formation units are not arbitrary and in fact tend to bear meaning (see Brentari (1998) and Van der Kooij (2002) for an analogy between the two modalities). This iconicity obscures the traditional division between phonemes and morphemes (Johnston & Schembri 1999). As for word formation, the two modalities have the same processes and phenomena at their disposal but show different preferences.<sup>1</sup> Sequential morphology in the visuo-spatial modality is rare and exclusively derivational; simultaneity is ubiquitous and applies to both inflectional and derivational processes (Aronoff et al. 2005). In general, signs are much more simultaneously organized (Stokoe 1960) and iconically motivated (Taub 2001) than words. These two characteristics can be well observed in classifier constructions.

### **1.2 Classifier constructions**

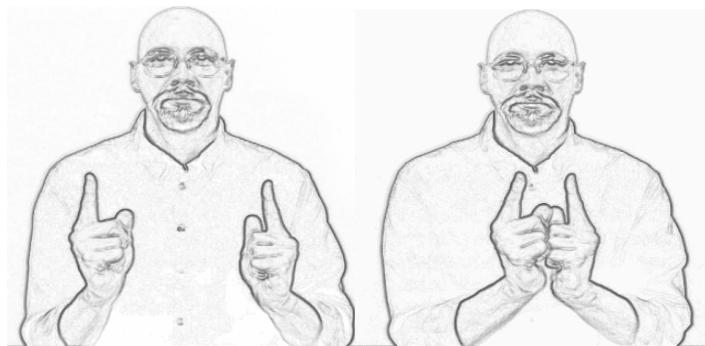
Classifier constructions seem to be a typical sign language phenomenon (Zwitserlood 2012). In this type of construction, handshapes represent referents according to their real-world properties and movement and location represent the real-world movement and location of the referent by analogue mappings of

---

<sup>1</sup> Certain morphological operations are only found in sign languages: see, for instance, Pfau & Steinbach (2005) for some unique reduplication types.

event space onto sign space (Emmorey 2002). Lexical signs have four phonological parameters: handshape, orientation, location and movement.<sup>2</sup> The particular handshape, orientation, location and movement of a lexical sign are themselves meaningless. Together they form a unit and changing one of the parameters of a lexical sign changes the meaning of it altogether. The ‘S’ (S) handshapes of the American Sign Language (ASL) sign CAR, for example, distinguish it from the sign WHICH (made with ‘A’ (A) handshapes in the same orientation and location with the same movement).<sup>3</sup> On the contrary, in classifier constructions, the phonological parameter settings take on morphological status. The two ‘1’ (1) handshapes of the ASL classifier construction in (1) contribute separate morphemes to the linguistic utterance: each hand here refers to a separate entity and identifies that entity as an upright-being. Using a ‘3’ (3) handshape or ‘bent V’ (V) handshape would change the meaning of the classifier construction partially: it would refer to two vehicles or animals, respectively, but it would still mean they are approaching each other face-to-face (or front-to-front). Likewise, reversing the movement of this sign while keeping the other parameter settings the same, would yield only a partial change in meaning and would result in something like this: ‘two\_upright\_beings\_walking\_backwards\_while\_facing\_each\_other’.

(1) Classifier construction in ASL (used by permission from [www.Lifeprint.com](http://www.Lifeprint.com))



CL:up-right-being-CL:up-right-being  
“two\_upright\_beings\_approach\_each\_other\_face\_to\_face”

Sign language classifier constructions are commonly analyzed as verbal (Supalla 1986; Glück & Pfau 1997; Aikhenevald 2003; Zwitserlood 2003, 2012; Sandler & Lillo-Martin 2006). Verbal classifiers occur inside the verb form: classifier morphemes attach to verbs as affixes and classify one of the nominal arguments of the verb (2). In sign language classifier constructions, it is the handshapes that fulfill this role.

(2) Verbal classifier example from spoken language Waris (Brown 1981: p.96)

sa	ka-m	put-ra-ho-o
coconut 1sg-to CL:round-get-benefact-imperative		
“Give me a coconut”		

<sup>2</sup> For simplicity’s sake, I am leaving out the non-manual component.

<sup>3</sup> As is standard in sign linguistics, I use English words that approximate the meaning of a lexical sign, in small capitals, to represent any given sign. To represent classifier handshapes, I use the symbols common in sign linguistics literature (letters and numbers, such as ‘1’, ‘3’, ‘A’, ‘S’, ‘bent V’), followed by a small drawing of the handshape that they denote in between parentheses (for example (1), (3), (A)).

### 1.3 Handshape morphemes

Although categorizations and terminology have varied over the past (Supalla 1982, 1986; Lidell & Johnson 1987; Schick 1987, 1990; Engberg-Pedersen 1993; Schembri 2001, 2003), several studies relating classifier handshapes to the argument structure of the verbal constructions they take part in, distinguish at least three types (Benedicto & Brentari 2004; Benedicto et al. 2007; Pavlic 2016; de Lint 2018). The first type is the body part classifier (BPCL), where the handshape represents a limb or other body part of an animate entity. The example in (3) shows an upside-down wiggling '3' () handshape, here referring to a person's legs, to illustrate this type of classifier.

(3) Body part classifier in ASL (used by permission from [www.Lifeprint.com](http://www.Lifeprint.com))



BPCL:a\_pair\_of\_legs+GO\_BY  
"he/she\_walks\_by"

The second type is the whole entity classifier (WECL), where the handshape refers to a whole entity. This type includes semantic classifiers, which represent classes of objects (such as the '3' () handshape for vehicles), descriptive instrumental classifiers, which refer to a whole instrument (such as the '1' () handshape as used for a toothbrush), and descriptive classifiers, which refer to a whole object defined primarily by their shape (such as the 'B' () handshape referring to a book/sheet of paper). An example of a WECL is given in (4). The '1' () handshape here is used as a descriptive classifier and refers to a pencil.

(4) Whole entity classifier in ASL (reprinted with permission from de Lint 2010)



WECL(1-handshape)+WECL(1-handshape)+BREAK

WECL:long\_thin\_object-WECL:long\_thin\_object+BREAK

"the pencil\_breaks"

The third type is the handling classifier (HdlgCL), where the handshape represents the manipulation of an object or instrument. This type then includes both direct handling of an object, such as the 'money' (⌚) handshape when it represents the hands breaking a pencil (see an example of this type in (5) below), or indirect handling of an object mediated by an instrument, such as the 'S' (牚) handshape when it refers to a person holding a saw.

(5) Handling classifier in ASL (reprinted with permission from de Lint 2010)



HdlgCL(money-handshape)+HdlgCL(money-handshape)+BREAK

HdlgCL:a\_hand\_manipulating\_a\_long\_thin\_object-HdlgCL:a\_hand\_manipulating\_a\_long\_thin\_object+BREAK

"he/she\_breaks\_the\_pencil"

This paper focuses on classifier handshape morphemes in American Sign Language (ASL) and their interaction with argument structure. In the next section, I will present the influential analysis of Benedicto & Brentari (2004), point out some of its problems and propose a modification. In section 3, I will describe the experiment designed to find empirical evidence for the modified hypothesis. I will present the results in section 4. Finally, in section 5, I will discuss the findings and present my conclusion.

## 2. Classifiers & argument structure

### 2.1 Theoretical background

In their 2004 paper, Benedicto & Brentari show that ASL appears to have overt morphological marking of argument structure in its classifier constructions: the classifier *type* seems to determine the argument structure of the verbal construction the classifier appears in. In the minimal pair (4) and (5) above, the same movement root combines with a WECL (1-handshape, ⓘ) classifying long thin objects in (4) and with a HdlgCL (money-handshape,⌚) classifying people handling long thin objects in (5). While (4) yields an intransitive/unaccusative structure, (5) yields a transitive structure.

According to Benedicto & Brentari, each of these three classifier types expresses a different argument structure. Benedicto & Brentari propose that classifier handshapes are instantiations of functional heads F1 and F2 (part of UG) that determine the external or internal position of the argument that lands in their specifier through a structural agreement relation (Figure 1).

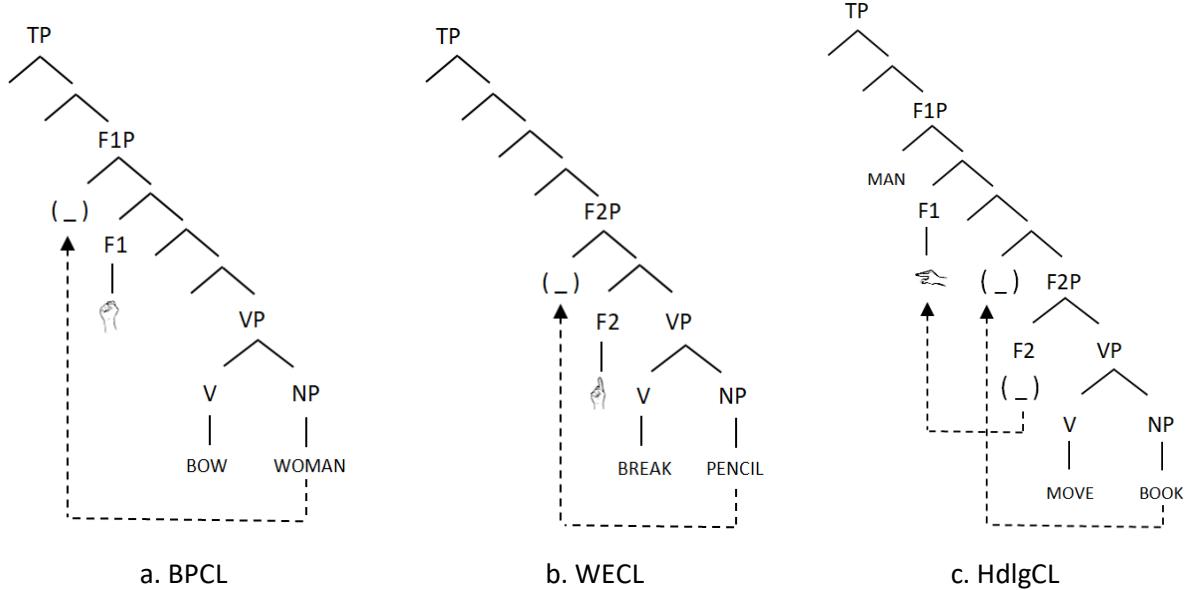


Figure 1. Syntactic structures proposed for BPCL (a), WECL (b) and HdIgCL (c) by Benedicto & Brentari (2004).

BPCLs (a) are instances of F1 heads: the arguments associated with them exhibit the behavior of *external* arguments, in particular that of agents. WECLs (b) are instances of F2 heads: the arguments associated with them exhibit the behavior of *internal* arguments. Finally, HdIgCLs (c) are a combination of an F1 and an F2 head and are thus associated with both an external and an internal argument. In other words, BPCLs give rise to unergatives, WECLs give rise to unaccusatives and HdIgCLs give rise to transitives. Table 1 gives an overview of the associations between classifier type and syntactic structure that Benedicto & Brentari describe.

Table 1. Associations between classifier type and syntactic structure reported by Benedicto & Brentari (2004).

Classifier Type	Functional Head	Argument Status	Syntactic Structure
BPCL	F1	External Argument	Unergative
WECL	F2	Internal Argument	Unaccusative
HdIgCL	F1 + F2	Internal Argument + External Argument	Transitive

Having established this trichotomy, Benedicto & Brentari go on to say that ASL classifier constructions appear in two systematic argument structure alternations: one is the alternation between unergative BPCL constructions and unaccusative WECL constructions, the other one is the alternation between transitive HdIgCL constructions and intransitive, unaccusative WECL constructions (Table 2). The minimal pair (4) and (5) in the previous section illustrates the second alternation.

Table 2. Systematic classifier construction alternations as claimed by Benedicto & Brentari (2004).

Alternation 1	BPCL (F1) -> Unergatives	WECL (F2) -> Unaccusatives
Alternation 2	HdIgCL (F1+F2) -> Transitives	WECL (F2) -> Intransitives (specifically: unaccusatives)

## 2.2 Implications

While Benedicto & Brentari put forward a highly interesting theoretical account, and have served as a basis for many follow-up studies (Benedicto et al. 2007; Grose et al. 2007; Mathur & Rathmann 2007; de Lint 2010, 2018; Pavlic 2016; Kimmelman et al. 2019; Abner 2017) some of its implications raise questions about the empirical adequacy. In the next section, I will expose some of the problems I found and set out the hypothesis for my experiment, which I will describe in section 4.

### 2.2.1 Agents versus human causes

Benedicto & Brentari speak of a system of two argument structure alternations, arising from the exploitation of F1 and F2 by ASL classifier constructions. The first one is known as split intransitivity: the verb alternates between an unergative version and an unaccusative version. A spoken language example of this kind can be seen in Dutch (6), where the verb form itself stays the same but the syntactic change is evidenced by the change in auxiliary (Hoekstra 1984, 1999; Hoekstra & Mulder 1990).

(6)

- |    |  |    |  |
|----|--|----|--|
| a) | Jan heeft (in de sloot) gesprongen.<br>Jan has (in the ditch) jumped(unerg)<br>"Jan has been jumping (in the ditch)" | b) | Jan is (in de sloot) gesprongen.<br>Jan is (in the ditch) jumped(unacc)<br>"Jan has jumped (into the ditch)" |
|----|--|----|--|
- Dutch

The second alternation looks like the well-known causative-inchoative alternation exemplified for English in (7), with a transitive version and an unaccusative, intransitive version. The ASL alternation, however, is crucially different in that the transitive alternate is specifically agentive and cannot be merely causative: the HdIgCL construction does not allow for an instrument or a natural cause as subject (8).

(7) Peter/the hammer/lightning broke the pencil <-> The pencil broke.

English

(8) PETER/\*HAMMER/\*LIGHTNING PENCIL HdIgCL+BREAK <-> PENCIL WECL+BREAK

ASL

This constitutes an important difference between ASL and other (spoken) languages. If it were true that the functional heads associated with argument structure are part of Universal Grammar and in principle available to all languages, we would expect to find agentive-inchoative alternations in other languages, too. This is not the case: there are several transitive-intransitive alternations cross-linguistically, but none of them alternates in the way that Benedicto & Brentari (2004) describe for ASL. Let us have a more

detailed look at the alternation in question. In (9) we see several types of transitive-intransitive alternations. What characterizes verbs partaking in the causative-inchoative alternation is the combination of an external causal argument (that can take the form of either an agent, an instrument or a natural cause) and an internal theme argument that can alternatively surface as subject to form an unaccusative. This is true for the English verb *open* in a). The verb *worry* in b) has an external causal argument but, unlike *open*, an internal experiencer argument. Although verbs like *worry* can have intransitive alternates (*Lucie worries*), these alternates are unergative rather than unaccusative (Reinhart 2002). Finally, the verb *eat* in c) has an internal theme argument but exclusively allows for agentive subjects. Although such agentive verbs may also have intransitive alternates (*The baby ate*), they do not allow for the internal theme argument to surface externally and form an unaccusative alternate (\**The soup ate*).

(9)

- a) Max /the key/the wind opened the door.
- b) Max /the noise /the gun worries Lucie.
- c) The baby/\*the spoon/\*the hunger ate the soup.

Independent of the assumed direction of derivation (from intransitive to transitive or vice versa), the fact that the transitive verbs in Benedicto & Brentari's ASL data only take agents as external arguments predicts alternations that are not attested cross-linguistically. If we assume that the intransitive is derived from the transitive (Reinhart 2000, 2002, a.o.), we would predict agentive verbs like "eat" to partake in the same alternation as verbs like "open" and we would predict sentences like "the soup ate" to be grammatical, in one language or another. This prediction is not borne out (e.g. \*SOUP EAT for ASL, and see just above (9) for English and generally).<sup>4</sup> On the other hand, if we assume that the transitive is derived from the intransitive (as Benedicto & Brentari do), we would not only predict agentive-inchoative alternations but also unergative-inchoative alternations. Benedicto & Brentari argue that the verbal root selects the number of the arguments. Therefore, they must assume that inchoative alternates of verbs like "break" only select one argument, which could then combine with either a HdIgCL (in which case F1 would add the agent of the transitive alternate) or a BPCL (in which case F1 would transform the internal status of the theme argument into an external, agentive one). We would thus predict to find both unergative and unaccusative alternates of "the door opened" (alongside the transitive alternate "Max opened the door"). This prediction is not borne out either (e.g. \*DOOR BPCL+OPEN for ASL). It is more likely in the face of empirical generalizations that the transitive alternates described by Benedicto & Brentari select for the broader role of causer (as in the causative-inchoative alternations of spoken languages), but that – for whatever reason – this role is restricted to [+animate] or maybe even [+human] causers.

## 2.2.2 Empirical adequacy

---

<sup>4</sup> At first sight, middle constructions ("This soup eats like a meal", "This book reads easily") may seem like a counterexample, but, crucially, middle constructions do contain agents (semantically, though not syntactically), contrary to unaccusative structures, and therefore do not present unaccusative alternates of agentive verbs. So "John eats the soup" -> "The soup eats (like a meal)" does not present an analogy to "John opens the door" -> "The door opens". Their semantic and syntactic properties, their marginality and the very specific conditions such constructions require (for example, they need to have a modifier -adverbial, negation, contrastive stress or environment) set them aside from the discussion here. See Marej (2004) for details about middle constructions.

After having pointed out how exceptional it would be to have the role of agent participate in a transitive-inchoative alternation, I want to make explicit a point that I have made implicitly in the previous paragraphs: it is unclear from Benedicto & Brentari's proposal what determines whether a verb partakes in the unergative-unaccusative alternation or in the transitive-intransitive alternation. It seems like nothing prohibits the verbal root to partake in both. In fact, since both alternations have at least one intransitive alternate and all alternates are derived in the syntax, Benedicto & Brentari seem to assume that all verbal roots to which classifier morphemes attach are underlyingly one-place and can freely alternate between unergative, unaccusative and agentive transitive. Such a system would wildly overgenerate. This cannot be Benedicto & Brentari's intention, but I do not see how their proposal as presented in their paper steers clear of this problem.

Contradicting the predicted abundance just mentioned, there are issues with respect to the productivity of the phenomena. Whether due to dialectal differences, inapplicability of tests, or (unjustified) assumptions on inter-linguistic transfer of unaccusativity, informants have had difficulty replicating data reported by Benedicto & Brentari and/or generating new data (see de Lint 2010 for details). If there exists a *syntactic* system in ASL such as described by Benedicto & Brentari, one would expect it to be a productive process and thus examples should be plenty. For the unergative-unaccusative alternation particularly, the scarcity of examples casts doubt on the existence of a syntactic derivation process.

### 2.2.3 Manner Verbs

Where my informants were able to extrapolate from the paper with reasonable ease was within the reported transitive-intransitive alternation. My claim is that hidden within this second alternation lies a third alternation. Benedicto & Brentari included both verbs like BREAK and MOVE that describe actions that may or may not be initiated by an agent (the classical causative verb type), and verbs like SAW and CUT that describe actions involving some instrument that necessarily involve the mediation of an agent (the manner verb type). Classifier pairs of the SAW type elicited less robust patterns of acceptance among my informants than those of the MOVE type and seemed to yield slightly different interpretations than Benedicto & Brentari's proposal would predict. A split between classifiers that refer to (handling of) an object and classifiers that refer to (handling of) an instrument became apparent. In the remainder of this paper I will label the HdIgCL and WECL forms according to this split in meaning as "HdIgCL<sub>o</sub>"//WECL<sub>o</sub>" and "HdIgCL<sub>i</sub>"//WECL<sub>i</sub>" respectively. When I use the labels "HdIgCL"/"WECL", without subscript, I mean to refer to HdIgCL<sub>o</sub> and/or HdIgCL<sub>i</sub>, and WECL<sub>o</sub> and/or WECL<sub>i</sub> respectively. Based on Reinhart (2000, 2002), I will now provide an analysis of manner verbs (SAW, CUT) that emphasizes the link between the presence of an instrument and the presence of an agent in the verb semantics and which is in conflict with an unaccusative analysis of the WECL<sub>i</sub> alternate of verbs of this type.

In her work on argument structure, Reinhart captures the different thematic roles that arguments may fulfil in terms of varying combinations of two binary features: one for causality (referred to as "c") and one for mental involvement (referred to as "m"). Allowing for underspecification, the system has a total of nine clusters, which are computationally (more) plausible replacements of the traditional labels "agent", "theme", "goal" and so on (see 10 below). In her view, the set of feature clusters a given verb is associated with, together with a limited set of derivation operations and mapping rules, determines what possible argument structure alternates this verb can have.

(10)

- a) [+c+m] - agent
- b) [+c-m] - instrument
- c) [-c+m] - experiencer
- d) [-c-m] - theme / patient

- e) [+c] - cause
- f) [+m] - sentient
- g) [-m] - subject matter /locative source (Typically Oblique)
- h) [-c] - goal / benefactor (Typically Dative (or PP))
- i) [] - Arb(bitrary)

Notation:

$[\alpha]$  = Feature cluster  $\alpha$ .

$/\alpha$  = Feature (and value)  $\alpha$ .

(E.g. the feature  $/+m$  occurs in the clusters  $[+c+m]$ ,  $[-c+m]$  and  $[+m]$ .)

$[\alpha]$  = A cluster one of whose features is  $/\alpha$ .

(E.g.  $[-c]$  clusters are  $[-c+m]$ ,  $[-c-m]$  and  $[-c]$ .)

$[+]$  = A cluster ALL of whose features have the value  $+$ .

(E.g.  $[-]$  clusters are  $[-c-m]$ ,  $[-c]$ ,  $[-m]$ .)

(Reinhart, 2002: p.10. Table 1.)

Reinhart assumes a difference in (lexically specified) theta grids between causative verbs ( $[+c]$ ,  $[-c-m]$ ) and agentive verbs ( $[+c+m]$ ,  $[-c-m]$ ) to explain the variable interpretation of the external argument in the first (agents  $[+c+m]$ , instruments  $[+c-m]$  or unspecified causes  $[+c]$ ) as opposed to the fixed interpretation of agent in the latter (as shown in (9a) vs. (9c)). This difference also allows her to explain the availability of an unaccusative alternate for the first as opposed to the latter, through selective application of a decausativization rule: it only applies to verbs with a  $[+c]$  cluster. Manner verbs, unlike causative verbs or agentive verbs, are argued to have two  $[/+c]$  clusters as part of their given grid, namely  $[+c+m]$  and  $[+c-m]$  (in addition to a  $[-c-m]$  cluster). This explains three facts. First, that manner verbs, like causative verbs and unlike agentive verbs, allow for instruments as subjects (compare (11)b to (9a) and (9c) above). Second, that manner verbs, unlike causative verbs and like agentive verbs, do not allow for natural causes to serve as subjects (compare (11c) below to (9a) and (9c) above). Third, that manner verbs, unlike causative verbs and like agentive verbs, do not have unaccusative alternates (11d).

(11)

- (a) Max peeled the apple (with the knife).
- (b) The knife peeled the apple.
- (c) \*The heat peeled the apple.
- (d) \*The apple peeled.

Reinhart shows that when a verb has two  $[/+c]$  clusters only one of them is obligatorily realized syntactically, the other one may be present in the semantics only. The mapping generalizations she formulates further determine that one of the two must be the external argument and that the agent takes precedence over the instrument. This can be seen in (11a) and (11b). Note that agentive verbs like *eat* allow for the addition of an instrument, optionally (as in *The baby ate the soup (with a spoon)*), but they do not take instruments as part of their theta grid and hence they do not have alternates with instruments as subjects (\**The spoon ate the soup*).

Regardless of the status of any instrument role, its presence is contingent on the presence of an agent. This is stated in the Instrument Generalization below (see Marej 2004 for references and discussion).

(12) Instrument Generalization:

an instrument requires the explicit (syntactic) or implicit (semantic) presence of an agent in order to be realized syntactically.

We can illustrate this for the causative verb *break* in (13). In (a-b), the presence of an agent allows for the optional addition of an instrument. In the unaccusative alternate in (c-d), decausativization has eliminated the [+c] cluster from both syntax and semantics and the addition of an instrument yields an ungrammatical sentence. The passive in (e-f), however, is derived through an operation that saturates the external role, making it unavailable for syntactic purposes yet leaving it semantically present. Here, the optional addition of an instrument is fine.

(13)

- (a) Max broke the window (with a hammer).
- (b)  $(\exists e) [\text{breaking } (e) \ \& \ \text{Agent } (e, \text{Max}) \ \& \ \text{Theme } (e, \text{the window})]$
  
- (c) The window broke (\*with a hammer).
- (d)  $(\exists e) [\text{breaking } (e) \ \& \ \text{Theme } (e, \text{the window})]$
  
- (e) The window was broken (with a hammer).
- (f)  $\exists e \ \exists x [\text{breaking } (e) \ \& \ \text{Agent } (e, x) \ \& \ [-c-m] (e, \text{the window})]$

(Marelj, 2004)

Thus, although both passives (“The window was broken”) and inchoatives (“The window broke”) are unaccusative in that both have derived subjects (their single, syntactic argument is internal), their semantics are crucially different: whereas passives have an implicit agent, inchoatives lack agents completely.

Instruments are inherent to the semantics of manner verbs: the action denoted by the verb simply cannot take place without it. Since instruments are dependent on agents, an agent is present in all alternations available for manner verbs, either syntactically or semantically. This can be seen in (14) below: the agent is syntactically present in the transitive in (14a) and both the instrument in the manner verb reduction (14b) and the agent-oriented adverb in the passive (14c) are licensed by the semantic presence of an agent.

(14) Manner verb alternations

- a) Peter sawed the planks.
- b) The saw sawed/cut the planks.
- c) The planks were sawed voluntarily.

Reinhart’s analysis shows that causative verbs and manner verbs have different semantics and that this has consequences for the possible argument structure alternations of the two verb types. By collapsing causative verbs like BREAK and manner verbs like SAW into one group, Benedicto & Brentari unjustly propose the same argument structure alternates for their classifier predicates. In the above, we have seen that manner verbs do not have unaccusative alternates: due to the defining role of the instrument, an agent is always present. Therefore, the WECL<sub>i</sub> construction of ASL verbs like SAW cannot represent an unaccusative alternate of a transitive-intransitive alternation, but rather represents a transitive alternate

of a manner verb. The class of WECL<sub>i</sub> morphemes thus must be distinguished from that of WECL<sub>o</sub> morphemes.

### 2.3 Goals & predictions

#### 2.3.1 Modified hypothesis

The general goal of this experiment was to empirically test for associations between classifier type and argument structure in ASL, by collecting responses from a larger group of participants than one-to-one consulting would allow. To motivate my claim that a third alternation is hidden within Benedicto & Brentari's second alternation, the specific goal of this experiment was to provide evidence for the hypothesis that the WECL<sub>i</sub> morpheme correlates with a transitive manner verb alternate, by showing that WECL<sub>i</sub> constructions, as opposed to WECL<sub>o</sub> constructions, do not function as unaccusatives.

Hypothesis: The WECL<sub>i</sub> morpheme correlates with a transitive alternate of a manner verb, rather than an unaccusative alternate of a transitive-intransitive alternation.

Table 3. Modified proposal for associations between classifier types and argument structure.

Alternation 1: unergative-unaccusative alternation	BPCL (F1) → Unergative	WECL (F2) → Unaccusative
Alternation 2: transitive-unaccusative alternation	HdgCL <sub>o</sub> (F1 + F2) → Transitive	WECL <sub>o</sub> (F2) → Unaccusative
Alternation 3: manner verb alternation	HdgCL <sub>i</sub> (F1 + F2) → Transitive	WECL <sub>i</sub> (F2) → Transitive (-Unaccusative)

To prove that any classifier construction is not an unaccusative, we need to show the presence of an agent. The semantic presence of an agent does not guarantee its syntactic presence (e.g. passives), so it is impossible to prove the active transitive nature of WECL<sub>i</sub> classifier constructions in this manner. It is however possible to rule out an unaccusative nature of these constructions this way, since the presence of an agent –be it syntactically or semantically- does rule out unaccusativity for these verbs.

#### 2.3.2 Predicted association pairs

Based in part on the analysis put forward by Benedicto & Brentari (2004), but with the modification for manner verbs based on Reinhart (2002), I have the following predictions regarding the semantic presence of an agent for the classifier alternation pairs (Table 4).

Table 4. Predictions for this experiment.

VERB TYPE 1: motion verbs	BPCL	agent
---------------------------	------	-------

e.g. BOW	WECL	no agent
VERB TYPE 2: causative verbs e.g. BREAK	HdIgCL <sub>o</sub>	agent
	WECL <sub>o</sub>	no agent
VERB TYPE 3: manner verbs e.g. SAW	HdIgCL <sub>i</sub>	agent
	WECL <sub>i</sub>	agent

### 3. Methodology

#### 3.1 Stimuli

Predicted associations were tested in a novel computer-based experiment, in which participants' preferred matches between classifier constructions and visualized interpretations (and vice versa) were recorded. Due to the lack of success and the problems associated with the only tests known for this language to detect syntactically internal or external arguments (i.e. the tests presented by Benedicto & Brentari), the task was designed to directly test for the presence or absence of an agent in the interpretation of a classifier construction.

On the one hand, videos of signed classifier constructions (henceforth: signs) were created for the pairs of alternating classifier types. The following four motion verbs, given in pairs of BPCLs vs. WECLs, were tested for the unergative-unaccusative alternation (15). The classifiers are represented by the names of the handshapes they use ('S' (◁); '1' (▷); 'money' (₩)) for the dominant hand<sup>5</sup>.

#### (15) VERB TYPE 1: motion verbs

		BPCL		WECL
1.	GO-UP+	'Upside-down, bent, wiggle' (◁)	vs.	'Upside-down, bent' (◁)
2.	BOW+	'S' (◁)	vs.	'1' (▷)
3.	TURN+	'S' (◁)	vs.	'1' (▷)
4.	GO-BY+	'Upside-down, wiggle' (◁)	vs.	'1' (▷)

For verbs of verb type 2, the transitive-intransitive alternation, the following six pairs of causative verbs were tested (16). The HdIgCL<sub>o</sub>s are presented on the left, the WECL<sub>o</sub>s on the right.

#### (16) VERB TYPE 2: causative verbs

<sup>5</sup> The utterance of some of these signs involves the non-dominant hand. The non-dominant handshape, however, has been disregarded for analysis and is therefore not mentioned here. For the full forms of the stimuli, see the videos in the appendix.

		HdIgCL <sub>o</sub>		WECL <sub>o</sub>
1.	OPEN (DOOR)+	'S' (☞)	vs.	'B' (☞)
2.	CLOSE (WINDOW)+	'S' (☞)	vs.	'B' (☞)
3.	MOVE (BOOK)+	'C' (☞)	vs.	'B' (☞)
4.	MOVE (HOCKEY PUCK)+	'claw' (☞)	vs.	'Cbaby' (☞)
5.	BREAK (PENCIL)+	'S' (☞)	vs.	'1' (☝)
6.	FLAP (PAPER)+	'Oflat' (☞)	vs.	'B5' (☞)

For the third verb type, composed of manner verbs, the following six pairs of WECL<sub>i</sub>s vs. HdIgCL<sub>i</sub>s were tested (17).

(17) VERB TYPE 3: manner verbs

		HdIgCL <sub>i</sub>		WECL <sub>i</sub>
1.	SWEEP (FLOOR)+	'S' (☞)	vs.	'B5' (☞)
2.	SAW (PLANKS)+	'S' (☞)	vs.	'B' (☞)
3.	BRUSH (TEETH)+	'Money' (☞)	vs.	'1' (☝)
4.	SLICE/CUT (POTATO)+	'Money' (☞)	vs.	'1' (☝)
5.	SCREW (A SCREW)+	'Money' (☞)	vs.	'U' (☞)

6.	SPOON-FEED S/O (YOGHURT)+	'Money' (首富)	vs.	'U' (首富)
----	------------------------------	--------------	-----	----------

On the other hand, videos of action scenes (henceforth: scenes) were created to match each sign pair. The scenes consist of the action expressed by the verb of the sign, occurring with either the presence or absence of an external entity that brings about this action. These will be referred to as +EXTERNAL and -EXTERNAL scenes. This was the same for all three verb types. The implications for agency, however, are reversed for motion verbs (verb type 1) as compared to causative and manner verbs (verb types 2 and 3) due to the difference in argument structure (motion verbs having two intransitive alternates, the causative and manner verbs having at least one transitive alternate). In the following paragraphs, I will therefore start with causative and manner verb scenes and then explain the difference with the motion verb scenes.

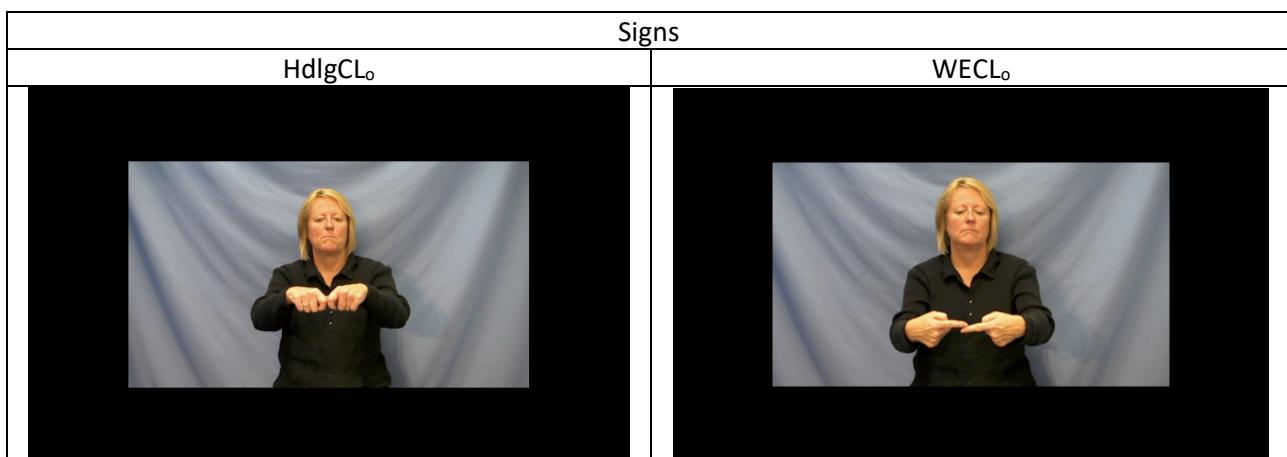
In the scene stimuli for causative and manner verbs, the external entity is a person, who takes up the role of agent in an action involving an object. Taking the first causative verb of the list as an example, this amounts to the following. There is a +EXTERNAL scene of a door being opened by a person (agent), and there is a -EXTERNAL scene of a door opening by itself (no agent). Hence, the +EXTERNAL and -EXTERNAL scenes straightforwardly correspond with the presence and absence of an agent, respectively.

Note that for the manner verbs this leads to rather implausible scenes. In the +EXTERNAL scene of the verb SAW, for example, a person is sawing planks with a saw. In the -EXTERNAL scene of this verb however, there is no agent doing the sawing: the saw is cutting the planks by itself. Making the scene truly unaccusative/intransitive as proposed by Benedicto & Brentari would mean leaving out the instrument as well so that there would be one sole argument (in this case: the planks), analogue to the true unaccusative case of a door opening by itself. That, however, would no longer depict the action of sawing at all. The stimuli in this experiment were based on their simple claim that WECLs –as opposed to HdIgCLs– correlate with structures with crucially NO AGENT.

In sum, for both causative and manner verbs an agentive interpretation is visualized by an external entity bringing about the action (the +EXTERNAL scene); a non-agentive interpretation is visualized by the action taking place without such an external entity (the -EXTERNAL scene).

So there are 4 stimuli for each verb, as illustrated for the causative verb BREAK and for the manner verb BRUSH in Tables 5 and 6 respectively.

Table 5. Screen shots of stimuli for BREAK (causative verb).



Scenes	
+EXTERNAL	-EXTERNAL
	

Table 6. Screen shots of stimuli for BRUSH (manner verb).

Signs	
HdIgCL	WECL
	

Scenes	
+EXTERNAL	-EXTERNAL
	

In the scene stimuli for the motion verbs, the external entity is a person or machine bringing about motion involving a person. Due to the motion verbs' intransitivity, the presence of the external entity makes the referent for the single argument of the sign undergo the motion as a mere theme; the same motion taking place without such an external entity lends agency to the verb's subject. Taking the first verb of the list (GO\_UP) as an example, this amounts to the following. There is a +EXTERNAL scene of a person being moved up by an escalator (no agency), and there is a -EXTERNAL scene of a person walking up a staircase by themselves (agency). The +EXTERNAL and -EXTERNAL scenes for motion verbs thus have reversed correspondences: the +EXTERNAL scene visualizes a non-agentive interpretation of the corresponding sign, while the -EXTERNAL scene visualizes an agentive interpretation.

So, here too, there are 4 stimuli for each verb, as illustrated for the verb GO-UP in Table 7.

Table 7. Screen shots of stimuli for GO-UP (motion verb).

Signs	
WECL	BPCL
Scenes	
+EXTERNAL	-EXTERNAL

### 3.2 Procedure

In order to test the hypotheses about the argument structure of the alternating verbal classifier pairs in ASL, participants' preferred interpretations of such constructions were recorded in a computer-based matching experiment. Since the literature provides no example of such a comprehension study on a

signed language, the experiment was designed *de novo*.<sup>6</sup> Due to the modality of spoken languages, linguistic stimuli in experimental matching tasks can be presented to the participant in a different format than the stimuli used to act as matches and mismatches: the linguistic stimuli can be presented aurally and the non-linguistic ones in the visual mode. This is different from signed languages, where the linguistic stimuli cannot be presented aurally. In sign language experiments, both the linguistic and the non-linguistic stimuli are of a visual nature. Rather than this being a shortcoming, it can be used as an advantage. It offers the opportunity to easily present the stimuli both ways: either put a linguistic one as the target and have non-linguistic ones be the alternative choices; or the other way around: have a non-linguistic one as the target and make the linguistic ones act as the alternative answers. In a spoken language experiment, you cannot easily present multiple linguistic stimuli at the same time: it would be very hard for participants to disentangle the sounds of the simultaneous utterances.<sup>7</sup> In my experiment, I presented participants with stimuli in both of these ways: participants were asked to both match signs to scenes and vice versa.

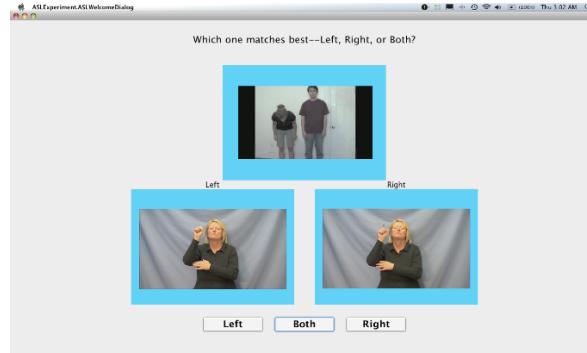
In the scene-matching task, participants were presented with a scene displayed at the top of the screen and two signs below. Participants' task was then to assign signs to scenes. They were forced to choose one out of three different responses: they could choose the target sign, the alternative sign, or both as the best match to the scene presented at the top.

In the sign-matching task, participants would be presented with a sign displayed on top and two scenes below. They then had the task to assign scenes to signs and were again forced to choose between three options: they could choose the target scene, the alternative scene, or both, as the best match to the sign at the top of the computer screen.

I refer to these different tasks as the two modes of presentation. When the participant is asked to give their preferred sign in response to a scene, this is referred to as SCENE-mode. When the participant is asked to choose the best scene to match a sign, this is referred to as SIGN-mode. This is illustrated below with a diagram and screen shot example for each mode (18 and 19).

(18) Diagram and screen shot example of SET-UP for SCENE-mode

	SCENE -EXTERNAL	
SIGN BPCL		SIGN WECL
RESPONSE “BPCL”	RESPONSE “BOTH”	RESPONSE “WECL”

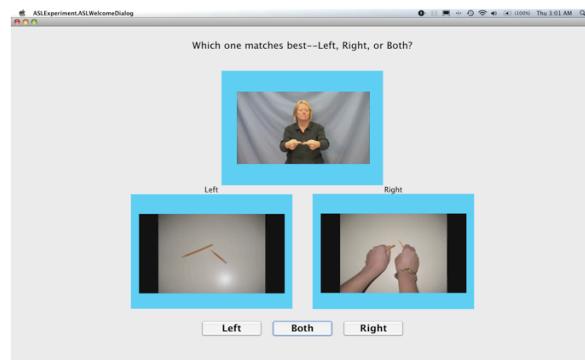


<sup>6</sup> Of course, plenty of work has been done on sign language classifier constructions, experimental studies included. Padden and colleagues, for instance, have done (cross-linguistic) experiments on WECLs vs. HdLgCLs classifier constructions (“instrumental” vs. “handling” in their terminology). Their work concentrates on the comparison of iconic strategies of gesturers and signers. This does not relate to the present study in that it concerns elicitation of signs (i.e. production, not comprehension) for hand-held tools (i.e. nouns, not verbs) (see for example Padden et al. 2013). In Padden et al. 2015 they do look at WECLs and HdLgCLs used for nouns and verbs. It is, however, not related to argument structure (alternations), nor does it compare WECLs and HdLgCLs to WECLs and HdLgCLs, around which the present study revolves. Crucially, the experimental task was new.

<sup>7</sup> Admittedly, experiments with written language stimuli (as is common practice in psycholinguistic research) do offer the same possibility as sign language.

(19) Diagram and screen shot example of SET-UP for SIGN-mode

	SIGN WECL <sub>o</sub>	
SCENE -EXTERNAL		SCENE +EXTERNAL
RESPONSE "-EXTERNAL"	RESPONSE "BOTH"	RESPONSE "+EXTERNAL"



A priori it was not clear which mode was the most appropriate one for this study. Presenting the stimuli in both modes was therefore the safest bet to capture any correlations between classifier types and argument structure. This feature of the experiment enables us to see whether the different classifier types are interpreted in a consistent manner across modes. Any noted differences between modes, or the lack thereof, will be important for the methodology of future experimental research on signed languages.

All verbs appeared in 4 conditions: per verb each member of the stimuli set was presented on top of the screen once. Per verb type, trials were replicated by testing the different conditions on a number of verbs. For verb type 1 we had 4 verbs, for verb type 2 we had 6 verbs and for verb type 3 we had 6 verbs, which makes 16 verbs. In total, then, there were 16 verbs x 4 conditions = 64 items. There was no counterbalancing of verbs and conditions within or across participants; all 64 items were simply randomized for each participant. Choice options were also randomized with respect to their left/right location on the screen.

Fourteen native signers, all of whom are deaf, were recruited in Washington, D.C. on Gallaudet University campus. If there was even the slightest uncertainty about their status as a native signer (due to missing or contradicting answers to a survey taken prior to starting the task) or about their ability to perform the task (due to diminished vision for example) they were excluded from analysis at this point.

### 3.3 Coding and analysis

The two modes of presentation were looked at separately. All participants' responses to the stimuli were coded as 0, 1 or 2 as schematized in (20). In scene mode, a BPCL or HdIgCL response (hypothesized to include agents) was coded as a 1; a WECL response (hypothesized to either include an agent or not, depending on the verb type) was coded as a 0. In sign mode, a "+EXTERNAL" scene (where an external entity brings about the action) response was coded as a 1, and a "-EXTERNAL" scene (where the action takes place without the intervention of an external entity) response was coded as a 0. A "BOTH"-response (where participants did not have a preference for either the target or non-target response) was coded as a 2.

(20) Schematization of coding of responses

SCENE MODE	WECL	BPCL/HdIgCL	BOTH
	0	1	2

SIGN MODE	-EXTERNAL	+EXTERNAL	BOTH
	0	1	2

### 3.3.1 Preference analyses

Based on the clear dichotomy proposed between classifier morpheme and syntactic structure, a one-to-one mapping by participants between signs and scenes could be expected. Therefore, I first did an analysis of participants' preference. To this end, I focused on responses where participants had selected either the target or the non-target as the best match, and excluded all "BOTH"-responses from analysis. Averages were computed for each participant over all non-"BOTH" answers per verb category per sign/scene type. For SCENE-mode this resulted in percentages BPCL- or HdgCL-response per verb category per scene type. For SIGN-mode this resulted in percentages "+EXTERNAL"-response per verb category per classifier type. Per mode an ANOVA was run using these percentages as the dependent factor.

### 3.3.2 Analyses of uncertainty

In the experiment, participants were given the option to select "BOTH" (i.e. both target *and* non-target) as best-matching the prompt at the top, instead of giving a preference for one or the other. This was done to accommodate ambiguous and neutral interpretations as well as indecision or total rejection. As mentioned above, the "BOTH"-responses were initially excluded from analysis so as to get an idea of what the preferences were. In addition to those preference analyses, two ANOVAs were run on the percentages of "BOTH"-responses counted over all responses (0's, 1's and 2's together). These uncertainty analyses (of the percentages of responses where participants had no preference) are used to give us an indication of the interpretability of those preferences analyzed in the preference analyses. Again, the two modes of representation were analyzed separately.

## 4. Results

### 4.1 Results from SCENE mode

Here are the results for SCENE mode (where participants are asked to choose between two signs as the best match to a scene presented at the top of the screen), first preference analysis (Figure 2), then uncertainty analysis (Figure 3).

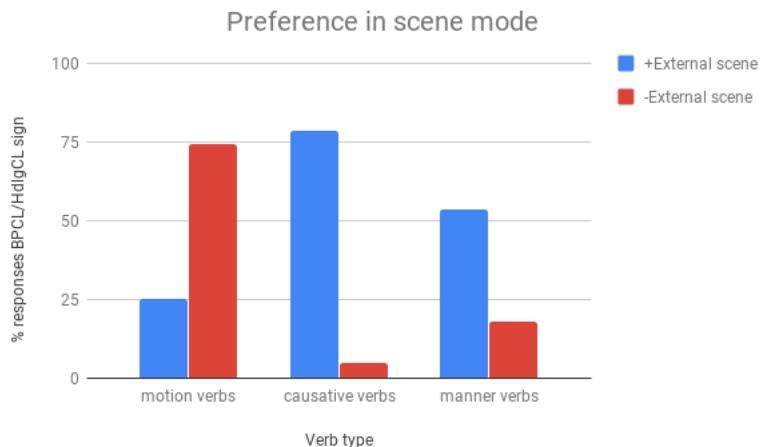


Figure 2. Preference analysis of responses obtained in SCENE mode.

The graph in Figure 2 represents the percentages of responses (on the y-axis) where participants selected a sign with a BPCL/HdIgCL as the best match to the scene prompt. Signs with a BPCL (motion verbs) or HdIgCL (causative verbs and manner verbs) are hypothesized to include agents. The percentages are presented per verb type (on the x-axis) and split up into prompts with a +EXTERNAL scene (where an external entity is bringing about the action) and prompts with a -EXTERNAL scene (where no such external entity is added).

The preference analysis reveals a significant interaction of verb type (motion/causative/manner) and scene type (+/-EXTERNAL) (Greenhouse-Geisser  $F(2,78)=104.8$ ,  $p<0.001$ ). Post-hoc results reveal that this interaction effect holds in all directions: all three verb types have different effects no matter the scene type (motion verbs  $\neq$  causative verbs ( $p<0.001$ ), motion verbs  $\neq$  manner verbs ( $p<0.001$ ) and causative verbs  $\neq$  manner verbs ( $p=0.045$ ) for +EXTERNAL scenes; motion verbs  $\neq$  causative verbs, motion verbs  $\neq$  manner verbs and causative verbs  $\neq$  manner verbs ( $p<0.001$  in all three cases) for -EXTERNAL scenes) and there is an effect of scene type in all three verb types (+EXTERNAL  $\neq$  -EXTERNAL ( $p<0.001$ ) for motion verbs, causative verbs and manner verbs). The -EXTERNAL scenes of motion verbs get more BPCL responses than WECL responses; this pattern is reversed for the +EXTERNAL scenes. For causative verbs, the +EXTERNAL scenes get more HdIgCL<sub>o</sub> responses than WECL<sub>o</sub> responses and for the -EXTERNAL scenes we see a very small percentage of HdIgCL<sub>o</sub> responses and thus most responses here were WECL<sub>o</sub>s. The +EXTERNAL scenes of manner verbs get almost as many WECL<sub>i</sub> responses as HdIgCL<sub>i</sub> responses; the -EXTERNAL scenes get fewer HdIgCL<sub>i</sub> responses than WECL<sub>i</sub> responses.

The uncertainty analysis is visualized in Figure 3 below. The graph represents the percentages of responses where participants selected both signs (the one with a BPCL/HdIgCL and the one with a WECL) as best matching the scene prompt. Here too, the results show a significant interaction effect of verb type and scene (Greenhouse-Geisser  $F(2,78)=3.5$ ,  $p=0.041$ ). There is a significant difference between causative verbs and manner verbs in both +EXTERNAL and -EXTERNAL scenes ( $p<0.001$  and  $p=0.013$  respectively) and an additional one between motion verbs and causative verbs ( $p<0.001$ ) in -EXTERNAL scenes. The other way around, for motion verbs there is no difference between the amounts of BOTH responses in the two scene types. The +EXTERNAL scenes for causative verbs and manner verbs, however, get significantly more BOTH responses than their -EXTERNAL alternatives ( $p=0.047$  and  $p=0.003$  respectively).

The effect of verb type (Greenhouse-Geisser  $F(2,78)=12.8$ ,  $p<0.001$ ) on the "BOTH"-responses in scene mode shows as a significant difference between motion verbs and causative verbs ( $p=0.001$ ) and

between causative verbs and manner verbs ( $p<0.001$ ). Overall, as we can see in the graph, causatives provoke the least amount of BOTH responses from participants.

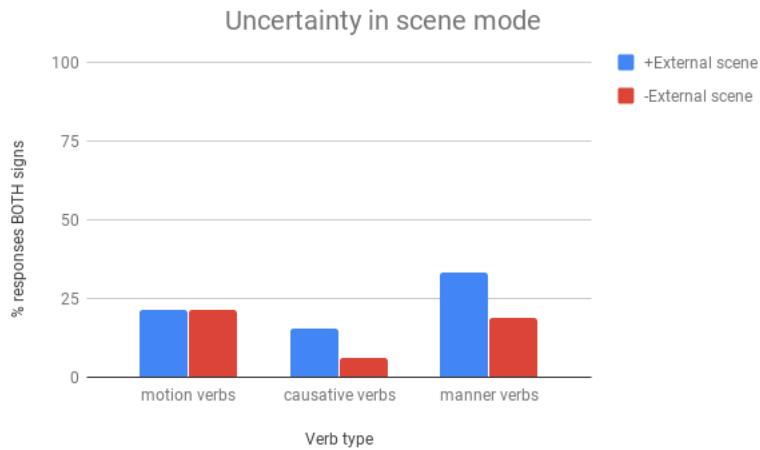


Figure 3. Uncertainty analysis of responses obtained in SCENE mode.

#### 4.2 Results from SIGN mode

In the graph below (Figure 4), I present the results from the preference analysis in SIGN mode (where participants are asked to choose between two scenes as the best match to a sign presented at the top of the screen).

The graph represents the percentages of responses (on the y-axis) where participants selected a +EXTERNAL scene (where an external entity is bringing about the action) as the best match to the sign prompt. The percentages are presented per verb type (on the x-axis) and split up into prompts with a BPCL/HdlgCL sign and prompts with a WECL sign. Signs with a BPCL (motion verbs) or HdlgCL (causative verbs and manner verbs) are hypothesized to include agents. Signs with a WECL have been hypothesized to *not* include agents, but in this paper the alternative hypothesis is put forward that in the case of WECLs (manner verbs) these signs *do* include an agent.

The interaction effect of verb type and sign (Greenhouse-Geisser  $F(2,78)=147.6$ ,  $p<0.001$ ) is similar to that between verb type and scene (in SCENE mode). The effect of sign (i.e. the effect of classifier type) is robustly significant for each of the three verb types ( $p<0.001$  in all cases). As for the effect of verb type per sign (classifier type), post-hoc comparisons confirm what is obvious from the graph: that the results for BPCLs in motion verbs differ significantly from both those for HdlgCL<sub>o</sub>s in causatives ( $p<0.001$ ) and from those for HdlgCL<sub>i</sub>s in manner verbs ( $p<0.001$ ), but that the results for HdlgCL<sub>o</sub>s in causatives do not differ significantly from those for HdlgCL<sub>i</sub>s in manner verbs ( $p=1.000$ ). Results for WECL<sub>o</sub>s in causatives however, differ significantly from those for WECLs in motion verbs ( $p<0.001$ ) as well as from the results for WECL<sub>i</sub>s in manner verbs ( $p<0.001$ ), but the results for WECLs in motion verbs and those for WECL<sub>i</sub>s in manner verbs are similar ( $p=1.000$ ).

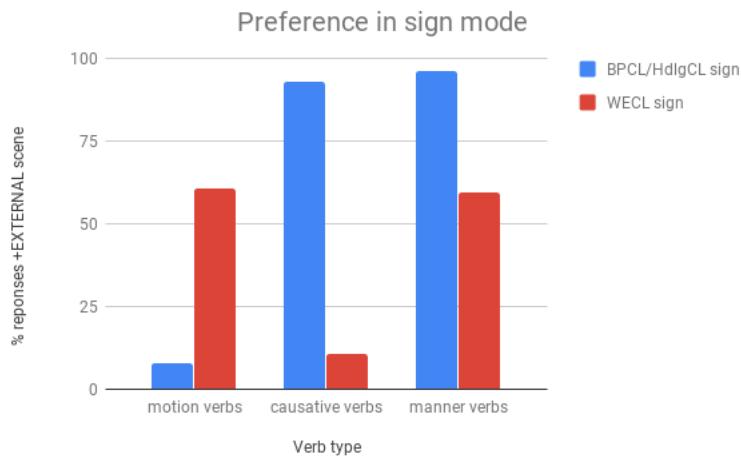


Figure 4. Preference analysis of responses obtained in SIGN mode.

The results from the uncertainty analysis in Figure 5 show that, as for BOTH responses, there is not much difference between patterns in SIGN and SCENE mode. There was a main effect of verb type (Greenhouse-Geisser  $F(2,78)=4.9$ ,  $p=0.010$ ) and of sign (classifier type) (Greenhouse-Geisser  $F(1,39)=25.2$ ,  $p<0.001$ ). The effect of verb type found in the ANOVA lies in a difference between causatives and manner verbs ( $p=0.005$ ) and a difference between motion verbs and causatives ( $p=0.053$ ).

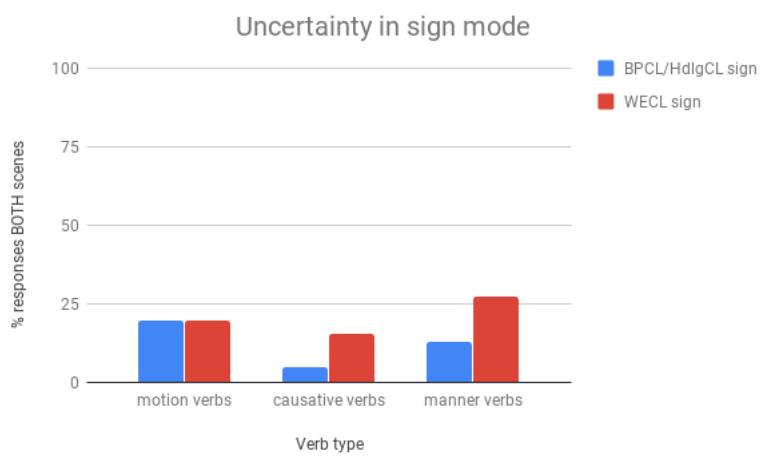


Figure 5. Uncertainty analysis of responses obtained in SIGN mode.

## 5. Discussion & conclusion

### 5.1 Agentive morphemes

To a large extent, the results of the experiment confirm the systematic associations between classifier morphemes and argument structure as reported by Benedicto & Brentari (2004): BPCLs/HdIgCLs and WECLs display a contrast in agentive interpretation. BPCLs (in motion verbs) and HdIgCLs (in causative and manner verbs) receive more responses with scenes visualizing an agentive interpretation than

WECLS (in all three verb types). Similarly, scenes visualizing an agentive interpretation receive more responses with BP and HdIg classifiers than scenes visualizing a non-agentive interpretation. This supports the hypothesis that both BPCL (motion verb) and HdIgCL (causative and manner verb) constructions include an agentive morpheme.

An important question to be answered in future research is whether the external arguments under consideration are true agents or rather animate/human causers (see section 2.2.1). Of interest is to see whether this phenomenon is limited to classifier constructions or applies more generally, to verbs of all classes (plain verbs, agreement verbs and spatial verbs) and/or other sign languages. The particular restriction of /+m (in Reinhart's terms) on the causer role, unseen in spoken languages, may be a modality specific issue, if it proves to be a common feature of sign languages.

Having confirmed a clear dichotomy between agentive and non-agentive morphemes, this study shows that the pattern is not equally robust throughout all three verb types: while the results for causatives seem categorical, motion verbs and manner verbs receive mixed responses from participants. The specific question in this paper concerns the splitting of meaning in one form: is the WECL morpheme consistently associated with non-agentive interpretation? We will look at the results per verb type first, then I will compare the two modes of presentation, and finally, I will make my concluding remarks.

## 5.2 The three verb types

### 5.2.1 Confirming Benedicto & Brentari (2004) – causatives

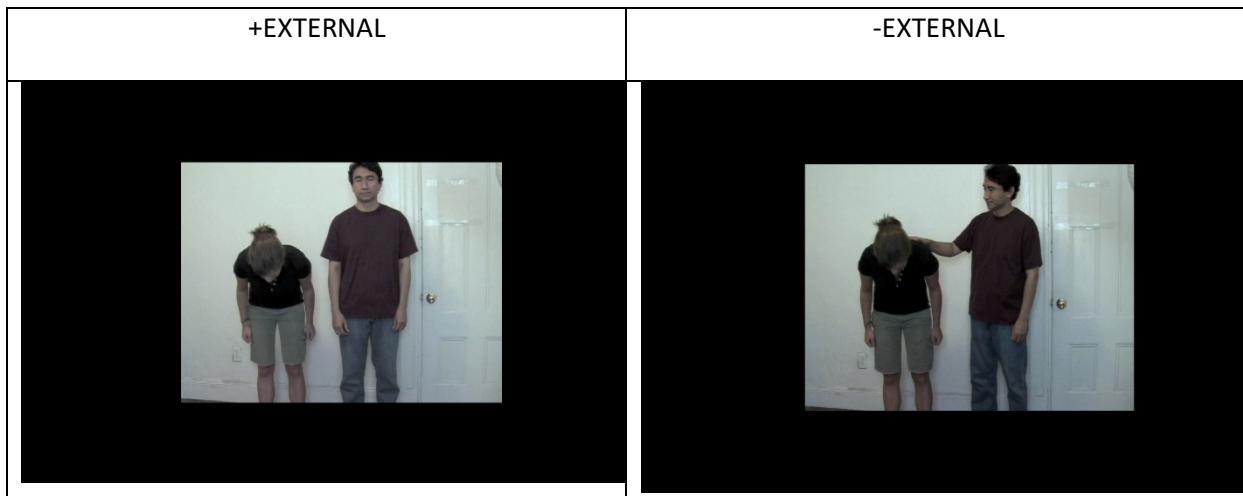
Of all verb types, the results for causative verbs come closest to predictions and give the best support for the hypothesized correlations between classifier types and argument structure. In SCENE mode, the preferred matches to -EXTERNAL scenes are undoubtedly the WECL<sub>o</sub> constructions; this is confirmed by a low percentage of BOTH responses. For +EXTERNAL scenes, participants clearly prefer HdIgCL<sub>o</sub> responses to WECL<sub>o</sub> responses, but they still allow WECL<sub>o</sub> responses part of the time. This can be explained in the following way. For causatives, the +EXTERNAL scene shows an agent performing an action, for example: a person opens a door. It is possible that some participants will accept both "he/she opens the door" and "the door opened" to apply in such a case. The -EXTERNAL scene in this example shows a door opening by itself. It is not likely that participants accept "he/she opens the door" in that case. This also follows under Reinhart's assumption that in the cases of decausativization, the external role is completely reduced and thus absent from syntax and semantics of unaccusatives (see section 2.2.3): in the absence of an agent in the scene (visualizing the intended semantics), these scenes are certainly not expected to correlate with a sign that contains an explicit (syntactic) agent. Compare in this respect the percentage of BOTH responses for +EXTERNAL scenes with that for -EXTERNAL scenes. The results from the uncertainty analysis may also shed some light on the reliability of the response patterns observed for causatives as compared to motion verbs and manner verbs. Although the +EXTERNAL scenes for causatives get significantly more BOTH responses than their -EXTERNAL alternatives, it is remarkable that both scene types get significantly less BOTH responses compared to motion verbs and manner verbs.

In SIGN mode, causative verbs stand out as confirming our predictions for the WECL constructions. Here, too, the uncertainty analyses show that participants seem to allow both +EXTERNAL and -EXTERNAL scenes to some extent (i.e. participants allow both a scene where a person opens a door and one where a door opens by itself to match the utterance "the door opened"). That does not, however, contradict our hypothesis for this verb type, since the truth conditions for the unaccusative are met by both visualizations.

### 5.2.2 Explaining the behavior of motion verbs

My predictions for motion verbs and causative verbs were the same as those of Benedicto & Brentari (2004), because I have no alternative hypothesis for the argument structure of the classifiers involved. However, taking my experiences with informants prior to the experiment into account, I was not surprised to find that the expected dichotomy did not flourish throughout. In particular for motion verbs, the informants consulted prior to the experiment gave no indication of a systematical interpretation of the two classifier types within this verb category. The results in SCENE mode show a pattern compatible with the interpretations implied by Benedicto and Brentari's hypothesis, but they also show participants' allowance for both classifier types to match both non-agentive and agentive scenes to a certain extent. This may indicate that participants differ from one another with respect to their judgment as to the appropriateness of a sign for the verbal interpretation visualized in the scene, or each participant individually may hold various interpretations. The high percentages of "BOTH" responses in the uncertainty analysis for motion verb scenes provide support for the latter case. This does not exclude the additional possibility of the former case. In addition, given the verbs tested for this verb type, the results may hide a split between the stimuli: the +EXTERNAL scenes for GO-UP and GO-BY contain non-human entities making a human undergo motion, while those for BOW and TURN-AROUND involve a second human to make the first one undergo motion. Compare +EXTERNAL and -EXTERNAL scenes for BOW below (Table 8) with those for GO-UP (as exemplified in section 3.1).

Table 8. Screen shots of scenes for BOW



There is a -EXTERNAL scene of a girl bowing by herself (without the intervention of an external entity) and there is a +EXTERNAL scene of a girl "being bowed" –i.e. forced/made to bow- (here the bowing takes place with the intervention of an external entity). Please note that, since we are testing the presence of an agent in the interpretation of the classifier construction and since the girl bowing is the only entity associated with the action denoted by the classifier construction, the agentivity of the other person in the scene is irrelevant on its own. It is only used to affect the agentivity of the girl bowing. However, this can be confusing.

Perhaps the GO-UP and GO-BY stimuli are better than those for BOW and TURN in representing (the lack of) agentivity of the subject of the verb, because the participation of the second individual in the action may confuse participants in the +EXTERNAL scenes for BOW and TURN. On the other hand, the addition of the second person (as opposed to a machine) is paralleling the addition of a human being in all the other +EXTERNAL scenes of the experiment (for causative verbs and manner verbs). Due to practical limitations

on the making of the stimuli as well as to the apparent lack of productivity of the phenomenon (leading to the limited number of verbs tested for this verb type), this experiment did not control for the influence of the second individual. This may be taken into account in future experimental design. The high percentage of “BOTH” responses in the +EXTERNAL scenes of motion verbs could have an alternative explanation. Namely, this could be the result of an interpretative effect such as the one present in another argument structure alternation, the one derived by the so-called Lexical Causativization or Agentivization (see Marelj (2004) for references and discussion). This operation derives sentences like “Peter walked the dog” from one like “The dog walked”. In these cases, though the original agent (“dog” in “The dog walked”) is demoted in that it is no longer the cause of the event, it is still in a way responsible for the event of walking (simply put: in “Peter walked the dog”, the dog is still doing the walking). Consequently, the correlation between a structurally unaccusative classifier construction and an agentive interpretation may simply be normal of the way we code such events in language, be it sign or spoken.

When participants are asked to match scenes to motion verb signs involving WECLs, they give mixed responses as well. Adding to the explanation provided above, reconsider the Dutch example in (6) (section 2.2.1), where both the unergative and the unaccusative would match scenes where the subject of the verb carries out the action voluntarily, on his/her own initiative. In (6a) “springen” (“to jump”) is used with a locative PP and the interpretation is that Jan jumps at a specific location, which is in the ditch; in (6b) “springen” is used with a directional PP and the interpretation is that Jan jumps into a specific location, which is the ditch. Though the argument may be in a different syntactic position, in both alternates does the jumper (Jan) maintain some thematical agentivity/volitionality. Transposing this to the ASL verbs that were tested for verb type 1 in this experiment, particularly the ‘1’ ( ) handshapes in the WECLs in GO-BY and TURN seem likely to allow an agentive interpretation even if the subject of the verb is a derived one.

The distinction between the directional and locative alternation in the Dutch example goes back to the hypothesis that unaccusativity can be determined in terms of the aspectual properties of the predicates. Namely, whereas the directional “jump” is aspectually an event, the locational “jump” is aspectually a state (it is still an activity, not a stative).<sup>8</sup> The prediction then is that all unaccusative predicates are events. Reinhart (2000), following Bennet & Partee (1972) and Vendler (1967), where the crucial property distinguishing states and events is homogeneity, rejects this on the basis of so-called gradual completion verbs (increase, decrease, etc.), which are not events but states (activities).<sup>9</sup>

Furthermore, Neeleman (1994) and Ackema (1995) explain why an unergative verb in combination with a directional PP (like run to the park) may show the syntactic behavior of the unaccusative. They argue that the thematic (predicative) properties of directional PPs enforce complex predicate formation, requiring that the PP subject must be identical to the matrix subject. This requirement then can best be satisfied if the subject is merged (generated) in the internal position and a chain is formed. The result is an interpretation effect along the lines of that of the demoted agent in “Peter walked the dog” as discussed earlier. All in all, the results for motion verbs are compatible with the hypothesized associations, but additional research is required (with more stimuli) in order to make a strong case.

### 5.2.3 Contradicting Benedicto & Brentari (2004) – manner verbs

---

<sup>8</sup> This goes back to Borer (1994) and van Hout (1995).

<sup>9</sup> See Dowty (1986), Reinhart (1986), Hatav (1989, 1993), Hay et al. 1999, Bobaljik (2012) and Alexiadou et al. 2015 for discussion on the nature of unaccusatives and telicity, causative components and degree achievements.

Both the results from the preference analysis and those from the uncertainty analysis in SCENE mode provide evidence that a distinction should be made not only between motion verbs on the one hand and causatives and manner verbs on the other, but also between causatives and manner verbs themselves. The bars in the graphs are not near the extremes, as we would expect on the basis of Benedicto & Brentari (2004). Neither are they both around 50% like I alternatively predicted, but very relevant to our discussion is that one of them is (Figure 2, second column from the right). For the +EXTERNAL scenes participants give both HdgCL<sub>i</sub> responses and WECL<sub>i</sub> responses, which confirms my hypothesis that both classifier types include an agent in their interpretation. Participants give the highest percentage of BOTH-responses for these scenes, which can be interpreted as an indication of the equal applicability of both classifier types. This is very different from what would be expected on the account of Benedicto & Brentari.

As we can see in the graph, the percentage of BOTH-responses for the -EXTERNAL scenes is also pretty high, which can be interpreted as a confirmation of the hypothesis that both classifier constructions include an agent and are therefore equally inapplicable to the scene. However, being at the same level as for both motion verb scenes, this percentage may also be interpreted as uncertainty on the part of the participants about the interpretation of the sign. If the WECL<sub>i</sub> construction represents a manner verb reduction like we hypothesized, the semantic but not syntactic presence of an agent in such a construction may cause participants to doubt. This would also explain that when participants make a choice between the two signs, they seem to prefer the WECL<sub>i</sub> to the HdgCL<sub>i</sub>, contrary to predictions. Participants can be expected to prefer the WECL<sub>i</sub> construction, if the agent in this construction is merely implied rather than syntactically present as in the HdgCL<sub>i</sub> and therefore less in contradiction with the scene depicted. It may be unclear at this point what the correct analysis of the WECL<sub>i</sub> constructions is, but the results from the preference analysis show significantly different behavior from participants with respect to manner verbs as compared to causatives. The results from the uncertainty analysis show the same: while causatives provoke the least amount of uncertainty from the participants or ambiguity of the stimuli, manner verbs provoke the most. This is yet more confirmation that native signers treat classifier constructions of causatives and classifier constructions of manner verbs differently.

In this light, Abner (2017) presents a very interesting paper. Her elaboration of the idea of iconicity in representation of event and argument structure includes a classifier projection lower than Benedicto & Brentari's F1 and F2: F3, or Classifier<sub>3</sub> in her terms. Her paper is about nominalization reduplication, and the Classifier<sub>3P</sub> she proposes explains the availability of a certain type of noun as an outcome of this process.<sup>10</sup> She motivates the existence of this third classifier projection with properties of the predicates it occurs in, such as the fact that "the nominals associated with the classifiers in these predicates function as locative or instrumental arguments" (p.340), and the insensitivity of this argumental role to classifier type. An analysis of the manner verbs in my experiment as containing a Classifier<sub>3P</sub> could help to set them aside from the other two verb classes: under such an analysis both Hdg<sub>s</sub>s and WECL<sub>s</sub>s would not introduce agent and/or theme arguments at all (p.340: "the classifiers present in the predicates that undergo nominalization reduplication do not, however, correspond to either an internal object or external argument..."). However, Abner (2017) leaves unexplained the observed difference between Hdg<sub>s</sub>s and WECL<sub>s</sub>s, within the class of manner verbs, in my experiment (the sentence on p.340 quoted above continues as follows: "..., nor do they exhibit argumental alternations of the type observed by Benedicto & Brentari"). Further research would have to address the interaction of Classifier<sub>3P</sub> with Classifier<sub>1P</sub> and Classifier<sub>2P</sub> (footnote 18, p.340: "just as the detailed interaction of Classifier<sub>1P</sub> and

---

<sup>10</sup> The main claim is, that, because the verbal classifier system plays a role in the argument structure of verbal predicates (in ASL and in other sign languages), "the potential availability of result- and concrete object-denoting interpretations correlates with whether or not verbal classifier structure is present" (p.333-334).

Classifier<sub>2</sub>P with verbal event structure is outside the scope of the present research, so too is the interaction of these classifier structures with the lower projection, Classifier<sub>3</sub>P, proposed here").<sup>11</sup> Back to the experiment, SIGN mode confirms the crucial finding that the WECL<sub>i</sub> type is certainly not interpreted as lacking an agent per se (Figure 4, rightmost column). It is mostly associated with an agentive interpretation, but contrary to predictions it is sometimes associated with the -EXTERNAL scene or with both scenes. Perhaps this is due to the fact that the WECL<sub>i</sub>s seem susceptible to a process of lexicalization, where they become "frozen" forms: the classifier construction is no longer analyzed as containing multiple morphemes but instead gets a fixed interpretation. Interestingly, this is also one of the characteristics Abner (2017) describes for Classifier<sub>3</sub> predicates. The WECL<sub>i</sub>s for SAW, SWEEP, BRUSH-TEETH, for example may then become associated with a generic meaning of "sawing", "sweeping" or "brushing one's teeth" respectively. Clearly, additional research is needed in this direction.

### 5.3 From meaning to form and back – modes of presentation

In psycholinguistic research multiple sources of information are preferred to reassure that the pattern found in one domain is also found in another domain. In comprehension studies, for example, potential ambiguities are often overlooked because participants are biased toward the interpretation that fits the context.<sup>12</sup> Perhaps the two modes of presentation in this experiment can be compared to the difference between production and comprehension: you are either going from meaning to form, or the other way around. Because this was a pioneer study, there was no experience to inform us about any difference between the two modes. To maximize the chance of revealing any ambiguity allowed by the participants for the stimuli presented, I used a "BOTH" response option in both SCENE mode and SIGN mode. This way I created an opportunity not only to reveal multiple interpretations participants may have, but also to compare their interpretations across the two modes.

Compared to the results in SCENE mode, the results in SIGN mode present a more robust pattern of classifier-argument structure correlations. This indicates that mode of presentation may affect results in sign language experiments. In this pioneer study, the two modes were analyzed separately and the factor as such can therefore not be assessed directly. Further research into the methodology is needed. The overall percentages of BOTH responses show that participants aren't just guessing: there is an indication of a certain reliability of the preference analysis. We see, though, that, where participants don't follow the paradigm, they give more BOTH responses: motion verbs and manner verbs provoke less pronounced preferences from our participants than causative verbs do, and especially the WECLs and WECL<sub>i</sub>s prove problematic for motion and manner verbs respectively. Instead of offering two alternatives and a BOTH button, the participant could be presented with a NONE button in addition. This would address the ambiguity of how to interpret the BOTH responses for this experiment. Or, the participant could be presented with just one possible match and be asked to approve or disapprove. This

---

<sup>11</sup> Abner suggests that the interaction of Classifier<sub>3</sub>P with Classifier<sub>1</sub>P and Classifier<sub>2</sub>P is minimal, because of the handshape variability, among other things. While Abner's account of nominalization reduplication revolves around the telicity of Classifier<sub>3</sub>P, she does not describe the relationship between event structure and Classifier<sub>1</sub>P and Classifier<sub>2</sub>P (corresponding to F1 and F2 in Benedicto & Brentari (2004)). She formulates her assumptions about the structural position of Classifier<sub>1</sub>P and Classifier<sub>2</sub>P, but states that "Benedicto & Brentari do not address the interaction of classifier structure with event structure" and that "A detailed investigation of these issues is outside the scope of the present project" (p.339). It would be highly interesting to continue this line of research in future work.

<sup>12</sup> See for example Hendriks (2014) for work on the difference between production and comprehension in spoken language research.

would enable us to study the finesse of interpretation in further detail, because the participant may then not be biased to respond contrastively by the simultaneous presence of both alternatives. Other methodological improvements may be adding a time constraint on participants' responses: this would possibly reveal bigger differences between modes.

#### 5.4 Conclusion

The current experiment studies correlations between argument structure and classifier type for three verb types in ASL. The results for causative verbs confirm the paradigm predicted by the hypotheses made by Bendicto & Brentari (2004). It becomes apparent, though, that these cannot explain the full range of data. Particularly, this study shows that WECL<sub>i</sub> constructions of manner verbs do not lack an agent the way WECL<sub>o</sub> constructions of causatives do. Combined, theory and experiment argue against an analysis of WECL morphemes as constituting one class.

## Acknowledgements

Many thanks to Massachusetts Institute of Technology (MIT), University of Connecticut, Gallaudet University, Utrecht University, University of Amsterdam and the following people: Diane Lillo-Martin, Marijana Marelj, Ken Wexler, Annemarie Kocab, Ian Smith, Rafael Raya, Ariel Glover, Elizabeth Roman, Elisse Lockhart, Miguel Angel Corona, Doreen Simons, Gaurav Mathur, Wanda Riddle, William Snyder, Esther Janse, Roland Pfau, Itamar Kastner and two anonymous reviewers. Work on this project has been funded by the Dutch Science Foundation (NWO), grant no. 360-70-520 (“Argument structure in three sign languages: Typological and theoretical aspects”).

## References

- Abner, N. 2017. What you see if what you get.get: surface transparency and ambiguity of nominalizing reduplication in American Sign Language. *Syntax* 20:4. 317-352.
- Ackema, P. 1995. *Syntax below Zero*. Ph.D. dissertation. Utrecht: LOT.
- Aikhenvald, A. 2003. Classifiers in spoken and signed languages: how to know more. In K. Emmorey (ed.), *Perspectives on classifier constructions in sign languages*, p. 87-90. Mahwah, NJ: Lawrence Erlbaum.
- Alexiadou, A., E. Anagnostopoulou & F. Schäfer. 2015. *External Arguments in Transitivity Alternations: A Layering Approach*. Oxford University Press.
- Aronoff, M., I. Meir & W. Sandler. 2005. The Paradox of Sign Language Morphology. *Language* 81. 301-344.
- Benedicto, E. & D. Brentari. 2004. Where did all the arguments go? Argument-changing properties of Classifiers in ASL. *Natural Language and Linguistic Theory*, 22(4). 743-810.
- Benedicto, E., S. Cvejanov & J. Quer. 2007. Valency in classifier predicates: A syntactic analysis. *Lingua* 117. 1202-1215.
- Bennet, M. & B. Partee. 1972. *Toward the logic of tense and aspect in English*. Distributed by Indiana University Linguistics Club.
- Bobaljik, J. 2012. *Universals in Comparative Morphology*. Cambridge, MA: MIT Press.
- Borer, H. 1994. The projection of arguments. In E. Benedicto & J. Runner (eds.), *Functional projections*, p. 19-47. Amherst, MA: GLSA.
- Brentari, D. 1998. *A Prosodic Model of Sign Language Phonology*. Cambridge, MA: MIT Press.
- Brown, R. 1981. Semantic aspects of some Waris predictions. In K.J. Franklin (ed.), *Syntax and semantics in Papua New Guinea languages*, p. 93-123. Summer Institute of Linguistics, Ukarumpa.
- Dowty, D. 1986. The effects of aspectual class on the temporal structure of discourse: semantics or pragmatics? *Linguistics and Philosophy* 9. 37-61.
- Emmorey, K. 2002. *Language, cognition and the brain: insights from sign language research*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Engberg-Pedersen, E. 1993. *Space in Danish Sign Language*. Hamburg: Signum.
- Glück, S. & R. Pfau. 1997. Eine Klasse für sich: Klassifizierende Verben in Deutscher Gebärdensprache [Classificatory verbs in German Sign Language]. *Zeitschrift für Sprachwissenschaft* 16(1/2). 181-208.
- Grose, D., R. Wilbur & K. Schalber. 2007. Events and telicity in classifier predicates: a reanalysis of body part classifier predicates in ASL. *Lingua* 117. 1258-1284.
- Hatav, G. 1989. Aspects, aktionsarten and the time line. *Linguistics* 27. 487-516.
- Hatav, G. 1993. The aspect system in English: an attempt for a unified analysis. *Linguistics* 31. 209-237.
- Hay, J., C. Kennedy & B. Levin. 1999. Scalar structure underlies telicity in “degree achievements”. In T. Matthews & D. Strolovitch (eds.), *SALT IX*, p. 127- 144. Ithaca, NY: Cornell University.
- Hendriks, P. 2014. Asymmetries between Language Production and Comprehension. *Studies in Theoretical Psycholinguistics* 42. Dordrecht: Springer.
- Hoekstra, T. 1984. *Transitivity: Grammatical relations in government-binding theory*. Dordrecht: Foris.
- Hoekstra, T. 1999. Auxiliary selection in Dutch. *Natural Language and Linguistic Theory* 17. 67-84.

- Hoekstra, T. & R. Mulder. 1990. Unergatives as copular verbs: Locational and existential predication. *The Linguistic Review* 7. 1-79.
- Hout, A. van. 1995. *Event semantics of verb frame alternations: a case study of Dutch and its acquisition*. Ph.D. dissertation. Tilburg: University of Tilburg.
- Johnston, T. & A. Schembri. 1999. On Defining Lexeme in a Signed Language. *Sign Language & Linguistics* 2(2). 115-185.
- Kimmelman, Vadim, Roland Pfau & Enoch O. Aboh. 2019. Argument structure of classifier predicates in Russian Sign Language. *Natural Language and Linguistic Theory* (online first: <https://rdcu.be/buAkU>)
- Klima, E. & U. Bellugi. 1979. *The Signs of Language*. Cambridge, MA: Harvard University Press.
- Liddell, S. & R.E. Johnson. 1987. An Analysis of Spatial-Locative Predicates in American Sign Language. Paper Presented at the 4th International Symposium on Sign Language Research, Lappeenranta, Finland.
- Lint, V. de. 2010. *Argument Structure in Classifier Constructions in American Sign Language (ASL): an experimental approach*. Utrecht: Utrecht University MA thesis.
- Lint, V. de. 2018. NGT classifier constructions: an inventory of arguments. *Sign Language & Linguistics* 21(1). 3-39.
- Marelj, M. 2004. *Middles and argument structure across languages*. Ph.D. dissertation. Utrecht: LOT.
- Mathur, G. & C. Rathmann. 2007. The argument structure of classifier predicates in American Sign Language. In A. Rose (ed.), *Proceedings of the Fourth Meeting on Semantics of Underrepresented Languages of the Americas*. Amherst: University of Massachusetts.
- Meir, I. 2012. Word classes and word formation. In R. Pfau, M. Steinbach & B. Woll (eds.), *Sign Language: An International Handbook*, p. 77-111. Berlin: De Gruyter Mouton.
- Neeleman, A. 1994. *Complex Predicates*. Ph.D. dissertation. Utrecht: LOT.
- Pavlič, M. 2016. *The word order parameter in Slovenian Sign Language Transitive, ditransitive, classifier and locative constructions*. PhD dissertation. Venice: Università Ca'Foscari Venezia.
- Pfau, R. & M. Steinbach. 2005. Backward and sideward reduplication in German Sign Language. In B. Hurch (ed.), *Studies on Reduplication*, p. 569-594. Berlin: Mouton de Gruyter.
- Reinhart, T. 1986. *States, events and reference time*. Lecture given at the MIT Lexicon project (handout, ms. Tel Aviv University).
- Reinhart, T. 2000. The Theta System: syntactic realization of verbal concepts. *UiL-OTS Working Papers*. Utrecht: University of Utrecht.
- Reinhart, T. 2002. The Theta System – An overview. *Theoretical Linguistics* 28. 229-290.
- Sandler, W. & D. Lillo-Martin. 2006. *Sign language and linguistic universals*. Cambridge: Cambridge University Press.
- Schembri, A. 2001. *Issues in the Analysis of Polycomponential Verbs in Australian Sign Language (Auslan)*. PhD Dissertation. Sydney: University of Sydney.
- Schembri, A. 2003. Rethinking “classifiers” in signed languages. In K. Emmorey (ed.), *Perspectives on classifier constructions in sign languages*, p. 3-34. Mahwah, NJ: Lawrence Erlbaum Associates.
- Schick, B. 1987. *The acquisition of classifier predicates in American Sign Language*. Ph.D. dissertation. West Lafayette: Purdue University.
- Schick, B. 1990. Classifier predicates in American Sign Language. *International Journal of Sign Linguistics* 1. 15-40.
- Stokoe, W.C. 1960. Sign language structure: an outline of the visual communication systems of the American deaf. *Studies in Linguistics. Occasional Papers* 8. Buffalo: University of Buffalo Press.
- Supalla, T. 1982. *Structure and acquisition of verbs of motion and location in American Sign Language*. Ph.D. dissertation. San Diego: University of California San Diego.
- Supalla, T. 1986. The classifier system in American Sign Language. In C. Craig (ed.), *Noun classes and categorization*, p. 181-214. Philadelphia: John Benjamins.

- Taub, S. F. 2001. *Language from the body: Iconicity and metaphor in American Sign Language*. Cambridge: Cambridge University Press.
- Van der Kooij, E. 2002. *Reducing phonological categories in Sign language of the Netherlands. Phonetic implementation and iconic motivation*. PhD dissertation. Utrecht: LOT.
- Vendler, Z. 1967. *Linguistics in philosophy*. Ithaca: Cornell University Press.
- Zwitserlood, I. 2003. *Classifying hand configurations in Nederlandse Gebarentaal (Sign Language of the Netherlands)*. Ph.D. dissertation. Utrecht: LOT.
- Zwitserlood, I. 2012. Classifiers. In R. Pfau, M. Steinbach & B. Woll (eds.), *Sign Language: An International Handbook*, p.158–186. Berlin: De Gruyter Mouton.

# Morphological causatives are Voice over Voice<sup>1</sup>

Yining Nie  
New York University  
yiningnie@nyu.edu

## Abstract

Causative morphology has been associated with either the introduction of an event of causation or the introduction of a causer argument. However, morphological causatives are mono-eventive, casting doubt on the notion that causatives fundamentally add a causing event. On the other hand, in some languages the causative morpheme is closer to the verb root than would be expected if the causative head is responsible for introducing the causer. Drawing on evidence primarily from Tagalog and Halkomelem, I argue that the syntactic configuration for morphological causatives involves Voice over Voice, and that languages differ in whether their ‘causative marker’ spells out the higher Voice, the lower Voice or both.

**Keywords:** causative, Voice, argument structure, morpheme order, typology, Tagalog

## 1. Introduction

Syntactic approaches to causatives generally fall into one of two camps. The first view builds on the discovery that causatives may semantically consist of multiple (sub)events (Jackendoff 1972, Dowty 1979, Parsons 1990, Levin and Rappaport Hovav 1994, a.o.). Consider the following English causative–anticausative pair. The anticausative in (1a) consists of an event of change of state, schematised in (1b). The causative in (2a) involves the same change of state plus an additional layer of semantics that conveys how that change of state is brought about (2a).

- (1) a. The stick broke.  
b. [ BECOME [ stick STATE(broken) ]]
- (2) a. Pat broke the stick.  
b. [ Pat CAUSE [ BECOME [ stick STATE(broken) ]]]

Several linguists have proposed that the semantic CAUSE and BECOME components of the causative are encoded as independent lexical verbal heads in the syntax (Harley 1995, Cuervo 2003, Folli and Harley 2005, Pylkkänen 2008, a.o.). Each of these verbal heads (known as ‘flavours’ of *v*) introduces a separate event into the syntax. Therefore the anticausative in (1a) consists of a change of state event introduced by *v*<sub>BECOME</sub> in (3a); the causative in (2b) involves the same change

---

<sup>1</sup>Thank you to Henrison Hsieh and A.J. Santos for their help with Tagalog. Thanks also to Hagen Blix, Heidi Harley, Itamar Kastner, Julie Anne Legate, Alec Marantz and audiences at NYU, MOTH 2016, NELS 47 and ALC 11 for their feedback at various stages of this work. Comments from two anonymous reviewers greatly helped to improve the paper. This research was supported in part by SSHRC Doctoral Fellowship #752-2016-0096. Any errors are mine.

Abbreviations follow the Leipzig Glossing Rules. Other abbreviations: POL = politeness marker, AIA = Ability/Involuntary Action Voice, AV = Actor Voice, CV = Circumstantial Voice, DIR.CAUS = direct causative, INDIR.CAUS = indirect causative, LK = linker, P = preposition, PN = proper noun.

of state event plus an additional causing event introduced by  $v_{CAUSE}$  (3b). This approach to causatives, which I will refer to as the CAUSE theory predicts that the events introduced by  $v_{CAUSE}$  and  $v_{BECOME}$  should be available for independent modification in the syntax.

- (3) a. [  $v_{BECOME}$  [ break stick ]]
- b. [ Pat  $v_{CAUSE}$  [  $v_{BECOME}$  [ break stick ]]]

The second view, which will be referred to as the Voice theory, takes the causative alternation to be a Voice alternation (Alexiadou et al. 2006, 2015; Schäfer 2008; Kastner 2016, 2018). In this approach, causatives are just like regular transitives in that the external argument is introduced by Voice (Kratzer 1996), sketched in (4b). The external argument is interpreted as the causer of a change of state, without introducing an additional causing event into the syntax. Thus causatives consist of a single event associated with a single  $v$ . Throughout the paper, I use the term ‘causer’ to refer to the highest argument in a causative, not to indicate a thematic role distinct from agent.

- (4) a. [  $v$  [ break stick ]]
- b. [ Pat Voice [  $v$  [ break stick ]]]

In a language with overt causative morphology, the causative marker would spell out CAUSE in the CAUSE theory, and Voice in the Voice theory. Thus one common prediction made by these two approaches to causatives is that causative morphology should be spelled out high. That is, if affix order reflects the scopal relationships between morphemes in the syntax (Rice 2000) as expected by the Mirror Principle (Muysken 1981, Baker 1985), languages with overt voice causative morphology should reflect the relatively high position of CAUSE or Voice.

A question to be explored in this paper is whether the high causative prediction should carry over to more complex causatives. To illustrate from English, a *have*-causative like (5) in the CAUSE theory might be assigned a structure such as (6), where a causing event introduced by  $v_{CAUSE}$  scopes over a doing event introduced by  $v_{DO}$ . Under the Voice theory, which assumes that both causers and regular transitive agents are introduced by Voice, the *have*-causative might be assigned a structure such as (7).

- (5) Sam had Pat eat the cookie.
- (6) [ Sam  $v_{CAUSE}$  [ Pat  $v_{DO}$  [ eat [ cookie ]]]]
- (7) [ Sam Voice [ Pat Voice [ eat [ cookie ]]]]

(6) and (7) show that for more complex causatives, the predictions of the CAUSE and Voice theories come apart. Causative morphology in the CAUSE theory should always be high. Causative morphology in the Voice theory, on the other hand, may in principle be realised in two positions: in the higher Voice position, lower Voice position or both.

This paper investigates whether the high causative prediction made by the CAUSE theory holds cross-linguistically for morphological causatives, defined as having (i) overt causative marking, (ii) a causee participant (as opposed to a theme, as in most lexical causatives), and (iii) an unmarked causative meaning (no coercion or permission of the causee). The high causative prediction is indeed borne out in Halkomelem, for example. As shown in the causative of an antipassive in (8), the causative affix  $-stəx^w$ , which also encodes agreement with the causee, falls outside of the antipassive affix  $-əm$  indicating the valency of the lower predicate.

- (8) ni? cən q'wəl-əm-stəx<sup>w</sup>              θə sleni? ɻə tθə səplil.  
 AUX 1SBJ bake-ANTIP-CAUS.3OBJ DET woman OBL DET bread  
 'I made the woman bake the bread.'              (Gerds 2004: 769)

The relative order of the causative and antipassive markers in Halkomelem reflect their syntactic and semantic scope: the causative is built on top of the antipassive.

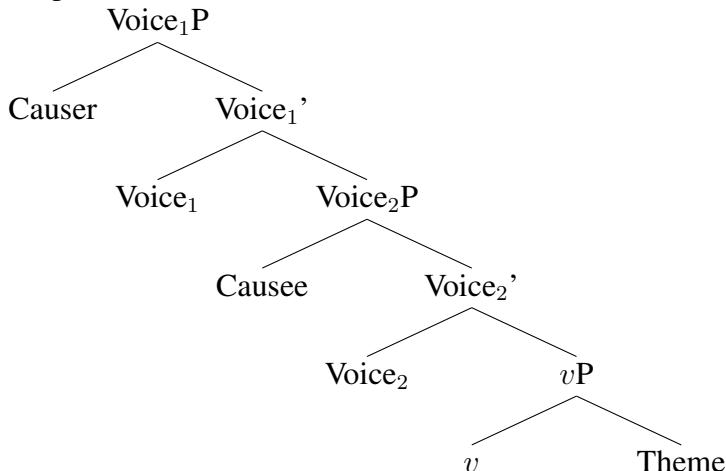
However, not all languages exhibit high causative morphology. In Tagalog, the causative marker *pa-* occurs inside of voice morphology, which reflects the transitivity of the entire clause. In the example in (9), the verb is prefixed with *nag-*, an Actor Voice (AV) marker which co-occurs with nominative case on the subject of the clause, in this case the causer. Notice that causative *pa-* appears closer to the verb than the *nag-* voice marker. Again, the relative order of the voice and causative markers reflects their syntactic scope: voice morphology is only determined once the entire causative predicate is built.

- (9) Nag-pa-takbo      ako      ng      bata-n<sup>g</sup>      lalaki.  
 AV.PFV-CAUS-run 1SG.NOM GEN child-LK man  
 'I made the boy run.'              (Rackowski 2002: 66)

Causative morphology in Tagalog therefore appears to be low. This is unexpected in the CAUSE theory, according to which causative morphology should always be high. It is possible, however, for the low position of *pa-* to be captured in a Voice theory of morphological causatives.

The empirical evidence points to the need for an approach to morphological causatives that allows causative morphology to appear high in some languages and low in others. I argue that the Voice theory of morphological causatives allows us to capture this cross-linguistic variation. I propose that morphological causatives involve a Voice head that selects for another VoiceP and that what has been identified as the ‘causative morpheme(s)’ in a given language can spell out either the higher Voice head, the lower one or both Voices. The causative marker in Halkomelem, for instance, spells out the higher Voice head, while the causative marker in Tagalog spells out the lower Voice head. Japanese and Kinande will be shown to spell out both. The proposed structure for causatives is given in (10), where *v* stands for a verbalising head *v* + √ROOT complex.

- (10) Proposed causative structure



Some previous proposals have suggested that the “recursion” of Voice may be necessary in morphological causatives (Rackowski 2002, Tubino-Blanco 2010, Harley 2013). However, these approaches also assume that causative semantics arises from a syntactically-present *vCAUSE* head that merges above the lower VoiceP and introduces a causing event; the result is a hybrid Voice+CAUSE approach to morphological causatives, sketched in (11).

- (11) [ Sam Voice [ *vCAUSE* [ Pat Voice [ *vDO* [ eat [ cookie ]]]]]]

My proposal takes the position that Voice over Voice is the defining property of morphological causatives, and that no dedicated CAUSE head is needed in the syntax.

The present analysis assumes a Minimalist syntactic approach to word building along the lines of Distributed Morphology (Halle and Marantz 1993), which assumes that the syntactic structure of a word is built in the syntax and gets sent to the PF and LF interfaces, where it receives a phonological form and semantic interpretation. One major conclusion of the current investigation is that morphological causatives contain no ‘causative head’ *per se*; rather, it is the Voice over Voice configuration that is assigned a causative interpretation at LF. Languages may choose to overtly realise different terminals in the causative configuration, which gives the impression of ‘causative morphology’ at varying heights in the structure. This kind of analysis is possible only if we assume that the determination of form and meaning follows compositional operations, as in realisational theories of morphology.

The rest of the paper is structured as follows. Section 2 presents data from morphological causatives in Halkomelem (Section 2.1), whose causative marker is high, and Tagalog (Section 2.2), whose causative marker is shown to be low. Section 2.3 then provides data from languages which exhibit ‘double’ causative marking, including Japanese and Kinande. Based on this evidence, I propose in Section 3 that morphological causatives involve Voice over Voice, which captures the variable spell-out of causative marking cross-linguistically. Evidence from agenthood diagnostics support the claim that causees in morphological causatives are indeed introduced by Voice. In Section 4, I show that CAUSE theories and hybrid Voice+CAUSE theories make incorrect predictions for the behaviour of morphological causatives. I argue against the presence of *vCAUSE* in the syntax, showing that morphological causatives do not involve two syntactically represented events (Section 4.1) and provide no morphological evidence for a dedicated causative head (Section 4.2). Section 5 concludes.

## 2. Two positions for causative markers

This section presents data on morphological causatives from languages with overt voice or transitivity morphology. The presence of overt voice morphology allows us to diagnose the relative position of the causative marker in these languages. I provide data from Halkomelem (Section 2.1) and Tagalog (Section 2.2), which have a single causative marker, as well as Japanese and Kinande, which have ‘double’ causative marking (Section 2.3).

### 2.1. Halkomelem causatives

In Halkomelem (Salish, ISO: hur), intransitive predicates receive no special marking (12a), but simple transitives are overtly marked by the transitive suffix *-t* and an ergative agreement marker (12b). As shown in (12c), Halkomelem can also express semantically transitive sentences using

an antipassive construction where the verb is marked by the antipassive suffix *-əm* and the internal argument is demoted to an oblique.

- (12) a. ni? ɿiməš tθə swiwləs.  
           AUX walk DET boy  
           ‘The boy walked.’ (Gerdts 2004: 769)
- b. ni? q'ʷəl-t-əs θə sleni? tθə səplil.  
           AUX bake-TR-3ERG DET woman DET bread  
           ‘The woman baked the bread.’
- c. ni? q'ʷəl-əm θə sleni? ?ə tθə səplil.  
           AUX bake-ANTIP DET woman OBL DET bread  
           ‘The woman baked the bread.’ (Gerdts 1980: 300)

The transitive and antipassive markers in Halkomelem are in complementary distribution in (12b) and (12c). I therefore assume that the language has both a transitive and antipassive Voice.

(13) gives the causativised versions of the sentences in (12). The causative suffix is *-stəx<sup>w</sup>*, which also encodes agreement with the causee.

- (13) a. ni? cən ɿiməš-stəx<sup>w</sup> tθə swiwləs.  
           AUX 1SBJ walk-CAUS.3OBJ DET boy  
           ‘I made the boy walk.’
- b. \*ni? cən q'ʷəl-ət-stəx<sup>w</sup> θə sleni? (?ə) tθə səplil.  
           AUX 1SBJ bake-TR-CAUS.3OBJ DET woman OBL DET bread  
           Intended: ‘I made the woman bake the bread.’
- c. ni? cən q'ʷəl-əm-stəx<sup>w</sup> θə sleni? ?ə tθə səplil.  
           AUX 1SBJ bake-ANTIP-CAUS.3OBJ DET woman OBL DET bread  
           ‘I made the woman bake the bread.’ (Gerdts 2004: 769)

Gerdts (1980, 2004) notes an interesting restriction on morphological causatives in Halkomelem: the language permits causatives of intransitives (13a) and causatives of antipassives (13c) but not causatives of transitives (13b). Such restrictions on the embedded clause are common cross-linguistically; see Section 3 for more discussion.

The licit causatives in (13a) and (13c) show that the causative is built on top of their simple unergative and antipassive counterparts. In (13c), we see that the antipassive marker *-əm*, which tracks the transitivity of the lower clause, is embedded inside the causative marker *-stəx<sup>w</sup>*. The causative marker is portmanteau with object agreement, which must be with the causee, as obliques do not control object agreement in the language. The resulting causative is therefore syntactically transitive. These facts indicate that whatever functional head is spelled out by *-stəx<sup>w</sup>* must be merged higher than the antipassive morpheme, as schematised in (14).

- (14) [ [ [ v ] əm ] stəx<sup>w</sup> ]

Any analysis of morphological causatives in Halkomelem must therefore allow the embedding of Voice.

Interestingly, despite being a transitive construction, causatives cannot be marked with the overt transitive suffix *-t* that occurs in simple transitives, as in (12b). This suggests that *-stəx<sup>w</sup>*

behaves simultaneously as a marker of causation and of transitivity. This is consistent with the simple CAUSE and Voice theories of morphological causatives, where it is a high causative or Voice head that introduces the causer argument. However, the ungrammaticality of transitive *-t* in causatives is unexpected in a hybrid Voice+CAUSE approach, where an additional Voice marker would be predicted to occur outside the causative marker.

## 2.2. Tagalog causatives

Tagalog, like many other Austronesian languages, displays a rich system of voice morphology. For simplicity, I focus on just the Actor Voice and Patient Voice constructions, which track nominative case on the subject and on the object, respectively. When the subject of a transitive clause is nominative, the verb surfaces with the *nag-* Actor Voice prefix (15a). When the object is nominative, the verb surfaces with a null Patient Voice suffix that conditions the appearance of the perfective marker *<in>* (15b), which infixes initially to the verb (Schachter and Otanes 1972, De Guzman 1978, MacLachlan 1996).

- (15) a. Nag-bagsak ang guro ng mag-aaral.  
AV.PFV-fail NOM teacher GEN student  
'The teacher flunked a student.' Actor Voice
- b. B<in>agsak-∅ ng guro ang mag-aaral.  
<PFV>fail-PV GEN teacher NOM student  
'The teacher flunked the student.' Patient Voice

The Patient Voice suffix is overt in, for example, the infinitive form of the verb *bagsak-in* 'fail-PV'. I take voice morphology in Tagalog to be a true morphological reflex of Voice heads (Rackowski 2002; Aldridge 2004, 2012; Nie 2017).<sup>2</sup> Following Aldridge (2004, 2012), I assume that Actor Voice and Patient Voice are equivalent to antipassive and transitive Voice, respectively. The Voice head can also condition allomorphy on a higher Aspect projection, which is spelled out by *<in>* in the context of Patient Voice (15b).<sup>3</sup>

The causativised counterparts of (15) are given in (16), where the verb is marked with the causative prefix *pa-*. In the Actor Voice causative in (16a), causative *pa-* appears in between the Actor Voice marker *nag-* and the verb. In the Patient Voice causative in (16b), the voice marker is null, but the perfective marker *<in>* infixes not to the verb but to the causative marker *pa-*; this

---

<sup>2</sup>Evidence that *nag-* spells out Voice comes from alternations with another Actor Voice affix *<um>* (i). As shown in (ii), *nag-* results in the addition of an external argument (Carrier-Duncan 1985, Travis 2000). This property of external argument introduction suggests that *nag-* is a true reflex of Voice.

- (i) B<um>agsak ang baso.  
<AV.PFV>drop NOM vase  
'The vase fell/dropped.'
- (ii) **Nag**-bagsak ng baso ang bata.  
AV.PFV-drop GEN vase NOM child  
'The child slammed down the vase.' (Rackowski 2002: 72)

<sup>3</sup>Aspect exhibits similar allomorphy for Actor Voice (Schachter and Otanes 1972, De Guzman 1978), which I will set aside for the sake of simplicity.

suggests that *pa-* prefixes to the verb complex first, and then <*in*> infixes to the resulting form.

- (16) a. Nag-pa-bagsak aka sa guro ng mag-aaral.  
AV.PFV-CAUS-fail 1SG.NOM OBL teacher GEN student  
'I made a teacher flunk a student.'
- b. P<*in*>a-bagsak-∅ ko ang guro ng mag-aaral.  
<PFV>CAUS-fail-PV 1SG.GEN NOM teacher GEN student  
'I made the teacher flunk a student.'

Note that the voice morphology in both causatives is tracking the case properties of the entire causative, rather than that of the lower clause. That is, Actor Voice tracks the nominative causer subject in (16a), rather than the agent of the lower clause, i.e. the causee. Similarly, Patient Voice tracks the nominative causee 'object' in (16b), rather than the patient of the lower clause. Tagalog therefore differs from Halkomelem in that overt voice morphology has syntactic scope above the causative marker. This accords with morpheme order in the Actor Voice, where the *nag-* prefix attaches outside of the *pa-* + verb complex, indicating that Actor Voice is merged higher than the head that spells out the causative marker. Assuming that morphosyntactically conditioned allomorphy must be local (Bobaljik 2000, Embick 2010), the contextual spell-out of the Aspect head as <*in*> in the context of Patient Voice suggests that Patient Voice is also merged higher than the causative marker.

Causatives of unergatives (17) and causatives of unaccusatives (18) in Tagalog show the same pattern as the causatives of transitives with respect to syntactic scope and morpheme order.<sup>4</sup>

- (17) a. Nag-pa-kanta aka ng bata.  
AV.PFV-CAUS-sing 1SG.NOM GEN child  
'I made a child sing.'
  - b. P<*in*>a-kanta-∅ ko ang bata.  
<PFV>CAUS-sing-PV 1SG.GEN NOM child  
'I made the child sing.'
- (18) a. Nag-pa-hulog aka ng bata.  
AV.PFV-CAUS-fall 1SG.NOM GEN child  
'I made a child fall.'
  - b. P<*in*>a-tumba-∅ ko ang bata.  
<PFV>CAUS-fall-PV 1SG.GEN NOM child  
'I made the child fall.'

Again, we see that voice morphology scopes above causative morphology in Tagalog. Actor Voice, for example, co-occurs with a nominative causer subject, not a nominative causee, which instead triggers Patient Voice.

The hierarchical structure of the Actor Voice causative verbal complex in Tagalog is given in (19). The head that spells out the causative marker merges before voice morphology and therefore appears low in the structure.

---

<sup>4</sup>Different verb roots (*hulog* and *tumba*) are used for the Actor Voice and Patient Voice causatives of unaccusatives in (18) due to what appears to be lexical incompatibility with one or the other Voice form of the causative. However, both roots appear to be unaccusative under standard tests.

- (19) [ nag- [ pa- [ v ] ] ]

Tagalog is not alone in its ‘low’ causative morphology. Other languages which have been proposed to have a low causative marker include such typologically diverse languages as Acehnese (Legate 2014), Hiaki (Tubino-Blanco 2010, Harley 2013) and Zulu (Halpert 2015). Like in Tagalog, the voice or transitivity markers in these languages also scope above the causative marker.

Languages with low causative morphology are possible under Voice and hybrid Voice+CAUSE theories of morphological causatives, where the causative marker can spell out a projection lower than the Voice head that introduces the causer—the lower Voice projection or CAUSE, respectively. However, these languages pose a problem for simple CAUSE theories, which predict that the causative marker should be uniformly spelled out high.

Note also that Tagalog differs from Halkomelem in that no voice morphology surfaces under the scope of the causative marker; there is no voice morphology on the verb that reflects the transitivity of the lower clause. However, Tagalog is *like* Halkomelem in that causatives only have two overt functional markers; Voice, whether high or low, is only spelled out once. This is problematic for the hybrid Voice+CAUSE theory of morphological causatives, which predicts that causatives should contain two reflexes of Voice, one for the lower clause and a second for the higher clause.

### 2.3. Doubly-marked causatives

Some languages exhibit apparent ‘double’ causative marking. In Japanese, for example, the anti-causative of some verbs surfaces with an -R- morpheme (20a), while their lexical causative counterparts are marked with -S- (20b), usually glossed as transitive or causative (Jacobsen 1982, Miyagawa 1998, Harley 2008, Oseki 2017).

- (20) a. Kabin-ga kowa-re-ta.  
vase-NOM break-R-PST  
'The vase broke.'  
b. John-ga kabin-o kowa-si-ta.  
John-NOM vase-ACC break-S-PST  
'John broke the vase.'

Japanese also has morphological causatives that employ *-sase-* (Shibatani 1976, Miyagawa 1998, Harley 2008), which Oseki (2017) has suggested may be decomposed into double -S- marking:

- (21) John-ga Mary-ni syasin-o mi-sa-se-ta.  
John-NOM Mary-DAT picture-ACC see-S-S-PST  
'John made Mary see a picture.' (Oseki 2017: 24)

Thus while (some) lexical causatives are marked with one -S-, morphological causatives surface with two -S- markers in Japanese.

Several Bantu languages also appear to have double causative marking. Kinande, for example, has what is known as the direct or short causative marker *-i-* in lexical causatives (22b). The short causative marker obligatorily co-occurs with the indirect or long causative marker *-is-* in morphological causatives, resulting in double causative marking (23b). Only the Kinande verb stems are given below.

- (22) a. -tsap- ‘get wet’  
       b. -tsap-i- ‘wet (tr.)’
- (23) a. -lim- ‘cultivate’  
       b. -lim-is-i- ‘cause to cultivate’

(Hyman 1993: 12)

(Hyman 1993: 13)

Morphological causatives in Bemba and Luganda also have both the short *-i-* and long *-is-* causative markers (Hyman 2003). Georgian is another, unrelated language that has been reported to have doubly-marked causatives; causatives of transitives in the language receive both an *a-* prefix and *-in* suffix (Nash 1994, 2017).

Double causative marking is problematic for CAUSE and hybrid Voice+CAUSE analyses of morphological causatives because there is only one CAUSE projection that can be spelled out by causative morphology. If morphological causatives involve two stacked Voice heads, however, then the double marking is explained. This approach is supported by Oseki’s (2017) reanalysis of Japanese *-s-* as a reflex of transitive Voice; double *-s-* marking therefore reflects the presence of two Voice heads.

### 3. Proposal

#### 3.1. Voice over Voice

The morphological causatives discussed in the previous section bear *exactly two* overt markers on the verb. This is summarised in (24), where Affix1 indicates a position closer to the verb.

- (24) Causative morphology

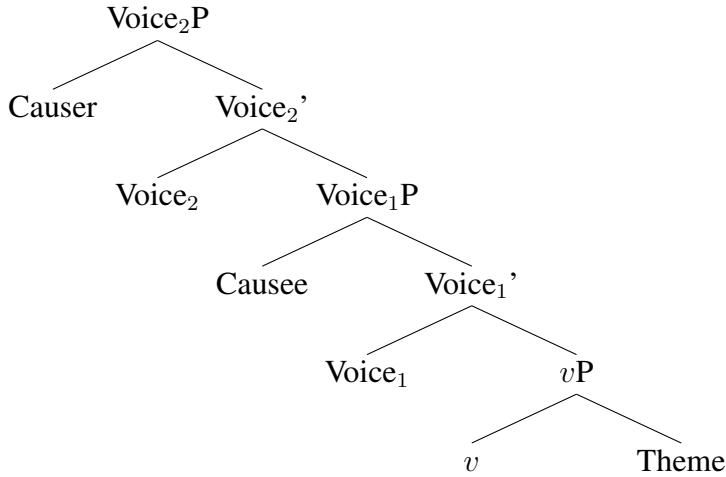
	Affix1	Affix2
Halkomelem	Voice	CAUS
Tagalog	CAUS	Voice
Japanese	-S-	-S-
Kinande	INDIR.CAUS	DIR.CAUS

Halkomelem and Tagalog both have one marker that conveys voice and another that conveys causation. In Halkomelem, the voice marker tracks the transitivity of the lower clause. In Tagalog, the voice marker reflects the transitivity of the entire clause. But why does neither language mark voice for both the inner and outer clauses? In other words, why don’t causatives always have *three* overt markers, Voice-CAUS-Voice, as is predicted by the hybrid Voice+CAUSE approach?

My answer is simple: morphological causatives are bimorphemic. They consist of two Voice projections, one of which may receive an invariant spell-out form, giving rise to the appearance of ‘causative’ morphology. In a sense, then, languages with morphological causatives are indeed marking voice for both the inner and outer clauses. Causatives do not have three overt markers because there is no dedicated syntactic CAUSE head in the extended projection of the verb.

Adopting Kratzer’s (1996) proposal that agents are generated in the syntax in the specifier of a functional head Voice, I propose that the causer and causee are each introduced by a Voice head. The higher Voice<sub>2</sub> introduces the causer, and the lower Voice<sub>1</sub> may introduce a transitive or unergative causee. The tree in (25), repeated from (10), sketches the structure for a causative of a transitive; *v* stands for the verbalising head *v* + √ROOT complex.

(25) Proposed causative structure



I assume that a Voice head is present in all predicate types, including unergatives and unaccusatives. This is possible if we allow our inventory of functional heads to include multiple Voice heads with different syntactic and semantic properties, including an unaccusative Voice head which prohibits a specifier but is nonetheless morphologically overt in many languages (see Schäfer 2008; Alexiou et al. 2015; Wood 2015; Kastner 2016, 2017; Oseki 2017). Therefore the causative of an unergative in this approach differs structurally from (25) only in the absence of a theme argument, while the causative of an unaccusative differs in the absence of a causee; the sequence of functional heads remains the same. This captures the identical morphological behaviour of causatives of transitives, unergatives and unaccusatives in, for example, Tagalog (see Section 2.2).

I assume that morphological causatives in all languages have the same syntactic hierarchy of heads, given in (25). However, languages will vary in whether one or both Voice heads receives an invariant ‘causative’ spell-out, where the form of Voice does not change according to the voice properties of the clause. These invariant forms are labelled CAUS (or -s- in the case of Japanese) in (24). For instance, the invariant Voice is high in Halkomelem and low in Tagalog. This can be captured with Vocabulary Items that obey contextual spell-out: the causative marker spells out Voice in the context of a lower Voice in Halkomelem (26) but in the context of a higher Voice in Tagalog (27).

(26) Halkomelem: Voice  $\leftrightarrow$  -stəx<sup>w</sup> / Voice ] \_\_ ]

(27) Tagalog: Voice  $\leftrightarrow$  pa- / [ Voice [ \_\_

Interestingly, the difference in the spell-out rules between Halkomelem and Tagalog causatives seem to reflect a difference in their syntax. The lower Voice in Tagalog may be transitive, unergative or unaccusative (Section 2.2); these Voices are all spelled out as *pa-*. The lower Voice in Halkomelem, by contrast, can be intransitive or antipassive but not transitive; variable voice morphology on the lower Voice marks this restriction. I speculate that causative morphology can be spelled out low in a language that has no restrictions on the lower Voice but is spelled out high in a language with such restrictions on the lower Voice.

Both Voice heads are invariant in Japanese and Kinande, which gives rise to their double causative marking. -s- marks any transitive Voice in Japanese (28). In Kinande, -is- marks transitive Voice in the context of a higher Voice projection, while -i- is the elsewhere form for transitive

Voice, which ensures that it gets spelled out on the highest Voice.

- (28) Japanese: Voice<sub>TR</sub> ↔ -s-
- (29) Kinande: Voice<sub>TR</sub> ↔ -i-, Voicetr ↔ -is- / \_\_ ] Voice ]

These simple contextually-conditioned Vocabulary Items allow the Voice head that spells out the causative marker(s) in these languages to be realised in its scopal position.

The Voice over Voice approach also provides a way to connect what have been traditionally called ‘lexical’ and ‘syntactic’ causatives. Lexical causatives in Japanese, for example, involve a single Voice head, as suggested by the single -s- in (30), while morphological or ‘syntactic’ causatives employ two Voice heads, as suggested by the double marking in (31).

- (30) John-ga kabin-o kowa-si-ta.  
John-NOM vase-ACC break-S-PST  
'John broke the vase.'
  - (31) John-ga Mary-ni syasin-o mi-sa-se-ta.  
John-NOM Mary-DAT picture-ACC see-S-S-PST  
'John made Mary see a picture.'
- (Oseki 2017: 24)

### 3.2. Agenthood

The evidence presented in favour of a Voice over Voice approach to morphological causatives has so far been mostly morphological. Recall that transitive Voice was originally proposed to introduce agentive external arguments (Kratzer 1996). Evidence that the causer and causee can both be agentive would therefore constitute further positive support for the Voice over Voice analysis of morphological causatives. Specifically, agenthood of the causee would support the proposal that morphological causatives contain an embedded Voice head that introduces the causee.

Agenthood can be diagnosed with the use of agent-oriented adverbs (Jackendoff 1972, Ernst 1984, Geuder 2000, Pylkkänen 2008). In simple unergatives in Tagalog, agent-oriented adverbs like *sinasadya* ‘deliberately’ associate straightforwardly with the agent, as shown in (32). In the causative of the same unergative predicate given in (33); postverbal *sinasadya* can associate with either the causer or unergative causee, suggesting that both the causer and causee are agents.<sup>5</sup>

- (32) Um-iyak si Kiko nang sinasadya.  
AV.PFV-cry NOM.PN Kiko ADV deliberately  
'Kiko<sub>2</sub> cried deliberately<sub>2</sub>'.
- (33) P<in>a-iyak-∅ ko si Kiko nang sinasadya.  
<PFV>CAUS-cry-PV 1SG.GEN NOM.PN Kiko ADV deliberately  
'I<sub>1</sub> made Kiko<sub>2</sub> cry deliberately<sub>1/2</sub>'.

Agenthood may also be demonstrated by the compatibility of an argument with an instrument (Fillmore 1968). The Tagalog causative of an unergative in (34) shows that the instrumental adjunct *gamit ang tungkod* ‘with the cane’ may associate with either the causer or the causee; the sentence

---

<sup>5</sup>The Actor Voice version of the causative in (33) is judged to be marginal with or without *sinasadya* ‘deliberately’, likely due to the non-specific interpretation of a genitive-marked causee.

can convey either that Kiko used the cane to walk with or that the speaker threatened Kiko with the cane. The association of the instrumental adjunct in the causative of transitive in (35) is similarly ambiguous between the causer and causee.

- (34) P<in>a-lakad-∅      ko      si      Kiko gamit ang tungkod.  
       <PFV>CAUS-walk-PV 1SG.GEN NOM.PN Kiko using NOM cane  
       'I<sub>1</sub> made Kiko<sub>2</sub> walk with<sub>1/2</sub> the cane.'

(35) P<in>a-luto-∅      ko      si      Kiko ng pansit gamit ang kahoy.  
       <PFV>CAUS-cook-PV 1SG.GEN NOM.PN Kiko GEN pancit using NOM stick  
       'I<sub>1</sub> made Kiko<sub>2</sub> cook pancit with<sub>1/2</sub> the stick.'

The agenthood diagnostics in (33) through (35) demonstrate that both the causer and causee are agents in Tagalog.

Transitive and unergative causees do not exhibit agentive characteristics in all languages, however. In Korean, for example, the agent-oriented adverb *ilupule* ‘on purpose’ can associate with the causer but not causee, as shown in (36).

- (36) Swuni-ka Minswu-eykey chayk-lul ilpule ilk-hi-ess-ta  
 Suni-NOM Minsu-DAT book-ACC on.purpose read-CAUS-PST-DECL  
 ‘Suni<sub>1</sub> had Minsu<sub>2</sub> read the book on purpose<sub>1/\*2</sub>.’ (Kim 2011: 500)

Similarly, in Acehnese, the agent-oriented adverb *ngon saba* ‘patiently’ can associate with the causee but not the causer:



On the basis of such evidence, Kim (2011) and Legate (2014) argue that while causers are indeed agents in Korean and Acehnese, respectively, causees are not agents, and a Voice over Voice approach to morphological causatives is therefore untenable. Kim (2011) suggests instead that transitive causees in Korean are introduced by a high Applicative head, while Legate (2014) posits a special kind of Applicative Voice to introduce transitive causees in Acehnese.

However, in the current approach we do not expect *all* embedded Voice heads in causatives to introduce agents. Causatives of unaccusatives, for instance, are proposed to contain a lower unaccusative Voice head; unaccusative Voice prohibits a specifier and therefore cannot introduce an agent. If it is indeed the case that causees of morphological causatives are never agentive in Korean and Acehnese, then this can be modelled as a language-specific restriction on the set of Voice heads that may be embedded under another Voice head. In fact, restrictions on the lower Voice are common cross-linguistically. Recall, for example, that morphological causatives in Halkomelem permit embedded antipassive Voice but not transitive Voice (Section 2.1). The variation observed across languages might then be due to different restrictions on the set of Voice heads they allow to be embedded; further investigation of these restrictions is left for future research.<sup>6</sup>

<sup>6</sup>As Svenonius (2005) and especially Key (2013) show, there is a limit to causative “recursion” or embedding cross-linguistically. It may be possible to model this also as a restriction on embedded Voice heads.

My approach therefore does not recognise a dedicated ‘causative morpheme’ or head in the syntax. Instead, I propose that the semantics of causation arises due to a rule of interpretation at LF that assigns a Voice over Voice configuration a causative interpretation. Such rules at LF are necessary in order to capture such ambiguities as in (38), from Japanese, in which an apparently causative -s- construction may have both a causative interpretation (a) and a non-causative, adversity interpretation (b).

- (38) Taroo-ga musuko-o sin-ase-ta.  
 Taroo-NOM son-ACC die-S-PST  
 a. ‘Taro caused his son to die.’  
 b. ‘Taro’s son died on him.’
- (Pylkkänen 2008: 90)

Pylkkänen (2008) proposes that both interpretations of (38) arise from causative structures with causative semantics. I adopt Wood and Marantz’s (2017) approach, which agrees with Pylkkänen that Japanese adversity causatives “look morphosyntactically like plain transitive causatives, because they have the same syntactic structure as plain [lexical] transitive causatives” (2017: 275) but “denies that the adversity causative asserts causative semantics” (276). The reader is referred to their paper for the details of their analysis, including its advantages over Pylkkänen’s approach. If Wood and Marantz are correct, then the availability of the adversity reading in (38) as well as the possibility of -s- doubling in (31) suggest that it is not the case that (each instance of) -s- always gives rise to causative semantics. Rather, there may be multiple rules of interpretation that are compatible with the syntactic structure of (38), one that leads to the causative reading and another to the adversity reading. This kind of analysis is only tenable within a realisational theory of morphology with regards to both form (PF) and meaning (LF) (see Marantz 2013, Wood 2015, Myler 2016, Wood and Marantz 2017).

#### 4. Alternatives

This section discusses the predictions made by the CAUSE and hybrid Voice+CAUSE approaches to morphological causatives. Both approaches claim that causatives contain a verbal head  $v_{CAUSE}$  that introduces a causing event in the syntax. In the simple CAUSE analysis, flavours of  $v$  can introduce both an event and an external argument (Harley 1995, Cuervo 2003, Folli and Harley 2005), as shown in (39) for *Sam had Pat eat the cookie*. In the hybrid Voice+CAUSE approach,  $v$  introduces just an event, and Voice introduces the external argument (Rackowski 2002, Pylkkänen 2008, Tubino-Blanco 2010, Harley 2013, Legate 2014), as shown in (40).

- (39) [ Sam  $v_{CAUSE}$  [ Pat  $v_{DO}$  [ eat [ cookie ]]]]  
 (40) [ Sam Voice [  $v_{CAUSE}$  [ Pat Voice [  $v_{DO}$  [ eat [ cookie ]]]]]]

Both theories predict that the causing event introduced by  $v_{CAUSE}$  and the doing event introduced by  $v_{DO}$  can be independently modified, for example, by temporal adverbials. The CAUSE theory furthermore predicts that causative morphology should always be spelled out high, while the hybrid Voice+CAUSE theory predicts that two voice markers should be spelled out alongside the causative morpheme in languages where Voice is overt.

Section 4.1 first shows that morphological causatives in Tagalog display no evidence for a syntactically-represented causing event. This conflicts with the claim that  $v_{CAUSE}$  introduces a

causing event that should be available for independent modification in the syntax. Section 4.2 then returns to the data from the high, low and doubly-marked causatives discussed in Section 2, demonstrating that CAUSE and Voice+CAUSE theories of morphological causatives make incorrect predictions for morpheme order.

#### 4.1. Eventhood

The CAUSE and hybrid Voice+CAUSE theories contend that both lexical and morphological causatives contain a syntactically-represented causing event not found in their non-causative counterparts. Consider again the causative–inchoative alternation in English. If the causative contains a causing event, we expect to be able to modify it using, for example, temporal and manner adjuncts independently of the change of state event. This prediction is not borne out, as shown in the lack of contrast between the inchoative of *break* in (41a) and -*ing* nominalisation in (41b) on the one hand and the causative of *break* in (42) on the other. There is no causing event in English lexical causatives that can be modified by temporal adjuncts (42a) or manner adjuncts (42b) independently of the change of state.

- (41) a. The stick broke on Monday.  
b. The breaking of the stick on Monday

(42) a. Pat broke the stick on Monday (\*by stepping on it on last week).  
b. Pat broke the stick quickly (\*by stepping on it slowly).

Bjorkman and Cowper (2013: 4) show that, like lexical causatives, *have*-causatives in English also disallow independent temporal modification of the supposed causing event and caused event (see also Ritter and Rosen 1993, 1996):<sup>7</sup>

- (43) \*They had the team throw the game on Monday by threatening them on Sunday night.

When we turn to morphological causatives in other languages, we find that the same generalisation holds. In the Tagalog causative in (44), the putative causing event and caused event cannot receive independent temporal modification.

- (44) P<in>a-iyak-∅ ko si Kiko sa Lunes (\*sa pang-iinsulto ko sa <PFV>CAUS-cry-PV 1SG.GEN NOM.PN Kiko P Monday P ADV-insulting 1SG.GEN P kanya sa Linggo).

3SG.OBL P Sunday  
I took it (I took it) Monday (I took it) Sunday

Because events are spatial-temporal entities, we expect to be able to modify them temporally. In (44), however, there appears to be no event for the temporal adjunct to modify.

*Again*-attachment has been widely used to diagnose event decomposition in the syntax (McCawley 1968, Dowty 1979, von Stechow 1996). Inchoatives with *again* are known to be ambiguous between restitutive and repetitive readings depending on where in the structure *again* attaches, as shown in (45). The restitutive reading in (45a) presupposes only that the baby was previously in a

<sup>7</sup>English *have*-causatives differ from *make*-causatives, for which the two events may indeed be subject to independent temporal modification.

state of wakefulness; *again* scopes over just this state. The repetitive reading in (45b) presupposes that the baby has previously undergone a dynamic event of waking up; *again* scopes over the entire change of state event.

(45) The baby woke up again.

- a. [ BECOME (*again* [ baby STATE(awake) ])]

Context: *Luz gave birth to a beautiful new baby. The baby was awake and crying when he was born. Soon he quieted down and fell asleep. A few hours later he woke up.*

- b. (*again* [ BECOME [ baby STATE(awake) ]])

Context: *Luz gave birth to a beautiful new baby. The baby was miraculously asleep when he was born, but soon he woke up and started crying. The baby eventually quieted down and fell asleep but a few hours later he woke up.*

Inchoatives therefore allow *again* to attach at two different points in the structure. If causatives contain an additional CAUSE event, then *again* should be able to attach at a third point in the structure. That is, causatives should be three-ways ambiguous. The crucial prediction is that *again* should be able to scope in between the CAUSE and BECOME components of the causative, which would provide evidence that they are present and differentiated in the syntax.

However, as von Stechow (1996: 99) shows, lexical causatives are only ambiguous between two meanings, one where *again* scopes over just the state of wakefulness (46a) and one where *again* scopes over the entire causative, including both participants (46c). What is unavailable is the reading in (46b), which is intended to presuppose a previous event of the baby waking up which the nurse was not necessarily involved in (see von Stechow 1996, Pylkkänen 2008, Schäfer 2008).

(46) The nurse woke the baby up again.

- a. [nurse CAUSE [ BECOME (*again* [ baby STATE(awake) ])]]

Context: *Luz gave birth to a beautiful new baby. The baby was awake and crying when he was born. Soon he quieted down and fell asleep. A few hours later the nurse woke the baby up.*

- b. \*[nurse CAUSE (*again* [ BECOME [ baby STATE(awake) ]])]

Context: *Luz gave birth to a beautiful new baby. The baby was miraculously asleep when he was born. The doctor woke him up and he started crying. The baby eventually quieted down and fell asleep but a few hours later a nurse woke him up.*

- c. (*again* [nurse CAUSE [ BECOME [ baby STATE(awake) ]]])

Context: *Luz gave birth to a beautiful new baby. The baby was miraculously asleep when he was born. The nurse woke him up and he started crying. The baby eventually quieted down and fell asleep but a few hours later the nurse woke him up.*

Just like in inchoatives, then, *again* only attaches at two points in the structure of lexical causatives, resulting in (i) a restitutive reading or (ii) a repetitive reading over the entire clause. Crucially, *again* cannot scope in between the CAUSE and BECOME components of the causative, suggesting that they are not in fact differentiated in the syntax.

The same *again*-attachment behaviour is exhibited by inchoatives and lexical causatives in Tagalog. Inchoatives take an Ability/Involuntary Action (AIA) prefix, which is frequently used to mark change of state events (Dell 1983). The inchoative of *gising* ‘wake up’ is given in (47)

with *ulit*, a second position element meaning ‘again’ (Aldridge 2004). Like its English counterpart in (45), the Tagalog inchoative is ambiguous between the restitutive reading (47a) and repetitive reading (47b). The contexts given for these readings were the same as those in (45).

- (47) Na-gising ulit ang sanggol.  
 AIA-wake.up again NOM baby  
 ‘The baby woke up again.’
- [ BECOME (*ulit* [ baby STATE(awake) ])]
  - (*ulit* [ BECOME [ baby STATE(awake) ]])

As shown in (48), the lexical causative of *gising*, which takes the Patient Voice form, also has only two readings: the restitutive reading (48a) and the repetitive reading over the whole clause (48c). Crucially, the interpretation where *ulit* scopes over just the change of state is unavailable (48b). The contexts given for these readings were the same as those in (46).

- (48) G<in>ising-∅ ulit ng nars ang sanggol.  
 <PFV>wake.up-PV again GEN nurse NOM baby  
 ‘The nurse woke the baby up again.’
- [nurse CAUSE [ BECOME (*ulit* [ baby STATE(awake) ])]]
  - \*[nurse CAUSE (*ulit* [ BECOME [ baby STATE(awake) ]])]
  - (*ulit* [nurse CAUSE [ BECOME [ baby STATE(awake) ]]])

Let us now return to morphological causatives, which are the focus of this paper. It could in principle be the case that morphological causatives behave differently from lexical causatives with respect to *ulit*-attachment in Tagalog. As it turns out, however, they exhibit the same behaviour. Consider the root *tulog* ‘sleep’, whose inchoative form with *ulit* in (49) is ambiguous between a restitutive reading (49a) and repetitive reading (49b).

- (49) Na-tulog ulit ang sanggol.  
 AIA-sleep again NOM baby  
 ‘The baby fell asleep again.’
- [ BECOME (*ulit* [ baby STATE(asleep) ])]  
 Context: *Luz gave birth to a beautiful new baby. The baby was miraculously asleep when he was born. Soon he woke up and started crying. A few hours later he quieted down and fell asleep.*
  - (*ulit* [ BECOME [ baby STATE(asleep) ]])  
 Context: *Luz gave birth to a beautiful new baby. The baby was awake when he was born. Soon he fell asleep. A few hours later he woke up and starting crying. Eventually he fell asleep.*

There is no lexical causative of *tulog*, but a morphological causative can be formed using the *pa-* causative marker (50). The morphological causative has the restitutive reading (50a) and the repetitive reading over the whole clause (50c). However, it crucially does not have the interpretation where *ulit* scopes over just the change of state event (50b).

- (50) P<in>a-tulog-∅      ulit ng nars ang sanggol.  
           <PFV>CAUS-sleep-PV again GEN nurse NOM baby  
           ‘The nurse put the baby to sleep.’
- a. [nurse CAUSE [ BECOME (ulit [ baby STATE(asleep) ])]]  
 Context: *Luz gave birth to a beautiful new baby. The baby was miraculously asleep when he was born. Soon he woke up and started crying. The nurse picked him up and rocked him until he fell asleep.*
  - b. \*[nurse CAUSE (ulit [ BECOME [ baby STATE(asleep) ]])]  
 Context: *Luz gave birth to a beautiful new baby. The baby was awake and crying when he was born. The doctor picked him up and rocked him until he fell asleep. A few hours later the baby woke up and starting crying. The nurse came and rocked him to sleep.*
  - c. (ulit [nurse CAUSE [ BECOME [ baby STATE(asleep) ]]])  
 Context: *Luz gave birth to a beautiful new baby. The baby was awake and crying when he was born. The nurse picked him up and rocked him until he fell asleep. A few hours later the baby woke up and starting crying. The nurse came and rocked him to sleep.*

Thus morphological causatives in Tagalog exhibit the same pattern as lexical causatives with respect to *ulit*-attachment. I take this evidence to suggest that morphological causatives do not necessarily introduce a causing event into the syntax. Instead, what distinguishes causatives from their non-causative counterparts is simply the addition of an external argument.

#### 4.2. Voice and *v*

As noted in Section 3, morphological causatives in languages that spell out both voice and causative morphology overtly generally have two markers on the verb. The data summary from the languages discussed in Section 2 is repeated in (51), where Affix1 indicates a position closer to the verb.

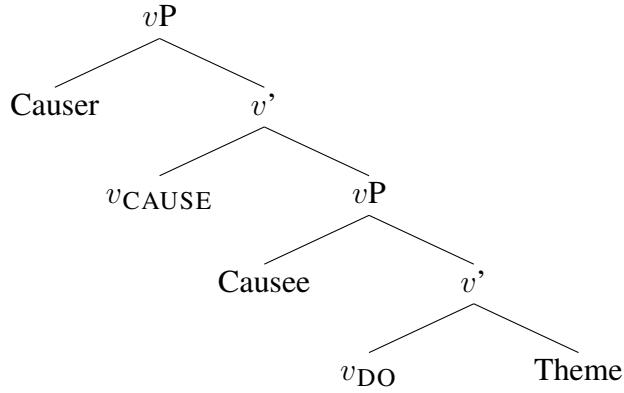
- (51) Causative morphology

	Affix1	Affix2
Halkomelem	Voice	CAUS
Tagalog	CAUS	Voice
Japanese	-S-	-S-
Kinande	INDIR.CAUS	DIR.CAUS

The Voice over Voice approach to morphological causatives presented in Section 3 predicts that (i) there are two positions eligible for overt realisation, and (ii) the ‘causative marker’ can be realised in either or both positions. (51) shows that this is a welcome result.

By contrast, theories that adopt a dedicated causative head *v<sub>CAUSE</sub>* make incorrect predictions for the morphology of causatives. Consider the simple CAUSE theory, in which flavours of *v* can introduce both an event and an external argument into the syntax (Harley 1995, Cuervo 2003, Folli and Harley 2005, a.o.). In this approach, *v<sub>CAUSE</sub>* introduces a causing event as well as the causer argument, as shown in the causative of transitive structure in (52). It is also assumed that overt causative morphology on the verb spells out *v<sub>CAUSE</sub>* rather than any other head. The only other head eligible for spell-out along the extended projection of the verb is *v<sub>DO</sub>*, which may be realised by overt voice morphology. *v<sub>CAUSE</sub>* always scopes higher than *v<sub>DO</sub>* in this approach.

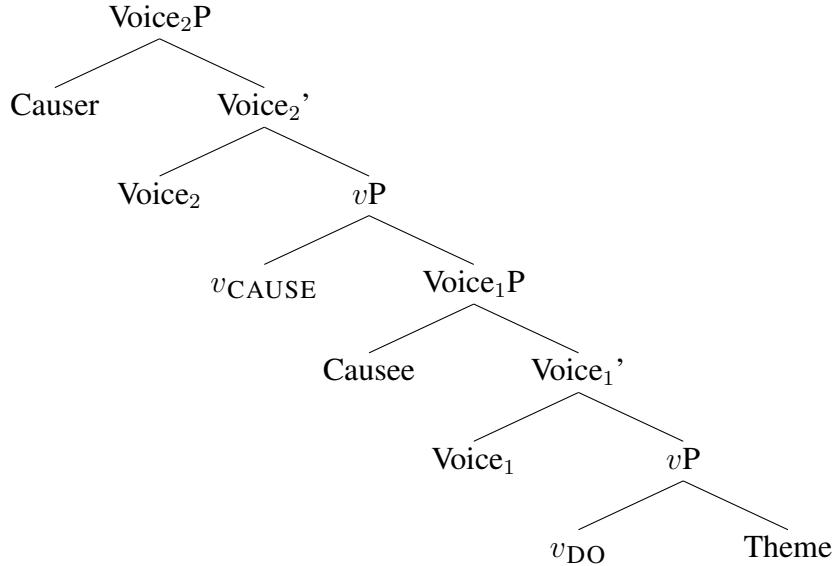
(52) CAUSE theory causative structure



The CAUSE theory therefore makes the following predictions: (i) morphological causatives are bi-morphemic, and (ii) causative morphology should be spelled out high relative to voice morphology and at most once on the verb. As (51) demonstrates, the second prediction is not borne out either in Tagalog, where the head that spells out voice morphology scopes over the head that spells out causative morphology, or in Japanese or Kinande, which have doubly-marked causatives.<sup>8</sup>

Some scholars have proposed a hybrid Voice+CAUSE theory of morphological causatives in which flavours of *v* introduce events in the syntax but Voice introduces external arguments (Rackowski 2002, Pylkkänen 2008, Tubino-Blanco 2010, Harley 2013). This is shown in the causative of transitive structure in (53) modelled after the proposal in Harley (2013), in which *vCAUSE* is merged above the *Voice<sub>2</sub>P* layer and below the *Voice<sub>1</sub>P* layer.

(53) Voice+CAUSE theory causative structure



<sup>8</sup>It is possible to conceive of an analysis within the CAUSE theory in which the two *v* heads in the causative are spelled out contextually, in parallel fashion to the proposal for Voice given in Section 3. In Tagalog, then, *vDO* would be spelled out as the causative marker *pa-* in the context of *vCAUSE*. While this approach could work out technically, given the lack of evidence that the two *v* heads introduce independent events into the syntax (Section 4.1), the *v* heads involved would essentially only be argument-introducers. However, this is precisely the function of Voice.

Notice that the structure in (53) has four heads along the extended projection of the verb that could in principle be spelled out overtly. A language with overt voice morphology and causative morphology might be therefore be expected to have causative forms like  $\text{Voice}_2\text{-}v\text{CAUSE}\text{-}\text{Voice}_1\text{-}v_{\text{DO}}\text{-Verb}$ , where two voice markers reflect the Voice heads of the inner and outer clause and two  $v$  markers reflect the event properties of the clause.

However, as Legate (2014) points out for Acehnese and as I have shown for all of the languages discussed in this paper, this prediction is not borne out. Causatives of antipassives in Halkomelem, for instance, mark the inner clause with an overt antipassive suffix but do not have an overt transitive  $-t$  suffix which reflects the transitivity of the outer clause; the hybrid theory would have to stipulate that the lower  $\text{Voice}_1$  is realised but the higher  $\text{Voice}_2$  is not. In Tagalog causatives, on the other hand,  $\text{Voice}_2$  would have to be overt while  $\text{Voice}_1$  is not. For Japanese and Halkomelem, it is unclear which heads would be responsible for their two overt markers. Thus there is no morphological evidence for a third or fourth position for spell-out, yet this is exactly what the hybrid Voice+CAUSE analysis predicts.

This section has demonstrated that CAUSE and hybrid Voice+CAUSE theories of morphological causatives make incorrect predictions for both the eventhood properties and the morphology of causatives. I conclude that there is no evidence for the presence of a dedicated causative head  $v\text{CAUSE}$  in morphological causatives. The properties of morphological causatives receive a natural account, on the other hand, under a Voice over Voice analysis in which either or both Voice heads can be spelled out by causative markers.

## 5. Conclusion

In this paper, I presented evidence from languages with overt voice and causative morphology that morphological causatives are bimorphemic. I argued that causatives also have a higher Voice head. The overall structure I propose for morphological causatives therefore involves a Voice head that selects for another Voice projection; the set of lexical Voice types that may be selected can vary from language to language. Languages also differ in whether the ‘causative marker’ spells out the higher Voice, lower Voice or both. There is no evidence from the morphology or from eventhood diagnostics that morphological causatives contain a verbal head  $v\text{CAUSE}$  that introduces an independent causing event into the syntax.

A consequence of my proposal is that there is no cross-linguistically identifiable dedicated ‘causative morpheme’ or head in the syntax. Rather, morphological causatives are in a sense epiphenomenal, the result of a Voice over Voice configuration that is assigned causative semantics. Languages may overtly realise one or both of these Voice heads with an invariant form, which may give the impression of ‘causative morphology’. This study of morphological causatives therefore supports a theory of morphology in which word-building takes place in the syntax and the resulting configurations are phonologically realised and semantically interpreted post-syntactically.

## References

- Aldridge, E. (2004). *Ergativity and word order in Austronesian languages*. Cornell: PhD dissertation.
- Aldridge, E. (2012). Antipassive and ergativity in Tagalog. *Lingua* 122: 192–203.
- Alexiadou, A., E. Anagnostopoulou & F. Schäfer. (2006). The properties of anticausatives crosslin-

- guistically. In *Phases of interpretation*, ed. M. Frascarelli, 187–212. Berlin: Mouton de Gruyter.
- Alexiadou, A., E. Anagnostopoulou & F. Schäfer. (2015). *External arguments in transitivity alternations: A layering approach*. Oxford: Oxford University Press.
- Baker, M.C. (1985). The mirror principle and morphosyntactic explanation. *Linguistic Inquiry* 16: 373–415.
- Bobaljik, J.D. (2000). The ins and outs of contextual allomorphy. In *University of Maryland Working Papers in Linguistics, Volume 10*, eds. K.K. Grohmann & C. Struijke, 35–71.
- Bjorkman, B. & E. Cowper. (2013). Inflectional shells and the syntax of causative have. *Proceedings of CLA 2013*.
- Cuervo, M.C. (2003). *Datives at large*. MIT: PhD dissertation.
- De Guzman, V.P. (1978). *The syntactic derivation of Tagalog verbs*. Honolulu, HI: University of Hawaii Press.
- Dell, F. (1983). An aspectual distinction in Tagalog. *Oceanic Linguistics*, 22/23: 175–206.
- Dowty, D. (1979). *Word meaning and Montague Grammar: The semantics of verbs and times in Generative Semantics and in Montague's PTQ*. Dordrecht: Reidel.
- Embick, D. (2010). *Localism versus globalism in morphology and phonology*. Cambridge, MA: MIT Press.
- Ernst, T. (1984). *Towards an integrated theory of adverb position in English*. Bloomington: Indiana University Linguistics Club.
- Fillmore, C. (1968). The case for Case. In *Universals in linguistic theory*, eds. E. Bach & R.T. Harms. New York: Holt, Rinehart & Winston.
- Folli, R. & H. Harley. (2005). Flavours of v: Consuming results in Italian & English. In *Aspectual Enquiries*, eds. P. Kempchinsky & R. Slabakova, 95–120. Dordrecht: Springer.
- Gerdts, D. (1980). Antipassives and causatives in Halkomelem. *Proceedings of BLS 6*, 300–314.
- Gerdts, D. (2004). Combinatory conditions on Halkomelem causatives. *Linguistics* 42: 767–789.
- Geuder, W. (2000). *Oriented Adverbs*. Universität Tübingen: PhD dissertation.
- Halle, M. & A. Marantz. (1993). Distributed Morphology and the pieces of inflection. In *The view from Building 20: Essays in Linguistics in Honor of Sylvain Bromberger*, eds. K. Hale & S.J. Keyser, 111–176. Cambridge, MA: MIT Press.
- Halpert, C. (2015). *Argument licensing and agreement*. Oxford: Oxford University Press.
- Harley, H. (1995). *Subjects, events, and licensing*. MIT: PhD dissertation.
- Harley, H. (2008). On the causative construction. In *The Oxford Handbook of Japanese Linguistics*, eds. S. Miyagawa & M. Saito, 20–53. Oxford: OUP.
- Harley, H. (2013). External arguments and the Mirror Principle: On the distinctness of Voice and v. *Lingua* 125: 34–57.
- Hyman, L. (1993). Conceptual issues in the comparative study of the Bantu verb stem. In *Topics in African Linguistics*, eds. S.S. Mufwene & L. Moshi, 3–34. Amsterdam: Benjamins.
- Hyman, L. (2003). Suffix ordering in Bantu: A morphocentric approach. *Yearbook of Morphology* 2002: 245–281.
- Jackendoff, R.S. (1972). *Semantic interpretation in Generative Grammar*. Cambridge, MA: MIT Press.
- Jacobsen, W. (1982). *Transitivity in the Japanese verbal system*. University of Chicago: PhD dissertation.
- Kastner, I. (2016). *Form and meaning in the Hebrew verb*. NYU: PhD dissertation.

- Kastner, I. (2017). Reflexive verbs in Hebrew: Deep unaccusativity meets lexical semantics. *Glossa: a journal of general linguistics* 2: 75.
- Key, G. (2013). *The morphosyntax of the Turkish causative construction*. University of Arizona: PhD dissertation.
- Kim, K. (2011). High applicatives in Korean causatives and passives. *Lingua* 121: 487–510.
- Kratzer, A. (1996). Severing the External Argument from its Verb. In *Phrase Structure and the Lexicon*, eds. J. Rooryck & L. Zaring, 109–137. Dordrecht: Kluwer.
- Legate, J.A. (2014). *Voice and v: Lessons from Acehnese*. Cambridge, MA: MIT Press.
- Levin, B. & M. Rappaport Hovav. (1994). A preliminary analysis of causative verbs in English. *Lingua* 92: 35–77.
- MacLachlan, A.E. (1996). *Aspects of ergativity in Tagalog*. McGill University: PhD dissertation.
- Marantz, A. (2013). Locality domains for contextual allomorphy across the interfaces. In *Distributed Morphology today: Morphemes for Morris Halle*, eds. A. Marantz & O. Matushansky, 95–115. Cambridge, MA: MIT Press.
- McCawley, J. (1986). The role of semantics in a grammar. In *Universals in linguistic theory*, eds. E. Bach & R.T. Harms, 125–170. New York: Holt, Rinehart & Winston.
- Miyagawa, S. (1998). (*S)ase as an elsewhere causative and the syntactic nature of words. *Journal of Japanese Linguistics* 16: 67–110.*
- Muysken, P. (1981). Quechua causatives and Logical Form: A case study in markedness. In *Theory of markedness in Generative Grammar: Proceedings of the 1979 GLOW Conference*, edited by A. Belletti, L. Brandi & L. Rizzi, 445–473. Pisa: Scuola normale superiore di Pisa.
- Myler, N. (2016). *Building and interpreting possession sentences*. Cambridge, MA: MIT Press.
- Nash, L. (1994). On the categorial specification of causative morphemes. In *Proceedings of NELS 24*, 411–425.
- Nash, L. (2017). Causees are not agents. *Linguistic Perspectives on Causation*, Hebrew University of Jerusalem.
- Nie, Y. (2017). Voice morphology and the features of transitivity. NYU: ms. lingbuzz/003750.
- Oseki, Y. (2017). Voice morphology in Japanese argument structures. NYU: ms. lingbuzz/003374.
- Parsons, T. (1990). *Events in the semantics of English: A study in subatomic semantics*. Cambridge, MA: MIT Press.
- Pylkkänen, L. (2008). *Introducing arguments*. Cambridge, MA: MIT Press.
- Rice, K. (2000). *Morpheme order and semantic scope: Word formation in the Athapaskan verb*. Cambridge: Cambridge University Press.
- Ritter, E. & S.T. Rosen. (1993). Deriving causation. *Natural Language and Linguistic Theory* 11: 519–555.
- Ritter, E. & S.T. Rosen. (1996). The function of *have*. *Lingua* 101: 295–321.
- Rackowski, A. (2002). *The structure of Tagalog: Specificity, Voice, and the distribution of arguments*. MIT: PhD dissertation.
- Schachter, P. & F.T. Otanes. (1972). *Tagalog Reference Grammar*. Berkeley and Los Angeles, CA: University of California Press.
- Schäfer, F. (2008). *The syntax of (anti-)causatives*. Amsterdam/Philadelphia: John Benjamins.
- Shibatani, M. (1976). Semantics of Japanese causativization. *Foundations of Language* 9: 327–373.
- Svenonius, P. (2005). What we think we know about inner and outer causatives. CASTL, 5 February 2005.

- Tubino-Blanco, M. (2010). *Contrasting causatives: A Minimalist approach*. University of Arizona: PhD dissertation.
- Von Stechow, A. (1996). The different readings of *wieder* ‘again’: A structural account. *Journal of Semantics* 13: 87–138.
- Wood, J. (2015). *Icelandic Morphosyntax and Argument Structure*. Dordrecht: Springer.
- Wood, J. & A. Marantz. (2017). The interpretation of external arguments. In *The verbal domain*, eds. R. D’Alessandro, I. Franco & À.J. Gallego, 255–278. Oxford: OUP.