Cumulative Conjunction and Exhaustification in Morphology: Clusivity, Typology, and Markedness in Person Paradigms

Uli Sauerland, ZAS
Jonathan David Bobaljik, Harvard

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Abstract

We review accounts of the generalization (Zwicky, 1977) that languages without an inclusive/exclusive contrast (almost) invariably treat the inclusive meaning as a first person rather than second. We focus on Harbour (2016), who proposes a system that describe all and only the attested categories without appeal to additional postulates such as a person hierarchy, but introduces several novel assumptions about the semantics of features. We suggest that the key innovation in Harbour's proposal is the use of cumulative (non-Boolean) conjunction in word-internal composition. We offer a more conservative alternative, showing that the main result can be derived with cumulative conjunction and exhaustification, while avoiding the other novel assumptions in Harbour's approach. Moreover, we contend that our approach is empirically superior regarding certain apparently mixed clusivity systems, notably Mandarin pronouns. More broadly, the result argues that cumulative conjunction and exhaustification are available in word-internal semantics just like in sentence semantics.

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1 Introduction

As cross-linguistic generalizations go, the following is especially robust (Zwicky, 1977; McGinnis, 2005; Harbour, 2016; Maldonado and Culbertson, 2020):

(1) The First person - Inclusive Generalization (FIG)
If a language does not mark clusivity contrasts morphologically, then the inclusive meaning (AUTHOR + ADDRESSEE) is expressed by the first person.

Accounts of person features since the 1970s have mostly fallen into one of two groups: One family of accounts takes the features AUTHOR and ADDRESSEE to be the atomic elements, and thus the *clusivity parameter* (i.e., whether a language does or does not mark clusivity) can be simply stated as whether a language does or does not allow conjunction of features. Such accounts, as Zwicky (1977) already noted, must be supplemented by an additional stipulated asymmetry between the features to ensure that AUTHOR takes precedence over ADDRESSEE when conjunction is not permitted. Another family of accounts posits PARTICIPANT and AUTHOR (but not ADDRESSEE) as the atomic elements. The second person on such accounts inherently picks out all participants, but comes to mean only the addressee since it competes

paradigmatically with a stronger alternative, namely AUTHOR. On these accounts, the asymmetry between first and second person that underlies (1) is not stipulated but instead characterized as a matter of logical strength (entailments). However, this approach cannot simply treat the inclusive as the conjunction of the two basic features, and requires something additional to describe languages with clusivity contrasts.

In a significant recent contribution, Harbour (2016) offers a novel account which derives the generalization in (1) and permits a characterization of clusivity, both from the same set of basic elements–a result that has eluded previous approaches. Harbour contends that achieving this result requires several novel assumptions not only about person, but about the semantics of features more generally (see also Ackema and Neeleman, 2018).

In this paper, we propose an alternative which takes from Harbour (2016) the assumption that non-Boolean conjunction (of features) is available in word-internal semantics, but dispenses with the remaining novel assumptions. After reviewing the empirical evidence (§2) and prior accounts (§3), we show (§4) that by combining non-Boolean conjunction with a version of presupposition maximization that uses a semantic exhaustification operator (Chierchia et al. 2012 and others) we can achieve the same overall result that Harbour does, but on a much more conservative semantic approach, in which person features contribute presuppositions on the value assigned to an index (Heim, 2008, e.g.,). In addition, we provide (§5) two types of empirically grounded argument in favour of our account over Harbour's.

2 Background: The clusivity problem

As noted above, it is an especially robust generalization that if a language does not signal *clusivity* in its morphology, i.e., distinguishing the combination of author (of speech act) and addressee (inclusive) from author without addressee (exclusive), then the meaning of the inclusive is subsumed by the first person rather than by the second (Zwicky, 1977; McGinnis, 2005; Harbour, 2016). Schematically, this can be expressed as in (2a). Taking the Speech Act participants to be the Author ([1]) and Addressee ([2]), there are four possible combinations, and thus maximally four possible grammatical persons, defined in terms of which participants are part of the referent of the person category. Harbour suggests the term *quadripartition* to designate the maximal division of the paradigm space. A *tripartition* is the division of the logical four-way contrast into a system of three grammatical categories. Among two logial tripartitions in which the inclusive is neutralized with one of its component elements, only one is widely attested:[1]

[1]Numbers indicate the frequency of each partition in the 200-language sample in Cysouw (2013). Two languages in that sample lack plural personal pronouns. Other surveys Bickel and Nichols (2005); Siewierska and Bakker (2005) find a broadly compara-

(2) a. quadripartition (n=68)

1, -2	1, 2	-1,2	-1, -2
EXCL	INCL	2	3

b. standard tripartition (n=130)

1, -2	1, 2	-1, 2	-1, -2
1		2	3

c. *syou-tripartition (n=0)

1, -2	1, 2	-1, 2	-1, -2
EXCL	***SYOU**		3

The contrast between Evenki (Tungusic; Nedjalkov, 1997, 200-201) and English plural pronouns in (3) illustrates the generalization. Evenki pronouns distinguish an inclusive (*mit*) from an exclusive (*bu)*, where English has a single pronoun *we*, used when the pronoun's referent is a group containing the author, whether or not the addressee is included.

(3)

referents included	(a) Evenki	(b) English	(c) *
AUTHOR (NOT ADDRESSEE)	bu	we	*swe
AUTHOR AND ADDRESSEE	mit	we	*syou
ADDRESSEE (NOT AUTHOR)	su	you	*syou
NEITHER OF THE ABOVE	nungartyn	they	they

Zwicky (1977) famously posed the question we started with, namely why languages that lack the clusivity distinction are systematically like English, rather than like the pattern in column (c) in (3), in which there is a single form, the hypothetical **syou*, used when the pronoun's referent is a group containing the addressee, whether or not the author is included.

Before we turn to the brief survey of accounts, an important qualification (noted by Zwicky, McGinnis, Harbour and others) is that the generalization in (1) holds over the system of contrastive person categories in a language as a whole, not over every individual paradigm. The Algonquian prefixes are the most well-known example of morphological paradigms with a *syou*-like element. Independent pronouns from Nishnaabemwin (Algonquian, Valentine, 2001, 122) illustrating this are given in (4) (verbal paradigms are similar):

(4) Nishnaabemwin Independent Pronouns (Long forms)

		SINGULAR	PLURAL
EXCL	[1,-2]	niin	niinwin
INCL	[1, 2]	–	giinwin
SECOND	[-1, 2]	giin	giinwaa
THIRD	[-1, -2]	wiin	wiinwaa

ble split: anywhere from a quarter to 40% of the world's languages mark clusivity.

If the initial components (corresponding to verbal prefixes) are considered in isolation, they instantiate the pattern excluded by the FIG: the initial portion *g-* has a *syou* distribution, characterizing all and only those forms that include the addressee, including the inclusive. But the suffix *-win* marks the plural of first person, whether inclusive or exclusive (like English *we*), and thus the system taken as a whole draws the four-way contrast of the qaudripartition. Daniel (2005) refers to such systems as 'hybrid' inclusives: Individual morphemes do not mark the clusivity contrast as they do in Evenki, but the combination of morphemes (in this case prefixes and suffixes) yields the quadripartition. Outside of such hybrid systems, **syou* distributions are vanishingly rare.[2] We therefore, with Zwicky, McGinnis, and Harbour, focus for the remainder of the discussion on (1) as it holds at the level of language-level contrasts, rather than individual, potentially syncretic, paradigms.

3 Approaching person

Two general approaches to grammatical person representing different perspectives on this puzzle have emerged in the literature, each leaving some part of Zwicky's puzzle unexplained. More recently, a solution is proposed in (Harbour, 2016) that in a way combines the insights of both previous approaches, but in doing so introduces new complications. Harbour's approach also, we suggest, leads to incorrect expectations about the patterning of 'mixed' systems, where the clusivity contrast is optional or not available in all contexts, for example, as in Mandarin. We demonstrate here that the core insight of Harbour's approach, as it pertains to the solution to Zwicky's problem, can in fact be emulated with more conventional semantic assumptions, and moreover that doing so appears to have empirical advantages in characterizing patterns like Mandarin. The two key theoretical ingredients that we argue are relevant to making our alternative work are: (i) allowing an exhaustivity operator (Chierchia et al. 2012 and others) to do the work of paradigmatic competition for which Harbour proposes a principle of *Lexical Complementarity*, and (ii) an appeal to non-Boolean conjunction (Link 1983; Schmitt 2013), which, we suggest, is implicit as well in both Harbour's and some previous approaches.

Let us begin by assuming an account of person features such as that of Heim (2008). For ease of exposition, we frame the discussion in terms of pro-

[2]The Yanomani language Sanuma appears to be the best, possibly only, example of a language that appears to have the **syou* partition across the board, though even that description is contested (see discussion in (Harbour, 2016, 238-239)). With McGinnis (2005); Harbour (2016), we assume that if there are such languages, they must be treated as a pattern of syncretism derived from an underlying quadripartition, in essence, a defective hybrid pattern, with their extreme rarity of occurrence plausibly attributable to the difficulty of learning them from the sparse evidence.

nouns, but the considerations carry over to bound person marking on verbs and possessed nouns. This perspective assumes that pronominals are indices and that person features contribute presuppositions on the value assigned to an index (see also Cooper 1979; Sauerland 2003). Recent work by Schlenker (2021) in other domains of semantics argues that presuppositionality is not a lexical property of morphemes, but predictable. We therefore propose that the basic meaning of ϕ-features is not inherently presuppositional as in prior work, but that a morpheme ∂ can 'presuppositionalize' properties, i.e. ∂P indicates that property P is presupposed.[3] For concreteness, we adopt an approach to presuppositions as domain restrictions. In the notation of Heim and Kratzer (1998), the presuppositionalizer morpheme ∂ would then be defined as follows – it maps P to a property that is only defined if P is satisfied, but is true whenever defined:

(5) $$[[\partial]]^c(P) = \lambda x \ : \ P(x) \ . \ 1$$

Heim's semantics of ϕ-features can then be captured by the following structure of a pronoun:[4]

(6)

In this structure, ϕ-FEATURES includes the person features (potentially also number, gender, etc.) interpreted as individual predicates and x is the referential index of the pronoun. Furthermore, it is assumed that when there are multiple person features of ∂, these are intersected by a Boolean operation, specifically predicate intersection—an assumption we come back to in the following.

As to the person features themselves, there are three that figure promi-

[3] Silent presuppositionalizing operators have been assumed in various semantic theories at least since (Beaver, 1992).

[4] Most of the morphological and typological literature is not explicit about the formal semantics of the features, in particular regarding whether person features should be characterized as presuppositions. We make an explicit assumption here for the purpose of commensurability among approaches.

nently in the literature:[5]

(7) $[[\text{AUTHOR}]]^c = \lambda x \,.\, \text{author}(c) \sqsubseteq x$

(8) $[[\text{ADDRESSEE}]]^c = \lambda x \,.\, \text{addressee}(c) \sqsubseteq x$

(9) $[[\text{PARTICIPANT}]]^c = \lambda x \,.\, \text{author}(c) \sqsubseteq x \vee \text{addressee}(c) \sqsubseteq x$

With this background, we may divide approaches to the formal analysis and typology of person features into two families. We sketch each briefly here (acknowledging in addition a hybrid) focusing on how each approach captures a part of Zwicky's problem, but must resort to an apparently ad hoc addition to capture the other part.

3.1 The classic account - Zwicky (1977)

The 'classic' account of Zwicky's puzzle, and in essence the one Zwicky advocated, uses the features AUTHOR and ADDRESSEE, or some notational variant thereof, as given in (10): Languages with an inclusive pronoun may be described by allowing conjunction of features as in (10a):[6]

(10)

	PERSON	SG	PL
a.	[+AUTHOR, +ADDRESSEE]	–	*mit*
b.	[+AUTHOR]	*bi*	*bu*
c.	[+ADDRESSEE]	*si*	*su*
d.	[ ]	*nungan*	*nungartyn*

The selection of a given item is regulated by a competition principle (the Elsewhere Principle) that selects the most specific element compatible with a given context. The inclusive is the most specific form, the third person the least specific.[7] The classic approach characterizes the quadripartition (clusivity), and also treats the inclusive as the most marked element (the only

[5] Defining features via the predicate "included in (the referent of the pronoun)" is motivated by the observation that first (and arguably second) person plurals universally have an associative plural semantics: the first person plural is a group that contains the author, not a plurality of authors (Lyons, 1968, 277, Moravcsik, 1978, 354, Bobaljik, 2008; Wechsler, 2010). Famously, no language is known to have a pronoun or other person marker specifically for a plurality of speakers (Cysouw, 2003, among many others).

[6] In some languages, this is transparent as in the widely-cited example of Tok Pisin inclusive *yumi*, composed of first (*mi*) and second (*yu*) person pronouns, from Foley 1986, 67, but this is rare, and in others, such as Evenki, the inclusive is not segmentable.

[7] Morphological analyses do not typically cast this in terms of presuppositions, but the core ingredients are analogous: individual forms (exponents) are associated with a set of features, which need not be maximally specified. A competition principle: Elsewhere/Paninian ordering for morphological approaches, Maximize Presupposition for semantic analyses, enforces the selection of the form associated with the most specific/narrowest/strongest set of features that is compatible with the given context. Some implementations of the classic account present the features as binary, but allowing reference to both positive and negative values of binary ±AUTHOR and ±ADDRESSEE potentially overgenerates in this domain. See Bobaljik 2008 and references therein for some discussion.

feature derived by conjunction of other features). This marked element is also the only element whose presence or absence in an inventory is a point of variation. In addition, this approach derives other universals (see Bobaljik, 2008 for a selected literature review), for example, the fact that no language draws a clusivity-like contrast in the second person (multiple addressees versus addressee and others) or more generally, the fact that no plural pronoun other than the third person includes non-speech-act-participants as part of its denotation (Noyer, 1997, Ch. 2). From the starting assumption that the only positively defined features are AUTHOR and ADDRESSEE, it follows that the only quadripartition that can be drawn is the one exemplified by Evenki, and drawing that distinction requires the "marked" option of allowing feature conjunction.

But this is where Zwicky's problem comes in. Since lines b. and c. in (10) are not ordered with respect to one another by specificity/strength of presupposition, some additional postulate is needed in order to ensure that in a language like English which lacks inclusive pronouns, the context [AUTHOR, ADDRESSEE] will neutralize to [AUTHOR] rather than to [ADDRESSEE]. Zwicky and others have proposed that a universal hierarchy of person (11) regulates the choice here:[8]

(11) The Person Hierarchy
+AUTHOR > +ADDRESSEE > OTHER

The tripartition is thus expressed as in (12), where it is the extrinsic ordering statement in (11) that ensures the ordering between a. and b. and which is thus crucially implicated in the account of the FIG:

(12)

	FEATURES	FORM
a.	[AUTHOR]	we
b.	[ADDRESSEE]	you
c.	[ ]	they

While this successfully describes the effects of the generalization, the account is open to the criticism that the person hierarchy is not a part of the feature system, but must be stated in addition, thus is not explanatory. This criticism is made poignant by the observation that the feature system does capture another aspect of the person hierarchy $1 > 2 > 3$, namely the unmarkedness of 3. To improve upon the classical account, we would want to derive also the derive the $1 > 2$ part of the person hierarchy from the feature system.

Before moving on, we note for completeness that some approaches in this classic family, notably Noyer (1997); Harley and Ritter (2002); McGinnis

[8] Zaslavsky et al. (2021) propose an information-theoretic account of (1) which encodes the hierarchy in (11) as a relative weighting 16:1:0.1 of the features AUTHOR:ADDRESSEE:OTHER.

(2005), make use of all three features in (7), not just two. The addition of a PARTICIPANT feature may be motivated by grammatical patterns that treat 1,2 separately from 3, e.g., plural marking or other morphological aspects that are shared among 1,2 person markers. But for present concerns, adding the third feature does not change anything: as long as AUTHOR and ADDRESSEE are both features in the inventory, Zwicky's problem remains and something in addition to the definition of the features and a Paninian competition principle must be brought to bear to explain why the inclusive context always neutralizes with first and (essentially) never with second person in a tripartition.

3.2 The other Participant

The problem for the classic account arises because AUTHOR and ADDRESSEE are both part of the inventory, and neither makes a stronger presupposition than the other, without an additional person hierarchy or equivalent assumption that effectively stipulates that author is privileged.

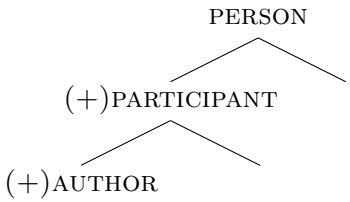
An alternative account (Sauerland, 2003; McGinnis, 2005; Sauerland, 2008; Singh, 2011) resolves this by starting instead from the assumption that the atomic features are AUTHOR and PARTICIPANT, but not ADDRESSEE:

(13) $$[[\textsc{author}]]^c = \lambda x \,.\, \text{author}(c) \sqsubseteq x$$

(14) $$[[\textsc{participant}]]^c = \lambda x \,.\, \text{author}(c) \sqsubseteq x \vee \text{addressee}(c) \sqsubseteq x$$

Note that while participant may be defined as "including author or including addressee", these are terms of the meta-language here. ADDRESSEE is not defined as a feature in this system, and the definition in (14) is not defined as a disjunction among features.[9] Since the author is a participant, there is an entailment relationship among the features, and the relationship may be diagrammed as follows: A first cut picks out participants in the speech act, and a second cut then singles out the author among the participants.

(15)



[9] One could represent it equivalently as follows:

(i) $[[\textsc{participant}]]^c = \lambda x \,.\, \text{participant-in-speech-act}(c) \sqsubseteq x$

However, this formulation does not reflect the logical entailment relations as perspicuously as (13) does.

The competition principle ensures that a tripartition will always group the inclusive with the first person, as desired:

(16)

	CONTEXT	FORM
a.	[AUTHOR]	we
b.	[PARTICIPANT]	you
c.	[ ]	they

Unlike the classic account, which requires an independent principle to order [1]>[2], on this account the ordering is determined by the relative strengths of the presuppositions: since the presupposition "includes author" is a proper subset of "includes a participant (author or addressee)", the morph with the narrower presupposition (16a) will always win out with first person referents. For the same reason, since the presupposition maximization principle blocks the use of the PARTICIPANT form with first person referents, that form is effectively limited to second person referents. And the third person is captured by an empty feature content of ∂ which as a null predicate intersection is interpreted as true of all entities. Again presupposition maximization applies to block the null feature set with first or second person referents.

But although this approach elegantly encodes the person hierarchy in the definition of features, and thereby accounts for Zwicky's puzzle without appeal to an independent hierarchy, this approach cannot straightforwardly derive the quadripartition. Recall that in the classic account, the inclusive is simply the conjunction of the two basic features. The clusivity parameter is expressible simply as whether a language does or does not admit conjunction of person features.

Precisely the entailment relation that determines the crucial markedness asymmetry renders conjunction of the two features redundant. Since AUTHOR entails PARTICIPANT, [AUTHOR $\wedge$ PARTICIPANT] is not meaningfully distinct from [AUTHOR] and in particular, does not draw an inclusive/exclusive distinction.

Adding the feature ADDRESSEE allows for the description of the quadripartition, but returns us to the classic account, and Zwicky's problem.[10] The alternative would thus seem to be to add a third primitive feature that is more specific than AUTHOR, i.e. either INCLUSIVE or EXCLUSIVE. We consider only INCLUSIVE with the semantics in (17) in detail since EXCLUSIVE would be analogous.Since INCLUSIVE is true only of referents including both

[10]For example, McGinnis (2005) simply stipulates that ADDRESSEE is only available in languages with an inclusive-exclusive opposition, characterizing the tripartion with just AUTHOR and PARTICIPANT. This is in all relevant respects the same solution as Zwicky's invocation of a person hierarchy, facing the same issue that the asymmetry between AUTHOR and ADDRESSEE is extrinsically stipulated and does not follow from the definition of the features and logical relations among them.

speaker and addressee, a feature system with three features ordered by logical entailment can then be given: [INCLUSIVE] > [AUTHOR] > [PARTICIPANT].

(17) $[[\text{INCLUSIVE}]]^c = \lambda x \,.\, \text{author}(c) \sqsubseteq x \wedge \text{addressee}(c) \sqsubseteq x$

But note that this definition refers to ADDRESSEE. Thus, either ADDRESSEE is available after all, or INCLUSIVE is not derived from the other atomic features, but is instead an ad hoc feature, defined solely for the sake of describing the attested variation and we are left with the question of why this feature is available (and parameterized) and not some other one.[11]

The goal, then, is two-fold: On the one hand to take from the AUTHOR-PARTICIPANT approach the idea that the asymmetry between first and second person is a matter of logical strength, thereby ensuring that a tripartition will always be the standard one and not the **syou* one; and on the other hand to take from the classic account the idea that the quadripartition arises from the same set of semantic primitives, but via an additional operation which languages may or may not admit.

Harbour (2016) in our view is an important benchmark, in that it proposes to achieve exactly this.[12] We turn to a brief presentation of that solution, then offer a more conservative alternative, and finally discuss an empirical consideration which, we suggest, leans in favour of our approach over Harbour's.

3.3 Harbour's Solution

Harbour (2016) proposes an account which seems to resolve this tension. His account is able to describe the quadripartition, yet at the same time it derives the asymmetry of [1]<[2] from the definition of the universal inventory of features (like the AUTHOR/PARTICIPANT account) and thus restricts available tripartitions to the standard one, excluding the **syou* tripartition without appeal to an additional hierarchy. He claims that his account requires an alternative conception of features, and in particular one that does not treat them as presuppositions (see also Ackema and Neeleman, 2018). We take issue with that claim here, and argue that Harrbour's main insight can be preserved under property-based approach to person features. We

[11] We argued above that the disjunctive statement of PARTICIPANT in the meta-language is compatible with postulating it as a primitive feature. For INCLUSIVE the meta-language contains a conjunction, but conjunction is also assumed to be available as a compositional operation in language; for example, in the interpretation of [AUTHOR, SINGULAR]. But it seems plausible to us that a general principle about possible primitive feature systems of a language should be that conjunction in the two cases should be either uniformly in the meta-language or in the language system. (see Sauerland & Alexiadou, ms. with 'decompose if you can' of Hirsch p.c.)

[12] A prominent other account is provided by Ackema and Neeleman (2013, 2018). We can only address that in the appendix.

claim in addition that our property-based implementation of his proposal avoids some problematic empirical predictions.

Harbour proposes that person features encode lattice-theoretic operations on an atomic lattice $\mathcal{L}$ with join operation $\sqcup$ that contains at least three atoms i, u, o, and the null element $\emptyset$. Of these atoms, i represents the author, u the addressee and o any third person referent. The join captures group formation Link (1983); for example $u \sqcup o = uo$ represents a group of the addressee and a third person.[13] While there can be further third person atoms, we can focus on the minimal case of the $\mathcal{L}$ with only three atoms for the following. Within the lattice $\mathcal{L}$, Harbour uses three semi-lattices for person distinctions, the general person semi-lattice $\mathcal{L}_\pi$, the author semi-lattice $\mathcal{L}_i$, and the participant semi-lattice $\mathcal{L}_{iu}$:

(18) $$\mathcal{L}_\pi = \{i, u, o, iu, io, uo, iuo\}$$

(19) $$\mathcal{L}_i = \{i\}$$

(20) $$\mathcal{L}_{iu} = \{i, u, iu\}$$

Harbour furthermore defines two binary operators, $\oplus$ and $\ominus$, that map two subsets of $\mathcal{L}$ to a third. $\oplus$ is defined via the pointwise application of the join operation. $\ominus$ is based on the lattice-theoretic analogue of set-subtraction. We use the function *atoms* that maps an element of $\mathcal{L}$ to the (possibly empty) set of atoms that are part of $\mathcal{L}$ to define it as in (22).[14]

(21) $$\mathcal{M} \oplus \mathcal{N} = \{m \sqcup n \mid m \in \mathcal{M} \wedge n \in \mathcal{N}\}$$

(22) $$\mathcal{M} \ominus \mathcal{N} = \{\sqcup(\text{atoms}(m) \setminus \text{atoms}(\sqcup(\mathcal{N}))) \mid m \in \mathcal{M}\}$$

Harbour proposes that person is universally captured via a selection of one or both of the features AUTHOR and PARTICIPANT and their order of application. For our purposes, only the two systems that make use of both AUTHOR and PARTICIPANT are of interest since only they result in three or more different cells. So, we focus below on the AUTHOR-before-PARTICIPANT and PARTICIPANT-before-AUTHOR system in that order.

Person marking of a morpheme in Harbour's proposal must then specify for each of the active features whether it applies positively $+$ or negatively $-$. The semantic effect of the specification is given by the following correspondence, where $\pm$ and $\odot$ represent one of $+/-$ and the corresponding operation of $\oplus/\ominus$ respectively and $\mathcal{L}(\text{F})$ is $\mathcal{L}_i$ for $\text{F} = \text{AUTHOR}$ and $\mathcal{L}_{iu}$ for $\text{F} = \text{PARTICIPANT}$.

(23) $$\pm\text{F}_1,\ \pm\text{F}_2 \quad \longleftrightarrow \quad [\mathcal{L}_\pi \odot \mathcal{L}(\text{F}_1)] \odot \mathcal{L}(\text{F}_2)$$

[13] Here and in the following, we adopt Harbour's practice to omit the join $\sqcup$ when it applies between atoms of $\mathcal{L}$. We also apply $\sqcup$ as a unary operator that maps a subset of $\mathcal{L}$ to the join of all its elements.

[14] We introduce $\ominus$ here only for the special case that the second set has a maximal element since only that case plays a role in the account (Harbour, 2016, p. 75).

The right side of (23) denotes for each feature specification a subset of $\mathcal{L}$. Only elements of this set are possible referents of a pronoun with that feature specification.

The AUTHOR-before-PARTICIPANT order derives the standard tripartion as follows:

(24) Harbour's (2016) account of the standard tripartion:

a. +AUTHOR, +PARTICIPANT: $[\mathcal{L}_\pi \oplus \mathcal{L}_i] \oplus \mathcal{L}_{iu} = \{i, iu, io, iuo\}$

b. −AUTHOR, +PARTICIPANT: $[\mathcal{L}_\pi \ominus \mathcal{L}_i] \oplus \mathcal{L}_{iu} = \{i, u, iu, io, uo, iuo\}$
$\overset{a.}{\rightsquigarrow} \{u, uo\}$ (via lexical complementarity with a., see below)

c. +AUTHOR, −PARTICIPANT: $[\mathcal{L}_\pi \oplus \mathcal{L}_i] \ominus \mathcal{L}_{iu} = \{o, \emptyset\}$

d. −AUTHOR, −PARTICIPANT: $[\mathcal{L}_\pi \ominus \mathcal{L}_i] \ominus \mathcal{L}_{iu} = \{o, \emptyset\}$

The first person comes out straightforwardly in (24a). But the second and third person require further discussion. The result of (24b) is a superset of (24a). To derive the second person, Harbour postulates the *Lexical Complementarity Principle*: If one feature combination derives a proper superset of possible referents of another feature combination, the former is restricted to those possible referents unique to it. Lexical Complementarity thus plays a role similar to Maximize Presupposition or Elsewhere ordering on other approaches. In (16), the English pronoun *you* as a PARTICIPANT pronoun is in principle compatible with any combination of participant arguments, but its restriction to second person arises because it is in paradigmatic competition with a more specific element for the expression of first person. The application of Lexical Complementarity in (24b) is entirely analogous.[15] For third person, however, Harbour (2016) makes a surprising prediction: namely, Harbour predicts third person to be ambiguous since it can be described by the two feature combinations (24c) and (24d).

If PARTICIPANT applies before AUTHOR, the quadripartition is derived:

(25) a. +PARTICIPANT, +AUTHOR: $\mathcal{L}_\pi \oplus \mathcal{L}_{iu} \oplus \mathcal{L}_i = \{i, iu, io, iou\}$
$\overset{b.}{\rightsquigarrow} \{iu, iou\}$

b. −PARTICIPANT, +AUTHOR: $\mathcal{L}_\pi \ominus \mathcal{L}_{iu} \oplus \mathcal{L}_i = \{i, io\}$

c. +PARTICIPANT, −AUTHOR: $\mathcal{L}_\pi \oplus \mathcal{L}_{iu} \ominus \mathcal{L}_i = \{u, uo, o, \emptyset\}$
$\overset{d.}{\rightsquigarrow} \{u, uo\}$

d. −PARTICIPANT, −AUTHOR: $\mathcal{L}_\pi \ominus \mathcal{L}_{iu} \ominus \mathcal{L}_i = \{o, \emptyset\}$

The first person exclusive is derived directly in (25b). But the first person inclusive in (25a) is derived via the application of lexical complementarity

[15] In (24b), (25a), and (25c), we indicate the application of Lexical Complementarity with the arrow $\rightsquigarrow$ and the relevant subset feature combination by letter above the arrow.

with the exclusive. Therefore, the exclusive is predicted to be the more marked form on Harbour's analysis; a point we come back to in the following. Furthermore the second person in (25c) is unmarked relative to the third person (25d), and also relies on lexical complementarity.[16]

Harbour's account represents a significant accomplishment in our view: Harbour shows that a non-stipulative account of Zwicky's **syou* problem is possible, without appeal to an independent hierarchy. At the same time, Harbour's account also gives rise to new questions. We mentioned above especially the surprising markedness predictions of the account. In the following, we focus on two related questions: 1) Is there a specific assumption within Harbour's account that is directly responsible for its success? And 2) what general conclusions for linguistic theory can we draw from Harbour's account? The first question arises since Harbour's innovation is not confined to a single component of earlier theories, but packages several innovations into one account. The second question is related to the first, because we cannot judge where changes to standard theory are necessitated by Harbour's arguments without understanding the role of the contents of his package. However, it would be tedious to unbundle Harbour's package in detail. Instead our approach in the following is therefore to present an alternative to Harbour's account that employs standard theory as much as possible, but adopts one of Harbour's innovations – the idea that morphological features can combine by the non-boolean operation $\oplus$. We show that assumption alone is sufficient to emulate Harbour's core accomplishment. After we have demonstrated that, we then proceed to a more detailed empirical comparison of the two analyses, especially with respect to markedness, which support our account.[17]

4 Our Alternative Account

Our proposal for the semantic typology of person is actually very conservative and deliberately so. We adopt the structure of the semantic analysis in (6) and also the two features AUTHOR and PARTICIPANT from (7). Two other assumptions we adopt are novel to this particular area of grammar, but quite well established in other areas. First, we adopt a version of presupposition maximization that uses a semantic exhaustification operator within the grammatical theory of implicature (Chierchia et al. 2012 and others). As we will see, exhaustification allows us to have a unified account of Harbour's two concepts of negative features and lexical complementarity. Secondly (and more controversially), we adopt non-Boolean predicate conjunction.

[16] Note that the unmarkedness of second person that Harbour predicts differs from the markedness pattern usually assumed (Benveniste, 1966; Sauerland, 2008) and also differs from Harbour's analysis of second person in the tripartition (24b).

[17] We postpone comments on the proposal in Ackema and Neeleman 2013, 2018 to an appendix, as it is less directly commensurate to the other accounts considered here.

Specically, the interpretation of English *and* that Schmitt (2013) argues for corresponds closely to Harbour's $\oplus$-operator in (21) as we discuss in (28) below. We implement these two ideas in the account of person in detail in the following paragraphs.

For exhaustification, we adopt the proposal of Mayr (2015) for the predicate-level exhaustification operator **exh** in (26).[18] Exhaustification applied to a predicate P creates a new predicate with stronger truth conditions than the original predicate P depending on the alternative predicates in the set Alt. Namely the exhaustified predicate $\mathbf{exh}_{\text{Alt}}\ P$ is true only if P is true and all predicates Q in Alt are false (i.e. Q is excluded) with the exception of predicates Q that are fully entailed by P.[19]

(26) $$[[\mathbf{exh}_{\text{Alt}}]]^w = \lambda P \in D_{et}\ \lambda x \in D_e\ .\ P(x)(w) \wedge \forall Q \in \text{Alt}\ .\ \neg Q(x)(w) \vee (\forall x\ (P(x) \rightarrow Q(x)))$$

The **exh** operator in (26) does not make reference to presupposition directly, but this is sufficient for our purposes since **exh** contributes to the assertive meaning in the scope of the presuppositionalizer ∂ from (5). Application of **exh** with a single, strictly stronger alternative has the same effect as earlier pragmatic principles including Harbour's (2016) Lexical Complementarity. For example, the account of second person is similar to those in (16) and (24b):

(27) $$\mathbf{exh}_{\{\text{AUTHOR,PARTICIPANT}\}}(\text{PARTICIPANT})(x) = \begin{cases} 1 & \text{if } x \in \{u, uo\} \\ 0 & \text{otherwise} \end{cases}$$

How is the set of alternatives of **exh** determined? We follow Katzir (2007) and subsequent work that the alternatives are determined from the sister constituent of **exh** by replacement or deletion operations. The alternatives always include the sister P of **exh**—PARTICIPANT in (27)—, which never directly lead to any exclusion because P always entails itself, but their presence can have an effect in cases of recursive application of **exh**. In the following, we only show elements of the set of alternatives that are actually excluded.

Comparing exhaustification with the classical and the PARTICIPANT-based account we introduced in section 3, observe that it is fully aligned with the PARTICIPANT-based account: The result of (27) is strictly stronger

[18] Mayr uses the notations **exh** for proposition-level and **exh2** for predicate-level exhaustification. In our discussion, only property-level exhaustification plays a role. Furthermore, the proposal could be restated using only proposition level exhaustification, for example in the type-inflexible semantics that Hirsch (2017) argues for.

[19] More recent work on exhaustification has argued that it can also include certain alternatives (Bar-Lev and Fox, 2020) and presuppose at least exclusion Bassi et al. (2021). As far as we can see, our proposal can be easily adjusted to these developments, but do not do so here for presentational reasons.

than the feature ADDRESSEE because ADDRESSEE is true of the inclusive referent *iu* and *iuo* while (27) is false. But the result of exhaustification in (27) is the same as that for PARTICIPANT after blocking by AUTHOR in (16). But as we show in the following, that **exh** captures blocking in the grammar is crucial for our account. With Magri (2009), Meyer (2015), and others, we furthermore assume that application of **exh** is obligatory when it can exclude a strictly stronger alternative as in the above case. We return to further applications of **exh** below, but first turn to the second piece of our proposal, non-Boolean conjunction.

Recall from above that individuals can be formally understood as a lattice, where atoms are singular objects and the join operation $\sqcup$ corresponds to forming a group $a \sqcup b$ out of two distinct objects a and b (Link 1983 and others). Recent work by Haslinger and Schmitt (2018) and Schmitt (2013, 2019) argues that non-Boolean conjunction is generally available as the meaning of the coordinator *and* across different categories. In particular (Schmitt, 2019, p. 12) proposes a $\sqcup$-operator that predicts (28) for P and Q of type $\langle e, t\rangle$:[20]

(28) $$P \sqcup Q = \lambda x\ \exists y, z \in D_e[y \sqcup z = x \wedge P(y) \wedge Q(z)]$$

The work cited above concerns conjunction in sentential semantics, not morphological processes. They argue that English conjunction *and* cannot be interpreted as Boolean conjunction, but must be interpreted as $\sqcup$. Consider briefly the account of (29), Schmitt (2019) argues for. She observes that (29) is entailed by the truth of the two sentences *Abe danced* and *Bert smoked*, and proposes to capture this from the application of $\sqcup$ twice: Once form a plural entity **abe⊔bert** as the subject denotation, and a second time to form a predicate **danced⊔smoked**. Since (28) determines the interpretation of the predicate conjunction, (29) is correctly predicted to be true if *Abe danced* and *Bert smoked*.

(29) Abe and Bert danced and smoked. (Schmitt, 2019, p. 32)

In Schmitt's account pluralities of meanings are combined compositionally by a general cumulative composition. Generally, composition of two pluralities A and B results in the plurality of meanings derived by combining parts of A with parts of B for any way of dividing up A and B into parts and lining up the parts with one another. The interpretation Schmitt provides for (29) is as in (30), where d and s are the lexical predicates *danced* and

[20] As we introduced above, Harbour (2016) uses $\sqcup$ for the join operation of type e, while he defines $\oplus$ for sets as in (21). It is easy to see though that Harbour's $\oplus$ could be subsumed under (28) by viewing sets as their characteristic functions – i.e. the property of being a member of a set.

smoked and a and b the individuals *Abe* and *Bert* respectively:

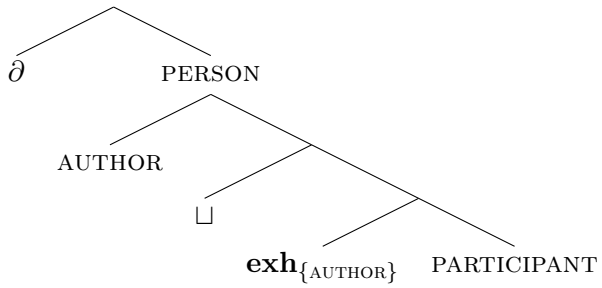
(30) $[d \sqcup s]\ (a \oplus b) = \{d(a) \oplus s(b), d(b) \oplus s(a), d(a) \oplus d(b) \oplus s(b), \ldots, d(a) \oplus d(b) \oplus s(a) \oplus s(b)\}$

The truth-conditions of (30) are given by the condition there must be at least one element of (30) such that all elementary propositions that are part of that element are true. This accounts for the observation that (29) is judged true, for example, if Abe danced and Bert smoked, but also if Abe smoked and Bert danced.

4.1 Deriving the Typology

The central idea of our proposal is that exhaustification and non-Boolean conjunction predict a different interpretation for the feature combination [AUTHOR,PARTICIPANT] from other frameworks. The predicted interpretation derives from the following structural representation:

(31)



In (31), **exh** applies to PARTICIPANT, which is interpreted as second person as we assume in (27).[21] We then assume furthermore that non-Boolean conjunction combines the meanings of AUTHOR and **exh**(PARTICIPANT). Since AUTHOR is true of i, iu and iuo and **exh** PARTICIPANT of u and uo, the non-Boolean conjunction results in the property true of only iu and iuo.

(32) $[\text{AUTHOR} \sqcup \textbf{exh}_{\{\text{AUTHOR}\}}(\text{PARTICIPANT})(x) = \begin{cases} 1 & \text{if } x \in \{iu, iuo\} \\ 0 & \text{otherwise} \end{cases}$

The result as shown in (32) is the meaning of the inclusive as in (17). But on our proposal, the inclusive does not need to be stipulated as an additional primitive – it is arises as the interpretation of [AUTHOR,PARTICIPANT]. Note that applying Boolean conjunction in (32) would result in a contradiction.[22]

[21] If **exh** was to apply to AUTHOR too, the application would be vacuous. Hence we don't represent **exh** for AUTHOR in (31).

[22] Schmitt (2013, 97–102) presents arguments that Boolean conjunction may never be available as the interpretation of conjunction in sentential semantics, i.e. *and* in English or *und* in German. A Boolean interpretation in (32) results in a contradictory predicate,

The account of the inclusive as [AUTHOR, PARTICIPANT] is the basis of our typological proposal. We assume that languages morphologically vary as to whether the PERSON-position is restricted to a single feature or allows multiple features. Furthermore we assume that at most the two person features AUTHOR and PARTICIPANT are available, and that **exh** and non-Boolean conjunction must apply in the person system.

The standard tripartition results straightforwardly if only a single feature is allowed:

(33) a. first person: $\mathbf{exh}_{\{\}}$ (AUTHOR)
b. second person: $\mathbf{exh}_{\{\text{AUTHOR}\}}$ (PARTICIPANT)
c. third person: $\mathbf{exh}_{\{\text{AUTHOR},\text{PARTICIPANT}\}}$ (NULL)

The procedure of Katzir (2007) predicts that the alternative set for all three cases of **exh** in (33) is {AUTHOR, PARTICIPANT, NULL}, but recall that we show only the excluded alternatives. Because all alternatives are entailed by AUTHOR, none are shown for the first person. The interpretation of third person follows analogously to that of second person shown in (27).

The quadripartition, we propose, results if more than one person feature can occur under PERSON, i.e. in a language where the feature conjunction AUTHOR and PARTICIPANT is possible. This feature conjunction makes the account of the inclusive in (32) available. To derive the exclusive in this system, we assume that the inclusive also becomes available as an alternative for exhaustification whenever it is morphologically possible. Specifically, we assume that, if **exh** applies to the PERSON-node and the language has a clusivity distinction (i.e. allows multiple features under PERSON), [AUTHOR, PARTICIPANT] is an alternative to [AUTHOR].[23] Then the exclusive meaning is captured by exhaustification of AUTHOR:

(34) $$\mathbf{exh}_{\{\text{AUTHOR}\sqcup\mathbf{exh}_{\{\text{AUTHOR}\}}(\text{PARTICIPANT})\}}(\text{AUTHOR})(x) = \begin{cases} 1 & \text{if } x \in \{i, io\} \\ 0 & \text{otherwise} \end{cases}$$

and may therefore not be available. But in the account of the exclusive in (34), we exclude the inclusive. This would not result in the exclusive interpretation if Boolean conjunction could apply in the inclusive. This suggests that a Boolean interpretation is also impossible for morphological conjunction and thereby corroborates Schmitt's conclusion.

[23] Buccola et al. (2021) propose that in specific circumstances also primitive concepts that cannot be pronounced in a language-specific way may be available as alternatives for **exh**. But we assume that the inclusive cannot be available as an alternative to AUTHOR in languages with a tripartition. The conflict between the two proposals is only apparent, however, because Buccola et al. address cases where the alternative is a primitive, while the inclusive is a structurally complex meaning. One implementation directly sensitive to this difference would to represent the exclusive as **exh** [AUTHOR, **exh** AUTHOR] or **exh** [AUTHOR, **exh** NULL]. Then the inclusive is a structural alternative for the outer **exh** in the sense of Katzir (2007). In sum, Buccola et al.'s (2021) proposal makes interesting, novel predictions when combined with our approach to person marking that we hope future work will explore.

The account of the second and third person in a quadripartition can be as in our proposal (33) for a tripartition.[24]

To conclude this subsection, compare our use of non-Boolean conjunction with that of Harbour (2016). We think our account demonstrates that non-Boolean conjunction is crucial to account for the **syou*-gap and thereby must be the crucial innovation of Harbour. But, the role it plays in the two accounts is different. We show this by considering whether our analysis of the inclusive as conjunction of AUTHOR and PARTICIPANT could be restated with Harbour's lattice theoretic operations. The closest we could come though is adding the set $\{u\}$ to algebraic primitives of Harbour's system to derive the desired set in (35).[25] But as far as we could tell it is impossible to derive $\{u\}$ with the primitives Harbour proposes, and especially the result in (36) contains the empty set in addition to u and which wouldn't lead to the same result as the singleton $\{u\}$ in (35).

(35) $$\mathcal{L}_\pi \oplus \mathcal{L}_i \oplus \{u\} = \{iu, iuo\}$$

(36) $$(\mathcal{L}_{iu} \ominus \mathcal{L}_i) \ominus (\mathcal{L}_\pi \ominus \mathcal{L}_{iu}) = \{u, \emptyset\}$$

In sum, our account of person is substantively different from that of Harbour (2016). On our account the inclusive is the most marked form, and the exclusive is derived from first person as the elsewhere case. Harbour's account as summarized in (25a) above assumes the reverse markedness relation, and as the preceding discussion shows, the markedness relation we assume couldn't be described with only the primitives of Harbour's account. In the following section, we explore this difference in empirical predictions, and argue that our analysis is corroborated by the data.

5 Optional Clusivity

Informally, the reason our proposal, like Harbour's, succeeds in taking the best of the classic account and the participant account lies in the way exhaustification gives certain morphemes both plain and derived (exhaustified) meanings. We start with two core features defined above. Since AUTHOR entails PARTICIPANT, the hierarchy is part of the definition of the features.

(37) $$[[\text{AUTHOR}]]^c = \lambda x \ : \ \text{author}(c) \sqsubseteq x$$

(38) $$[[\text{PARTICIPANT}]]^c = \lambda x \ . \ \text{author}(c) \sqsubseteq x \vee \text{addressee}(c) \sqsubseteq x$$

[24] There is a small technical difference. Namely, while only AUTHOR and PARTICIPANT occur in (33) as elements of the alternative set, also the complex [AUTHOR, PARTICIPANT] is an alternative in the quadripartition. But the semantic result is the same because of the entailment relations from [AUTHOR, PARTICIPANT] to [AUTHOR] and further to [PARTICIPANT].

[25] Note that adding $\{u\}$ would make the **syou*-partition easily available because $\mathcal{L}_\pi \oplus \{u\} = \{u, iu, uo, iuo\}$ describes the **syou*-cell.

Presupposition maximization thus ensures that where there is no dedicated inclusive morph available, the inclusive will pattern with the first person. To this point, the account is effectively the same as the participant account discussed in (16) and repeated here:

(39)

	CONTEXT	FORM
a.	[AUTHOR]	we
b.	[PARTICIPANT]	you
c.	[ ]	they

Where exhaustification makes a difference is in extending the account to the quadripartition. Recall that the problem faced by the original participant account is that it had no straightforward means to describe a system with clusivity: The combination [+AUTHOR,+PARTICIPANT], without exhaustification, is the same as [+AUTHOR] on its own: [a group that includes the author and that includes the author or the addressee] is the same as [a group that includes the author]. Both characterizations will pick out the same group (namely the group denoted by English *I/we*). But after the application of exhaustification, **exh**(PARTICIPANT) no longer means "includes the author or the addressee"—exhaustification removes the author from the disjunction, and $\mathbf{exh}_{\{\text{AUTHOR}\}}$(PARTICIPANT) effectively comes to mean (just) "includes the addressee." It is because of exhaustification, as shown above, that (32) and (34) have different meanings, namely inclusive and exclusive, respectively. In this way, we can have our cake and eat it too: because $\mathbf{exh}_{\{\text{AUTHOR}\}}$(PARTICIPANT) "means" ADDRESSEE, we get the correct quadripartion, but $\mathbf{exh}_{\{\text{AUTHOR}\}}$(PARTICIPANT) only effectively means ADDRESSEE because AUTHOR is a stronger meaning than (non-exhaustified) PARTICIPANT, and so the inherent (markedness) asymmetry among the tripartitions arises.

Like Harbour's account, our proposal derives the asymmetry between first and second person, central to Zwicky's problem, from the definition of the features, eschewing the need for an independent hierarchy. And like Harbour's, our account derives the quadripartition and the standard tripartion from the same two atomic features (without positing an ad hoc third feature), but excludes the **syou*-tripartition.

But we part ways with Harbour in two respects: first, our approach is compatible with a conventional semantics for person features that treats them as presuppositions, and second, our approach retains from the classic (Zwickian) approach a formal identity between the general first person in a standard tripartion and the first person exclusive in a quadripartition language. In both instances, the inherent semantics of such an element is simply AUTHOR. The difference is that in the quadripartition, the existence of a stronger alternative, the inclusive, triggers exhaustification, leaving the first person with only the exclusive meaning. Harbour's account, as noted

above, gives very different semantics to the various persons in the two systems, and if anything, treats the inclusive as underlyingly the more general form in the quadripartition, being restricted to the inclusive via Lexical Complementarity: Prior to the effects of Lexical Complementarity, it is the inclusive (25a), rather than the exclusive, that has the same set of referents as the general first person of a tripartition language like English (24a). The table below summarizes the differences.

(40) Comparison of featural specification of tri- and quadripartition

	Harbour (2016)		present analysis	
	tripartition	quadripartition	tripartition	quadripartition
exclusive	+A, +P	−P, +A	A	A
inclusive	+A, +P	+P, +A	A	A, P
second	−A, +P	+P, −A	P	P
third	± A, −P	−P, −A	–	–

We believe our approach has an empirical advantage on this point, to which we now turn.

5.1 Optional Clusivity

We submit that the two approaches make different predictions where clusivity varies within one and the same language, for example, where the inclusive form is described as optional, or syntactically restricted, as in Mandarin.

There are two ways that the Mandarin pronoun inventory is presented in descriptions, given in (41). Some descriptions (e.g., Ross and Ma, 2006) present it has having an inclusive-exclusive distinction, while others (such as Li and Thompson, 1981) present it as having the standard tripartition, like English:

(41) Mandarin pronouns

		plural	
	singular	quadripartition	tripartition
inclusive		*zánmen*	
exclusive/first	*wǒ*	*wǒmen*	*wǒmen*
second	*nǐ*	*nǐmen*	*nǐmen*
third	*tā*	*tāmen*	*tāmen*

To some extent, this evidently represents dialect variation. Ross and Ma (2006, 25) note that the inclusive pronoun *zánmen* is used in Northern dialects. But even within those dialects the pattern is not a straightforward quadripartition. As Ross and Ma describe it, *zánmen* receives only an inclusive interpretation, and moreover is used only as a subject, never as an

object. When standing in contrast to *zánmen*, *wǒmen* has an exclusive interpretation. But otherwise, *wǒmen* is ambiguous or vague, like English *we*, between an inclusive and exclusive sense.

This distribution of *wǒmen* is exactly as predicted under (our modification of) the classic account of person. A first person pronoun like *we* or *wǒmen* is inherently associated only with the feature AUTHOR. If that pronoun has a paradigmatic competitor with the stronger presupposition AUTHOR ⊔ ADDRESSEE,[26] then exhaustification strengthens the presupposition to the exclusive meaning. When there is no competitor, it is the regular first person. This expresses the oft-reported view that the exclusive in a system with clusivity is fundamentally the same as the general first person in the tripartite system. We note in addition that Mandarin morphology makes this relationship transparent: the exclusive (not the inclusive) is transparently the plural of the first person, just as it is in Evenki.[27]

In contrast to our proposal, the analysis of Harbour (2016) cannot directly account for the varying interpretation of *wǒmen* with a single lexical entry, as far as we can see. In Harbour's account, it is the inclusive, not the exclusive, that has the same features as the first person in a tripartition. Moreover, the difference between the two systems cannot be characterized as the availability of a particular lexical item in a particular context, since in addition to the featural differences, the order of semantic composition of the features AUTHOR and PARTICIPANT needs to be reversed (and for that matter, the features of the third person pronoun could in principle differ depending on whether the pronoun is embedded in a quadripartition or a tripartition). While it is not inconceivable that speakers may have multiple mental grammars (internally bi-dialectal), we suggest that this view is particularly ill-suited to the subject versus non-subject contrast in Mandarin. Mandarin, as is well-known, has no formal morphological marking of grammatical function, notably no case or agreement. Yet Harbour's account forces such a distinction: for speakers who use *zánmen*, the form *wǒmen* must have different lexical entries (different features) for subject and object positions, and in addition, the order of composition of features must differ

[26] More precisely: AUTHOR ⊔ $\mathbf{exh}_{\{\text{AUTHOR}\}}$PARTICIPANT

[27] This is not atypical: Bickel and Nichols (2005) found this to be the case in 45% (52/116) of the languages with clusivity contrasts that they surveyed, while in the remainder, neither inclusive nor exclusive is morphologically derived from the first person singular. Using different criteria, Moskal (2018) found a largely convergent result in her survey of 233 languages. Moskal suggested that this is also a potential problem for Harbour's approach, in particular, that Harbour's approach might treat the inclusive rather than the exclusive as sharing more features with the singular. Harbour is explicit about the representation of the singular forms in languages that have a quadripartition only in the non-singular (or more accurately: non-atomic) numbers, but the brief comment on p.138 along with his Figure 6.12, p.140 suggests that he does take the first person singular in a language with a clusivity contrast to have the feature structure of the exclusive, and not the underspecified representation that would allow Moskal's criticism to go through.

between subject and object position for all of the personal pronouns. Our account (and the classic one) requires no such differences: the lexical meaning of *wǒmen* is consistent across all of its uses, the apparent difference in exclusivity is paradigmatic, in essentially the sense known since Saussure first drew this distinction between 'signified' and 'value' (de Saussure, 1959, Part 2, Ch IV). Formally, we encode that through the general applicability of exhaustification.

We note that Harbour does give somewhat cursory mention of Mandarin *zánmen*, but as far as we can tell, his characterization does not match to the theory he proposes. In the discussion of the intersection of number and person, Harbour first presents the tripartite version of Mandarin (without *zánmen*). For the three singular-plural pronoun pairs, including *wǒ*∼*wǒ-men*, he relates the plurals to the singulars with the feature [±ATOMIC]. Thus, he provides the lexical entries in (42) which differ only in number (p.134):

(42) $wǒ = +\text{ATOMIC}(+\text{PARTICIPANT}(+\text{AUTHOR}(\pi)))$

(43) $wǒ\text{-}men = -\text{ATOMIC}(+\text{PARTICIPANT}(+\text{AUTHOR}(\pi)))$

Turning to the discussion of number in quadripartitions, he states that "northern Mandarin …simply has inclusive *zánmen* alongside the pronouns described in the previous section" (p.138). But while this is a correct description of the facts (modulo the important issues of optionality and the subject restriction), and an accurate characterization of the classic approach (and ours), we don't see that this can be correct internal to Harbour's theory. In addition to the hypothesis that the component person features compose in the opposite order in a quadripartion versus in a tripartition, the key to his proposal for a quadripartition is that it is the **inclusive** pronoun, not the exclusive, that has the features [+PARTICIPANT] and [+AUTHOR] (see (25a). The inclusive only comes to be restricted to the inclusive via competition (Lexical Complementarity) with the more narrow exclusive alternative [−PARTICIPANT[+AUTHOR[π]], which is not the meaning that Harbour gives to *wǒ-men* in (42). Even if two pronouns in the same paradigm could (in Harbour's theory) compose in different orders, adding *zánmen* to the inventory in (42) gives (46), in which the two pronouns have identical meanings: lexical complementarity is thus not triggered, and there is no inclusive/exclusive contrast.

(46) a. +PARTICIPANT, +AUTHOR: $\mathcal{L}_\pi \oplus \mathcal{L}_{iu} \oplus \mathcal{L}_i = \{i, iu, io, iou\}$

b. +AUTHOR,+PARTICIPANT: $\mathcal{L}_\pi \oplus \mathcal{L}_{iu} \oplus \mathcal{L}_i = \{i, iu, io, iou\}$

5.2 Agreement

Another difference between Harbour's approach and ours is that only our approach is compatible with a treatment of agreement as feature copying or feature matching, as far as we can tell. The issue arises, for example, in languages where (free) pronouns and bound person markers (agreement) draw different person distinctions. In a sample including 330 languages that have both free and bound person markers, Siewierska and Bakker (2005) find that only 74 (22%) show the same distinctions in both, and that in nearly a quarter, there is a difference in clusivity. They note (p.172) that "[t]he vast majority of these differences involve presence of the encoding of inclusivity in free as compared to bound forms, though the reverse is also found." They provide examples from Daur (Mongolic) free pronouns and non-past subject subject person suffixes to illustrate. We give the plural forms only here:

(47)

	Daur	
	pronoun	agreement
1.INCL	bed	-bəi-ba:
1.EXCL	ba:	
2	ta:	-bəi-ta:
3	a:n	-bəi-sul

In our approach, the features of *ba:* can be the same both as free pronoun and bound agreement marker, namely [+AUTHOR], thus agreement can be straightforwardly treated as copying or matching of features. As with Mandarin *wǒmen*, exhaustification only applies if there is a paradigmatic competitor, so *ba:* signals general first person in agreement, but first person exclusive as a free pronoun, where it competes with *bed*. Copying/matching will also work for the inclusive, with the additional assumption that feature conjunction is not supported in agreement morphemes, so only a subset of features are copied or matched. But on Harbour's approach, this is not obvious. The problem is similar to the issue with Mandarin: the order of composition of features is reversed between the free and bound morpheme contexts, so if order of composition is represented (e.g., structurally) than the copying/matching process must swap this. In addition, the morphological identity between the general first person agreement marker *-ba:* and the free element *ba:* is unexpected: apart from the order of feature composition (which characterizes the whole paradigm), the general first person matches the feature content of the inclusive, not the exclusive, of the free series.

We do not exclude the possibility of an approach to agreement compatible with Harbour's representations, but we suggest that all else being equal, the compatibility of our more conservative approach with the most straightforward approaches to agreement speaks in its favour.

6 Conclusion

This paper has considered Harbour's (2016) analysis of person from a new perspective. As the first account of Zwicky's (1977) **syou*-gap in person typology without any appeal to an explicit ordering of $1 > 2$, Harbour's account represents a momentous achievement, but we perceive it also as highly idiosyncratic. Therefore it has been difficult to identify which one of the several new assumptions is really necessary for its success.

We conclude that Harbour's use of non-Boolean conjunction is the key feature of his account. To demonstrate this conclusion, we adopted the account of non-Boolean conjunction that Schmitt (2013, 2019) has established for the conjunction *and* in sentential semantics. In our morphological account, we furthermore adopted a version of the exhaustification operator **exh** that has become standard in sentential semantics.[28] Exhaustification could replace both Harbour's Lexical Complementarity Principle with his $\ominus$ operation (see (22) above). By adopting these two independently motivated assumptions, we show that the inclusive can be accounted for as the combination of the two features AUTHOR and PARTICIPANT in languages with a clusivity distinction, while the exclusive would be captured by just AUTHOR. Because the account of clusivity works only with the two features AUTHOR and PARTICIPANT, it predicts the **syou* gap just like Harbour's. We then went on to show that the new account we propose makes good predictions in two types of hybrid systems where the predictions of Harbour's (2016) account are problematic: the hybrid system of Mandarin Chinese where the inclusive has a restricted distribution, and hybrid systems with agreement between a paradigm with clusivity and one without. This shows that our account goes beyond accomplishing a clarification of Harbour's work, but is a genuine improvement while maintaining his central insight.

One final, general point concerns the relationship between sentential and morpheme-internal semantic composition. Our novel analysis of person typology is successful because it incorporates two semantic assumptions already established in sentential semantics: generalized non-Boolean conjunction (Schmitt 2013, and others) and embedded exhaustification (Chierchia et al. 2012, and others). While both advances are based on sentential composition, we demonstrated that there is good reason to believe that they are equally applicable for morpheme internal composition. This result corroborates the hypothesis that the semantic operations available in morphology are identical to those in sentential semantics.

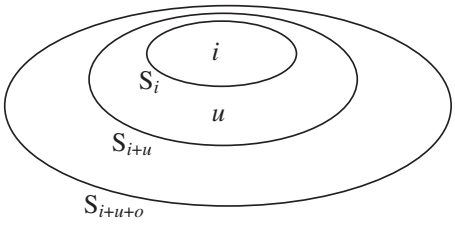
[28] Embedded **exh** operators have also been applied in the analysis of number morphology by Ahn et al. (2020); Mayr (2015); Elliott and Sauerland (2019); Elliott et al. (2021).

A Ackema and Neeleman

We have focused in this paper primarily on the proposal in Harbour (2016) and our alternative. In doing so, we have put aside engagement with the theory of Ackema and Neeleman (2013, 2018) [A&N], who adopt from Harbour the proposal that features perform sequential functions on sets to ultimately characterize meaning, and also claim (but with a qualification) to derive Zwicky's generalization in (1). We have done so for two reasons. First, in contrast to all the accounts mentioned above, from Zwicky through Harbour to ours, A&N do not treat Zwicky's generalization (1) as being about the inventories of person categories. Instead, they treat all languages as having the quadripartition, and suggest that the observed distribution is a matter of morphological syncretism: syncretism between inclusive and exclusive is common, while syncretism between inclusive and second person is not. This is an interesting alternative view, but we suggest that their account does not, on its own terms, provide an explanation as to why (52) is as robust as it is. Second, while we believe we understand Harbour's proposal, and can therefore with some degree of confidence lay out the empirical differences between his proposal and ours, we found A&N to be less explicit about some of the assumptions that turn out to be relevant for this discussion, and which make direct comparison thus harder. In the interests of allowing a more transparent discussion in the future, we attempt to identify here the places where we see potential issues, without resolving them one way or another.

A&N's account, like Harbour's, starts with the set of all possible persons $S_{i+u+o} = \{iuo, iu, uo, io, i, o, u\}$, and defines two features PROX and DIST, that combine by function application with this set. Although this receives only brief mention (Ackema and Neeleman, 2013, 910;Ackema and Neeleman, 2018, 28), they claim that their proposal requires only these two features, and that it derives inventories with clusivity as well as restricting the tripartition to the standard one, excluding **syou*. It is worth noting, though, that an additional assumption for them is doing some of the work that is done by the definition of features on other approaches. Specifically, they propose that there is a universally ordered arrangement of the possible referents, as diagrammed here:

(48) concentric structure of the A&N's sets of person atoms (Ackema and Neeleman, 2018, p. 23)



The innermost circle S_i consists of one obligatory member, the author, optionally with one or more "associates" (see below), but no addressees. The middle circle S_{i+u} consists of two obligatory members, the author and addressee. Note that there is no set S_u consisting of the addressee but not the author. In an important sense, A&N make use of AUTHOR and PARTICIPANT, here encoded as possible sets, with PROX and DIST performing a function similar (but not exactly parallel) to + and − in a binary system.

A&N define the function Pred (Predecessor) to define the ordered relation among the subsets in (48):

$$\text{Pred} = \begin{bmatrix} S_{i+u+o} \mapsto S_{i+u} \\ S_{i+u} \mapsto S_i \end{bmatrix} \tag{47}$$

A&N propose that the inventory of person categories is derived by applying (possibly iteratively) the functions PROX and DIST to the set S_{i+u+o} or to the outcome of a previous function. A&N provide the following interpretatoins for these functions:

$$[[\text{PROX}]](S) = \text{Pred}(S) \tag{48}$$

$$[[\text{DIST}]](S) = S - \text{Pred}(S) \tag{49}$$

The intended interpretation of − in (49) is not fully transparent to us. A&N (p. 24) write that '*DIST selects those elements that are part of the outermost layer of the input set.*' To us the quoted sentence suggests that A&N have in mind the set difference between one layer (the input set) and its predecessor as the result of −. Both '\' and '−' are commonly used symbols for the set difference. However, understanding '−' as '\' seems to us to be inconsistent with A&N's subsequent discussion, as we show now. For the following discussion, we use the symbol '\' with the standard interpretation – $M \setminus N = \{x \in M \mid x \notin N\}$ – and '−' only in reference to A&N's proposal.

On the basis of the above assumptions, A&N assume that the four persons distinguishable in the plural are captured by these feature combinations:

(52)

category	features	interpretation with '−' as '\'
exclusive	PROX, PROX	$\text{PROX}(\text{PROX}(S_{i+u+o})) = S_i$
inclusive	PROX	$\text{PROX}(S_{i+u+o}) = S_{i+u}$
second	PROX, DIST	$\text{DIST}(\text{PROX}(S_{i+u+o})) = S_{i+u} \setminus S_i$
third	DIST	$S_{i+u+o} \setminus S_{i+u}$

If '−' is the symbol for the set difference '\', the feature combinations are understood as follows: the third person is defined by starting from the set of all person categories S_{i+u+o} and removing S_{i+u}, i.e., all subsets that contain participants, leaving only the non-participants. Conversely, the exclusive

is derived (as is the first person singular) by iterative application of PROX to S_{i+u+o}: the first application PROX(S_{i+u+o}) selects the subset S_{i+u} of S_{i+u+o} that contains the author and addressee as obligatory members, and then another application–PROX(PROX(S_{i+u+o}))–selects the Predecessor of that, namely S_i. The second person, as in other PARTICIPANT-AUTHOR accounts, is supposed to be derived as the set of participants minus the author: $S_{i+u} \setminus S_i$.

The table (52) shows why, in our opinion, '−' cannot be understood as set difference '\' by A&N. The problem is rooted in the following mathematical property of set difference: if a set N is a subset of another set M, the M is equal to the union of the subset N and the set difference $M \setminus N$. With $N = S_i$ and $M = S_{i+u}$, this property relates the top three lines of table (52): the meaning of the inclusive is equal to the union of the exclusive and the second person. There is the spectre of a contradiction here: if the sets picked out by inclusive person markers $\{iu, iuo\}$ are subsets of S_{i+u}, then either they are in the subset S_i or they are in its complement $S_{i+u} \setminus S_i$. A&N's system relies however on the inclusive meaning being contained in neither. That is, although DIST is like set difference, the result that they have in mind is one where *iu* and *iuo* are not elements of S_i, but DIST applied to S_{i+u} returns the set $\{u, uo\}$, which also excludes *iu* and *iuo*. With this modification, the correct inclusive would arise from it being morphologically blocked for *i*, *u*, *io* and *uo* (as these have more specific realizations) and therefore only used for *iu* and *iuo*. It appears they intend to avoid the contradiction by asserting that these are sets of atoms rather than power sets (p.23). At this point, we assume that A&N have another interpretation for '−' in mind, and leave it up to future work to debate the interpretation once it is clarified.

Putting these technical difficulties aside, the structure of A&N's proposal is interesting. A&N depart from all other accounts discussed above, from Zwicky through Harbour (and ours), in that they do not treat the clusivity parameter as a difference in the person categories across languages: rather, they contend that all languages have the quadripartition underlyingly, and that tripartions (standard and **syou*) are a matter of morphological syncretism. They deny that there is a grammatical person category of generalized first person, instantiated by English *we* etc., and claim instead that the syncretism of inclusive and exclusive represents a natural class: English *we* spells out the (underspecified) feature PROX, shared by both the inclusive and the exclusive. They propose an additional postulate, the Russian Doll Principle, to ensure that the more peripheral occurrence of DIST in the second person serves to block *we* from spelling out the PROX feature on the second person. They claim (p.28) that their theory accounts for the absence of **syou* tripartitions because there is no natural class that includes inclusive and second person, but not the exclusive, yet they qualify this in a footnote (Ackema and Neeleman, 2018, 289:n6) by recognizing that an impoverishment rule deleting DIST would allow them to account for **syou*

morphemes, and thus a *syou*-tripartition. They contend, in effect, that the *syou*-tripartitions are rarer than the standard one, since one involves only underspecification and the other requires in addition an impoverishment rule. We take issue with this approach, since impoverishment of DIST from second person (along with underspecified PROX exponents) is precisely the tool they invoke to capture syncretism of first and second person to the exclusion of third, in a chapter (ch. 7) where they discuss why this pattern is more common than syncretism of first and third person. We understand their suggestion that, all else being equal, patterns of syncretism that require a special rule may be less common than those that do not require the rule, but the discussion from Zwicky onwards expresses the intuition that there is a qualitative, rather than just a quantitative, difference in play: at the level of categorial distinctions (Harbour's *partitions*), the **syou* partition isn't just less frequent than the standard one, it is vanishingly rare, if attested at all (an empirical claim of course open to further debate). As far as we can see, though A&N's account is compatible with that state of affairs, it does not explain it.

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References

Ackema, Peter, and Ad Neeleman. 2013. Person features and syncretism. *Natural Language and Linguistic Theory* 31:901–950.

Ackema, Peter, and Ad Neeleman. 2018. *Features of person: From the inventory of persons to their morphological realization.* Cambridge MA: MIT Press.

Adger, David, Daniel Harbour, and Susana Béjar, ed. 2008. *Phi theory: Phi-features across modules and interfaces.* Oxford, UK: Oxford University Press.

Ahn, Dorothy, Ankana Saha, and Uli Sauerland. 2020. Positively polar plurals: Theory and predictions. *Semantics and Linguistic Theory* 30:450–463.

Bar-Lev, Moshe E., and Danny Fox. 2020. Free choice, simplification, and innocent inclusion. *Natural Language Semantics* 28:175–223.

Bassi, Itai, Guillermo Del Pinal, and Uli Sauerland. 2021. Presuppositional exhaustification. *Semantics and Pragmatics* 14.

Beaver, David I. 1992. The kinematics of presupposition. URL https://eprints.illc.uva.nl/id/eprint/1178/.

Benveniste, Emilé. 1966. La nature des pronoms. In *For Roman Jakobson: Essays on the Occasion of his Sixtieth Birthday*, ed. Morris Halle, Horace G. Lunt, Hugh MacLean, and Cornelis H. van Schooneveld, 34–37. The Hague, Netherlands: Mouton.

Bickel, Balthasar, and Johanna Nichols. 2005. Inclusive–exclusive as person vs. number categories worldwide. In Filimonova (2005), 49–72.

Bobaljik, Jonathan David. 2008. Missing persons: A case study in morphological universals. *The Linguistic Review* 25:203–230.

Buccola, Brian, Manuel Križ, and Emmanuel Chemla. 2021. Conceptual alternatives. *Linguistics and Philosophy* .

Chierchia, Gennaro, Danny Fox, and Benjamin Spector. 2012. Scalar implicature as a grammatical phenomenon. In *Handbook of semantics*, ed. Klaus von Heusinger, Claudia Maienborn, and Paul Portner, volume 3, 2297–2331. Mouton de Gruyter.

Cooper, Robin. 1979. The interpretation of pronouns. In *Selections from the third Groningen round table, syntax and semantics, volume 10*, ed. F. Heny and H. Schnelle, 61–92. New York: Academic Press.

Cysouw, Michael. 2003. *The paragdigmatic structure of person marking*. Oxford: Oxford University Press.

Cysouw, Michael. 2013. Inclusive/exclusive distinction in independent pronouns. In *The world atlas of language structures online*, ed. Matthew S. Dryer and Martin Haspelmath. Leipzig: Max Planck Institute for Evolutionary Anthropology. URL https://wals.info/chapter/39.

Daniel, Michael. 2005. Understanding inclusives. In Filimonova (2005), 3–48.

Elliott, Patrick D., Andreea C. Nicolae, and Uli Sauerland. 2021. Who and what do who and what range over cross-linguistically? lingbuzz/003959 (*Journal of Semantics*, to appear).

Elliott, Patrick D., and Uli Sauerland. 2019. Ineffability and unexhaustification. In *Proceedings of Sinn und Bedeutung 23*, ed. M. Teresa Espinal et al., volume 1, 399–411. Bellaterra, Spain: Universitat Autònoma de Barcelona.

Filimonova, Elena, ed. 2005. *Clusivity: Typology and case studies of the inclusive-exclusive distinction*. Amsterdam: John Benjamins.

Foley, William A. 1986. *The Papuan languages of New Guinea*. Cambridge: Cambridge University Press.

Harbour, Daniel. 2016. *Impossible persons*. MIT Press.

Harley, Heidi, and Elizabeth Ritter. 2002. A feature-geometric analysis of person and number. *Language* 78:482–526.

Haslinger, Nina, and Viola Schmitt. 2018. Scope-related cumulativity asymmetries and cumulative composition. In *Semantics and Linguistic Theory*, volume 28, 197–216.

Heim, Irene. 2008. Features on bound pronouns. In Adger et al. (2008), 35–56.

Heim, Irene, and Angelika Kratzer. 1998. *Semantics in generative grammar*. Oxford, UK: Blackwell.

Hirsch, Aron. 2017. An inflexible semantics for cross-categorial operators. Doctoral Dissertation, Massachusetts Institute of Technology, Cambridge, Mass.

Katzir, Roni. 2007. Structurally-defined alternatives. *Linguistics and Philosophy* 30:669–690.

Li, Charles N., and Sandra A. Thompson. 1981. *Mandarin Chinese: A functional reference grammar*. Berkeley: University of California Press.

Link, Godehard. 1983. The logical analysis of plurals and mass terms: A lattice theoretical approach. In *Meaning, use, and the interpretation of language*, ed. R. Bäuerle, C. Schwarze, and A. von Stechow, 302–323. Berlin: de Gruyter.

Lyons, John. 1968. *Introduction to theoretical linguistics*. Cambridge: Cambridge University Press.

Magri, Giorgio. 2009. A theory of individual-level predicates based on blind mandatory scalar implicatures. constraint promotion for optimality theory. Doctoral Dissertation, Massachusetts Institute of Technology, Cambridge, Mass.

Maldonado, Mora, and Jennifer Culbertson. 2020. Person of interest: Experimental investigations into the learnability of person systems. *Linguistic Inquiry* 1–42. (early access).

Mayr, Clemens. 2015. Plural definite NPs presuppose multiplicity via embedded exhaustification. In *Semantics and Linguistic Theory*, volume 25, 204–224.

McGinnis, Martha. 2005. On markedness asymmetries in person and number. *Language* 81:699–718.

Meyer, Marie-Christine. 2015. Redundancy and embedded exhaustification. In *Semantics and Linguistic Theory (SALT) XXV*, ed. S. D'Antonio, M. Moroney, and C.R. Little, 491–511.

Moravcsik, Edith A. 1978. Agreement. In *Universals of human language: IV: Syntax*, ed. Joseph H. Greenberg, 331–374. Stanford: Stanford University Press.

Moskal, Beata. 2018. Excluding exclusively the exclusive: Suppletion patterns in clusivity. *Glossa: a journal of general linguistics* 3.

Nedjalkov, Igor. 1997. *Evenki*. London: Routledge.

Noyer, Rolf. 1997. *Features, positions and affixes in autonomous morphological structure*. New York: Garland.

Ross, Claudia, and Jing-heng Sheng Ma. 2006. *Modern Mandarin Chinese grammar: a practical guide*. Abingdon, UK: Routledge.

Sauerland, Uli. 2003. A new semantics for number. In *The Proceedings of SALT 13*, ed. Robert B. Young and Yuping Zhou, 258–275. Cornell University, Ithaca, N.Y.: CLC-Publications.

Sauerland, Uli. 2008. The semantic markedness of ϕ-features. In Adger et al. (2008), 57–82.

de Saussure, Ferdinand. 1959. *Course in general linguistics*. New York: The Philosophical Library.

Schlenker, Philippe. 2021. Triggering presuppositions. *Glossa: a journal of general linguistics* 6.

Schmitt, Viola. 2013. More pluralities. Doctoral Dissertation, University of Vienna, Vienna, Austria.

Schmitt, Viola. 2019. Pluralities across categories and plural projection. *Semantics and Pragmatics* 12:17.

Siewierska, Anna, and Dik Bakker. 2005. Inclusive and exclusive in free and bound person forms. In Filimonova (2005), 151–178.

Singh, Raj. 2011. Maximize presupposition! and local contexts. *Natural Language Semantics* 19:149–168.

Valentine, Randy. 2001. *Nishnaabemwin reference grammar*. Toronto: University of Toronto Press.

Wechsler, Stephen. 2010. What 'you' and 'I' mean to each other: Person indexicals, self-ascription, and theory of mind. *Language* 86:332–365.

Zaslavsky, Noga, Mora Maldonado, and Jennifer Culbertson. 2021. Let's talk (efficiently) about us: Person systems achieve near-optimal compression. Unpublished manuscript MIT and Universitat Pompeu Fabru and University of Edinburgh.

Zwicky, Arnold M. 1977. Hierarchies of person. In *CLS 13*, 714–733.