Generalised Quantifier Restrictions on the Arguments of the Polish Distributive Preposition PO*

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Abstract

It has been shown that English existential *there* contexts like *There are some / two / many / no / *most / *all students in the class* only allow determiners expressing a certain well-defined subclass of generalised quantifiers (Keenan, 1987, 2003). In this paper we show that the Polish distributive preposition PO imposes a stronger constraint, namely, requires that its argument express a cardinal quantifier.

1 Introduction

The generalisation of quantifiers as, ultimately, relations between sets was introduced by a Polish mathematician, Andrzej Mostowski, a student of Alfred Tarski, in his seminal paper Mostowski 1957, and further developed by Lindström (1966). The relevance of this notion to the linguistic analysis was demonstrated in the early 1980ies, most clearly in Barwise and Cooper 1981, Higginbotham and May 1981 and Keenan and Stavi 1986. In particular, Barwise and Cooper 1981 and, especially, Keenan 1987, 2003 showed that the notion of generalised quantifiers makes it possible to describe the restrictions on possible determiners D in constructions like *There were D students in the class* (so-called existential *there* contexts). It turns out that, to the first approximation, the D in such contexts must express an intersective quantifier (cf. §3 below).

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The aim of this paper is to demonstrate that the Polish distributive preposition PO imposes a slightly stricter semantic constraint on its argument, namely, that the argument expresses a cardinal quantifier. To the best of our knowledge, this is the first attempt at providing a semantic account of subcategorisation restrictions of PO, and also the first report of a linguistic context requiring the presence of an expression denoting a cardinal quantifier.

In the remainder of this article we first introduce the empirical scope of this study, the Polish distributive preposition PO, and discuss some syntactic restrictions on its arguments in §2. In §3 we present some prominent classes of generalised quantifiers, including the classes of intersective and cardinal quantifiers. In §4, the main section of the paper, we demonstrate that semantic restrictions on the arguments of PO are best characterised in terms of the notion of cardinal quantifiers, a proper subclass of intersective quantifiers. Finally, we conclude in §5.

2 Syntactic Restrictions on Arguments of PO

The empirical object of this paper is the distributive preposition PO as used in the following sentences:

(1) Dałem im *po jabłku.*
gave-I them.DAT PO apple.LOC
'I gave them an apple each.'

(2) Dałem im *po dwa jabłka.*
gave-I them.DAT PO two.ACC apples.ACC
'I gave them two apples each.'

One of the idiosyncrasies concerning the distributive PO is that it takes some arguments in the locative case, as in (1), and other arguments in the accusative, as in (2). Until recently the common assumption (expressed, e.g., in Łojasiewicz 1979, p. 155, and Franks 1995, pp. 160–161) has been that PO combines with singular locative and plural accusative arguments, but we show in Przepiórkowski 2006a that the case of the argument of PO depends on the grammatical class (part of speech) of that argument, and not on its number: nominal phrases must occur in the locative while numeral phrases occur in the accusative case.

This generalisation was difficult to reach because only singular nominal phrases and plural numeral phrases are easily observed as arguments of PO; there are no singular numeral phrases in Polish,[1] while the distribution

[1] We argue in Przepiórkowski 2006b that even the fractional numerals ĆWIERĆ 'quarter', PÓŁ 'half' and PÓŁTORA 'one and a half' are grammatically plural.

of plural nominal phrases is heavily constrained by the semantic restrictions discussed in §4 below. Nevertheless, as shown in Przepiórkowski 2006a (and contrary to the claim in Łojasiewicz 1979), PO may combine with *plurale tantum* nominal phrases, as in the following attested examples (from Przepiórkowski 2006a, which adduces many more examples of this kind), and when it does, the nominal phrase must occur in the locative case, just as singular nominal arguments of PO do, and in contradistinction to the accusative numeral arguments.[2]

(3) I wszyscy w studio po dwoje oczu, po jednym nosie i *po*
and all in studio PO two eyes PO one nose and PO
jednych *ustach* na twarz.
one.PL.LOC lips.LOC for face

'And everybody in the studio: two eyes, one nose and one pair of lips per face.'

(`http://www.wosp.org.pl/fundacja/index.php/11/2/2/2873`)

(4) Dostaliśmy *po* *extra* *czekoladkach.*
got-we PO additional chocolates.LOC

'We got an additional box of chocolates each.'

(`http://palmtop.pl/view.php?news_id=456`)

This is a welcome conclusion, as — in Polish — grammatical case seems to never depend on grammatical number, but it may depend on grammatical class. Two known cases of such interdependence between case and part of speech are: predicative arguments of the copula (roughly, only nominative when adjectival, and instrumental or — marginally — nominative when nominal) and subject arguments of finite verbs (accusative when numeral, cf. Przepiórkowski 1999, 2004b, and nominative otherwise).

3 Generalised Quantifiers

A simple binary generalised quantifier[3] is a two-place relation on the powerset (i.e., set of all subsets) of a domain E.[4] For example, the classical universal quantifier may be defined as that relation ALL which holds between two sets A and B exactly when A is a subset of B:

(5) $\mathsf{ALL}(A, B)$ iff $A \subseteq B$

[2]Note that in (3) *jednych* is an adjectival form, so the whole phrase *jednych ustach* is — syntactically — a nominal phrase, not a numeral phrase; cf. Saloni 1974, Gruszczyński and Saloni 1978 and Przepiórkowski 2006a.

[3]This introductory section is based on van der Does and van Eijck 1996 and Keenan 2002. A more recent comprehensive overview article is Westerståhl 2005.

[4]Sometimes we will refer to such quantifiers by their characteristic functions from pairs of sets to truth values.

Similarly, the existential quantifier is the relation which is true of two sets just in case their intersection is not empty:

(6) $\mathsf{SOME}(A, B)$ iff $A \cap B \neq \varnothing$

However, this view of quantification makes it possible to define many other quantifiers, corrsponding to expressions of natural languages, but not easily available, or even not definable, in first order logic. Here are some examples of such expressions and the definitions of corresponding quantifiers:

(7)

expression	**quantifier**	**true iff**
NO	$\mathsf{NO}(A, B)$	$A \cap B = \varnothing$
NEITHER	$\mathsf{NEITHER}(A, B)$	$A \cap B = \varnothing$ and $\lvert A\rvert = 2$
SEVEN	$\mathsf{7}(A, B)$	$\lvert A \cap B\rvert = 7$
AT LEAST SEVEN	$\geq \mathsf{7}(A, B)$	$\lvert A \cap B\rvert \geq 7$
ALL BUT SEVEN	$\mathsf{ALL\text{-}7}(A, B)$	$\lvert A - B\rvert = 7$
MOST	$\mathsf{MOST}(A, B)$	$\lvert A \cap B\rvert > \lvert A\rvert/2$
UNCOUNTABLY MANY	$\mathsf{UNCOUNT}(A, B)$	$\lvert A \cap B\rvert > \aleph_0$
ONLY	$\mathsf{ONLY}(A, B)$	$A \supseteq B$

The definition of a quantifier may refer to the whole domain E of which A and B are subsets, so quantifier names are often subscripted with the name of the domain. However, quantifiers expressed in natural languages, including all quantifiers mentioned above, usually satisfy the extension condition which says that the value of the quantifier $Q(A, B)$ only depends on A and B:

(8) **EXT**: $Q_E(A, B) = Q_{E'}(A, B)$ for all $A, B \subseteq E \subseteq E'$

For obvious reasons, this property is also called *domain independence* (**DI**; cf. Keenan 2002).

As mentioned in van der Does and van Eijck 1996, p. 8, one of the apparent interpretations of the English determiner MANY, meaning roughly *relatively many* and denoted as MANY_E below, does not satisfy **EXT**:

(9) $\mathsf{MANY}_E(A, B)$ iff $\lvert A \cap B\rvert > \lvert E\rvert/2$

Another important property of quantifiers is conservativity on the first argument (often simply called "conservativity"), i.e., the requirement that, beyond the subset $A \cap B$, the set B be immaterial for the value of the quantifier:

(10) $\mathbf{CONS}_1$: $Q_E(A, B) = Q_E(A, A \cap B)$ for all $A, B \subseteq E$

It has been hypothesised (Keenan and Stavi, 1986; Keenan, 2002) that natural language determiners (almost) always share both properties, **EXT** and $\mathbf{CONS}_1$, and in fact all quantifiers introduced above, apart from

$\mathsf{ONLY}(A, B)$ (expressed not by a determiner, but by the modifier ONLY), satisfy $\mathbf{CONS}_1$.[5]

A property dual to $\mathbf{CONS}_1$ is conservativity on the second argument:

(11) $\mathbf{CONS}_2$: $Q_E(A, B) = Q_E(A \cap B, B)$ for all $A, B \subseteq E$

Three well-known non-trivial subclasses of generalised quantifiers are: intersective (generalised existential), co-intersective (generalised universal) and proportional quantifiers, satisfying, respectively, the properties **INT**, **CO-INT** and **PROP**:

(12) **INT**: for all $A, B, X, Y \subseteq E$ such that $A \cap B = X \cap Y$, $Q_E(A, B) = Q_E(X, Y)$

(13) **CO-INT**: for all $A, B, X, Y \subseteq E$ such that $A - B = X - Y$, $Q_E(A, B) = Q_E(X, Y)$

(14) **PROP**: for all $A, B, X, Y \subseteq E$ such that $|A \cap B|/|A| = |X \cap Y|/|X|$, $Q_E(A, B) = Q_E(X, Y)$

Intersective quantifiers are those functions from pairs of sets A and B to truth values (cf. fn. 4) whose values depend only on the intersection $A \cap B$. It can be proven that intersective quantifiers are exactly those quantifiers which simultaneously satisfy $\mathbf{CONS}_1$ and $\mathbf{CONS}_2$. English determiners expressing such quantifiers, i.e., intersective determiners, are, e.g., *some*, *no*, *ten*, *more/fewer than ten*, *just finitely many*, etc., as well as as the interrogative determiners *how many?* and *which?*, and complex determiners such as *more male than female*.

It has been claimed (Keenan, 1987) that intersective determiners and their combinations are exactly the determiners which may occur as D in the English existential *there* (ET) constructions of the form *There are D As in B*, e.g., *There are no students in the classroom*, *There are more male than female students in the classroom*, etc. Keenan 2003 revises this characterisation of ET constructions, by extending it to all determiners which are (expressions of quantifiers) conservative on their second arguments. This includes all intersective determiners, as well as determiners expressing quantifiers conservative on the second argument only, i.e., in English, *mostly* and *only/just*.

[5] Zuber 2004 argues that Polish plural forms of SAM 'only, alone' are determiners denoting a non-conservative quantifier. His argument is based on the observation that such forms may only be a part of an NP, i.e., that SAM is not categorically polyvalent the way the English modifier ONLY is. However, it is not clear what it means to be a determiner in Polish and, in fact, SAM has all the morphosyntactic properties of an adjective, similarly to the (currently *plurale tantum*) adjective WSZYSCY 'all' and the adjective KAŻDY 'every', and in contradistinction to the morphosyntactic numerals WIELE 'many', KILKA 'a few', etc.

Co-intersective quantifiers depend only on that part of the first set argument which is not shared with the second argument. For example, *All As are B* is true just in case $A - B = \varnothing$, *Every student but John came* is true iff the only student not contained in the set of entities that came is John, etc. The repertoire of co-intersective determiners is more limited than the set of intersective determiners and it includes expressions such as *all*, *all ... but six*, *all ... but finitely many* and *every ... but John*. Typical co-intersective quantifiers are not conservative on the second argument.

Proportional quantifiers, expressed, e.g., by *most* and *23%*, are those quantifiers which depend on the proportion of the intersection of the two sets to the first set. Typical proportional quantifiers are not conservative on the second argument. Note that neither co-intersective determiners, nor proportional determiners, may occur in the ET constructions: **There are all/most students in the classroom.*

A subclass of intersective quantifiers which is often mentioned is that of cardinal quantifiers, as defined by the property **CARD**:

(15) **CARD**: for all $A, B, X, Y \subseteq E$ such that $|A \cap B| = |X \cap Y|$, $Q_E(A, B) = Q_E(X, Y)$

That is, the value of a cardinal quantifier depends only on the cardinality of the intersection of the two sets. This class seems to be linguistically important, as almost all of the intersective determiners, including *some*, *no*, *ten*, *more/fewer than ten*, *how many?*, etc., are in fact cardinal determiners. One exception is *which?*, and more complex exceptions are of the types: *more male than female*, *no ... but John*, etc. This sparseness of non-cardinal intersective *determiners* should be contrasted with the abundance of non-cardinal intersective *quantifiers*: it has been noted (Keenan and Moss, 1985; Keenan, 2004) that for a universe E of cardinality $|E|$, there are $2^{|E|+1}$ possible cardinal quantifiers and as many as $2^{2^{|E|}}$ possible intersective quantifiers.[6]

Direct reflexes of various subclasses of generalised quantifiers have been found in natural languages (Keenan, 2004), including intersective quantifiers and quantifiers conservative on the second argument (cf. ET constructions mentioned above), downward monotone quantifiers (as licensors of negative polarity items, cf., e.g., Ladusaw 1980 and van der Wouden 1994, and as facilitators of complement set anaphora, cf. Sanford *et al.* 1994) and so-called principal filters (as occurring naturally after *of* in English plural partitives such as *the ten* in *two of the ten students*, cf. Barwise and Cooper 1981). However, to the best of our knowledge, no such characteristic context has ever been found for the class of cardinal quantifiers. The aim of this paper is to show that the Polish distributive preposition PO creates just such a context.

[6]For example, for a 4-element set E this gives $2^5 = 32$ possible cardinal quantifiers and as many as $2^{16} = 65\,536$ possible intersective quantifiers, which gives $65\,536 - 32 = 65\,504$ non-cardinal intersective quantifiers.

4 Semantic Restrictions on Arguments of PO

The thesis we want to defend in this section is that there is a semantic restriction on the possible arguments of the distributive PO, namely, that such arguments must express a cardinal quantifier. We present the basic data supporting some such restriction in terms of intersective or cardinal quantifiers in §4.1, while in §4.2 we show that expressions of non-cardinal intersective quantifers are banned from this position, i.e., that the restriction should really be stated in terms of cardinal quantifers. Further, §4.3 demonstrates that the ambiguity of *wiele* 'many' supports this thesis, as apparently only the cardinal senses of *wiele* are expressible after the distributive PO. However, there are some data which are not readily accommodated by our proposal, and such problematic data are discussed in §4.4.

Most of the argumentation in this section follows the traditional 'armchair linguistics' methodology (or lack of it, according to some), i.e., the main data are the author's acceptability judgements, sometimes confirmed by other native speakers, with unacceptable sentences marked with an asterisk '*'. Moreover, degrees of acceptability are marked with '?' (slightly degraded), '??' (degraged, but possibly still acceptable) and '?*' (very degraded, probably should be treated as unacceptable). It should be noted that this way of data collection has been critised by many, and more careful procedures have been proposed (cf., e.g., Bard *et al.* 1996, Schütze 1996 and Cowart 1997, but also Sprouse 2007 for a different view), so — ideally — the judgments given below should be confirmed in the future in a more experimental setting.

On the other hand, whenever possible, we support the empirical generalisations with corpus data drawn from the 30-million segment[7] sample part of the IPI PAN Corpus of Polish (the `2.sample.30` subcorpus; cf. `http://korpus.pl/` and Przepiórkowski 2004a). Note, however, that corpora can only provide one kind of evidence: if a theory forbids a construction which occurs in a corpus sufficiently frequently, then the theory is wrong, but if the theory predicts a construction that does not occur in a corpus, then more explanations are available, apart from a flaw in the theory: the corpus may be too small or additional constraints may play a role which forbid the construction.

4.1 Basic Data

In this section we show that PO may occur with expressions of typical intersective quantifiers, i.e., cardinal quantifiers (§4.1.1), and that it cannot occur with expressions of non-intersective quantifiers (§4.1.2).

[7]Roughly, segments are orthographic words and punctuation marks. In some relatively rare cases orthographic words are split into smaller segments. See Przepiórkowski 2004a for details.

4.1.1 Intersective Quantifiers

The following data illustrate that the distributive PO may occur with phrases expressing various kinds of cardinal quantifiers:

(16) Przesłałem im / każdemu po...
sent-I them / each PO
'I sent each of them...'

a. ...pięć / dwanaście / sto wiadomości.
five / twelve / hundred messages

b. ...kilka / kilkanaście / kilkadziesiąt wiadomości.
a few / upteen / a few tens messages

c. ...tuzinie wiadomości.
dozen messages

d. ...ile wiadomości?
how many messages

e. ...ponad / prawie / około 100 wiadomości.
over / almost / about 100 messages

f. ?...(nie)skończenie wiele wiadomości.
(in)finitely many messages

(17) Nie dałem im po żadnym jabłku / po żadnym z tych jabłek.
not gave-I them PO no apple / PO none of these apples
'I gave them no apple / none of these apples.'

PO with cardinal quantifiers is also readily attested in the corpus. It is difficult to give exact counts, as there are as many as 100 464 occurrences of PO in the 30-million sample of the IPI PAN Corpus, most of which are non-distributive POs, so the following counts are for the results of corpus queries like the following query for KILKA 'a few':[8]

(18) `[base=po] [base=kilka & case~acc] [pos=noun & case~gen]`

This query finds a sequence of three tokens such that the base form of the first token is PO, the second token is a possibly accusative form of KILKA, and the third token is a possibly genitive noun. Such queries have high precision (they find almost only the distributive PO with KILKA expressing the quantifier) but possibly low recall (they may leave out many legitimate cases of PO+KILKA, e.g., when the following noun is preceded by an adjective).

[8]The syntax of corpus queries in the IPI PAN Corpus is fully described and exemplified in Przepiórkowski 2004a. An abridged description may be found at `http://korpus.pl/en/cheatsheet/`.

For cardinal numerals (cf. (16a)), such a query[9] gives 256 results, for KILKA 'a few' (cf. (16b)) the query in (18) returns 123 results, for KILKANAŚCIE 'upteen' a fully analogous query gives 48 results, for KILKADZIESIĄT 'a few tens' — 26 results, for KILKASET 'a few hundred' — 6. Note that KILKA, KILKANAŚCIE, etc., all express cardinal — even if somewhat vague, in some cases — quantifiers; e.g., KILKA specifies that the number of elements in the intersection of the two sets be roughly between 2 and 10, typically between 3 and 9.

For TUZIN 'dozen' and ILE 'how many' (cf. (16c–d)) analogous queries return only one result each, but they are both perfectly acceptable sentences, e.g., for ILE:

(19) Pytam, a po ile osób doktor dziennie przyjmuje.
ask-I and PO how many persons doctor daily receives
'I am asking: and how many people does the doctor see every day?'

Similarly low numbers of results are returned when a cardinal numeral is modified by PONAD 'over', etc. (cf. (16e)): there are only two examples involving PONAD (with the meanings of over two hours and over thirty years).[10] No results are returned for queries aiming at finding examples similar to (16f) and (17).

4.1.2 Non-intersective Quantifiers

The following examples demonstrate that the distributive PO cannot felicitously occur with typical expressions of co-intersective quantifiers:

(20) Przesłałem im / każdemu po...
sent-I them / each PO

[9]The actual query used was: `[base=po] [pos=num & base!="kilka|kilkoro|..." & case~acc] [pos=noun & case~gen] meta autor!="Maciej Piasecki"`, where the disjunction in `base!="kilka|kilkoro|..."` contains, apart from KILKA and KILKORO, also other mostly indefinite numerals: KILKANAŚCIE, KILKADZIESIĄT, KILKASET, OBA, OBYDWA, PARĘ, WIELE, TYLE, ILE, PÓŁTORA. The specification `meta autor!="Maciej Piasecki"` was used to exclude from the search a linguistic paper by Maciej Piasecki (one of corpus texts) which happens to contain artificially constructed examples with the distributive PO and numerals. Note that this query will only find numerals expressed in texts by words and not those expressed by digits.

[10]In the full 250-million IPI PAN Corpus, 10 cases of OKOŁO 'about' and 3 cases of PONAD were found, but still no examples of PRAWIE 'almost'.

'I sent each of them...'

a. *...wszystkich wiadomościach.
   all messages

b. *...wszystkich wiadomościach oprócz sześciu.
   all messages but six

c. *...każdej wiadomości oprócz najnowszej.
   every message but newest.SG

Note the the unacceptability of examples in (20) cannot be blamed on some internal semantic incoherence of the intended meanings of these examples. Such meanings can be expressed in different ways, e.g.:

(20′) Każdemu z nich przesłałem ...
each of them sent-I

'I sent each of them...'

a. ...wszystkie wiadomości.
   all messages

b. ...wszystkie wiadomości oprócz sześciu.
   all messages but six

c. ...każdą wiadomość oprócz najnowszej.
   every message but newest.SG

As far as corpus search is concerned, within the 187 results of the query `[base=po] [orth="każdym|każdej|każdych"]` (cf. (20c)) run on the 30-million sample of the IPI PAN Corpus, there were no occurrences of the distributive PO. Similarly, within the 113 results of `[base=po] [orth=wszystkich]` (cf. (20a–b)), there were no occurrences of the kind of distributive PO which is the focus of this article.[11]

The distributive PO is also incompatible with WIĘKSZOŚĆ, which expresses the most typical proportional quantifier, as well as with some other proportional quantifiers:

[11] There were examples of an apparently different PO, discussed by Tabakowska (1999), also distributive in some (spatio-temporal) sense, such as:

(i) najczulsza aparatura porozmieszczana po wszystkich zakątkach globu
most sensitive equipment distributed PO all nooks globe.GEN
'the most sensitive equipement distributed over all nooks and corners of the globe'

(21) Przesłałem im / każdemu po...
sent-I them / each PO

a. ?*... większości wiadomości.
most messages

b. *... mniej niż połowie nowych wiadomości.
less than half new messages

Again, the intended meaning may be conveyed without the use of PO:

(21′) Każdemu z nich przesłałem ...
each of them sent-I

a. ... większość wiadomości.
most messages

b. ... mniej niż połowę nowych wiadomości.
less than half new messages

And again, relevant corpus queries produced no results analogous to (21): only one result was produced by the query `[base=po] [orth=większości]`, which involved the temporal rather than the distributive PO, while `[base=po] [orth="mniej|więcej"] niż` produced two results, one of which involved the distributive PO but with a following expression of a cardinal quantifier (*Oszczędzać musieliby po mniej niż tysiąc dolarów miesięcznie*; 'they would have to save PO less than thousand dollars monthly').

On the other hand, there are apparent expressions of proportional quantifiers which seem to be compatible with the distributive PO; we will discuss such cases in §4.4.2.

Finally, expressions like OBA 'both' seem to denote quantifiers which are neither intersective, nor co-intersective, nor proportional. The cardinality of the intersection of sets A and B expressed by DWA 'two' and OBA 'both' is the same, but while the former is a prototypical expression of a cardinal quantifier, the latter also refers to the cardinality of the whole set A.

(22) Każdemu z nich przesłałem ...
each of them sent-I
'I sent each of them...'

a. *... po obie wiadomości / obu wiadomościach.
PO both.ACC messages.ACC both.LOC messages.LOC

b. ... obie wiadomości.
both messages

c. ... po dwie wiadomości.
PO two messages

Again, although the intended meaning may be expressed without PO (cf. (22b)), example (22a) shows that PO is incompatible with quantifiers like those expressed by OBA 'both'. The contrast between (22a) and (22c) is particularly telling here.

4.2 Non-cardinal Intersective Quantifiers

Examples in the previous section could suggest that the Polish distributive PO imposes the same semantic constraints as the English existential *there* constructions, namely, that it allows only expressions of intersective quantifiers or, more generally, quantifiers conservative on the second argument. However, as examples below show, the restriction is stricter in case of PO: non-cardinal intersective quantifiers are not allowed:[12]

(23) Przesłałem im / każdemu po...
sent-I them / each PO

a. *...których wiadomościach?
which.PL messages

b. *...której wiadomości?
which.SG message

c. *...więcej żółtych niż czerwonych jabłek.
more yellow than red apples

No utterances of this kind were found in the corpus.

Examples in (23) should be contrasted with the acceptable ET constructions involving the same non-cardinal intersective quantifiers:

(24) Which messages are there already in your INBOX?

(25) There are more yellow than red apples in the box.

This contrast shows that PO imposes stronger restrictions than English ET constructions. On the basis of examples so far, the restrictions seems to be that the argument of the distributive PO should express a cardinal quantifier (together with its restrictor).

[12] In order to facilitate comparison with other examples, the questions in (23a–b) have word order which is possible but not typical of Polish questions. This is immaterial for our argument, as corresponding questions with the usual *wh*-fronting and pied-piping (and with the pragmatically more likely second person) are equally unacceptable, e.g.:

(i) *Po których wiadomościach przesłałeś każdemu z nich?
PO which.PL messages sent-you each of them

4.3 WIELE ‘many’

Native speakers, when confonted with artificially constructed examples involving PO and WIELE ‘many’, report a clear drop of acceptability in comparison to PO and KILKA ‘a few’:

(26) Dałem im / każdemu po...
gave-I them / each PO

a. ...kilka jabłek.
a few apples

b. ??...wiele jabłek.
many apples

On the other hand, among the three results of `[base=po] [orth=wiele]`, there is one that involves the distributive PO, and it is fully acceptable:

(27) A jednak na Popioły chodzono, i to po wiele razy!
and still on (film title) go.IMPS and to boot PO many times
‘But still people went to see *Popioły*, and many times, as well!’

A few additional fully acceptable examples of PO + WIELE may be found in the full IPI PAN Corpus, and the nominal form modified by WIELE is usually *razy* ‘times, instances’, but also *godzin* ‘hours’, *tygodni* ‘weeks’, *lat* ‘years’ and *kilometrów* ‘kilometres’, e.g.:

(28) Czekali po wiele godzin.
waited-they PO many hours
‘They waited many hours each / each time.’

(29) ...musimy często podróżować po wiele kilometrów na posiedzenia
must-we often travel PO many kilometres for sittings
komisji...
commission.GEN.PL/SG
‘...we often have to travel many kilometres to commission meetings...’

How can this behaviour of WIELE ‘many’, apparently less stable than the behaviour of KILKA ‘a few’, be explained? And does WIELE express a cardinal quantifier, i.e., should it be allowed within the argument of PO at all?

According to Partee 1989, the English MANY is ambiguous between a proportional quantifier and a contextual cardinal quantifier. In the first meaning, the intersection of the two sets should be a suffiently large proportion of the first set for the quantifier to be true, while in the second meaning, the cardinality of the intersection should exceed a certain contextually given

reference cardinality. Some such distinction, often more fine grained, is assumed by many semanticists, cf., e.g., Lappin 2000 and references therein.

Polish WIELE seems to exhibit the same ambiguity. For example, (30) says that for people it is usual to die due to natural causes, i.e., a very large proportion of the set of people die this way, while (31) clearly does not have this meaning, i.e., it rather says that more people than necessary or expected die in car accidents.

(30) Wiele osób umiera śmiercią naturalną.
many persons die death.INST natural.INST
'Many people die the natural death.'

(31) Wiele osób umiera w wypadkach samochodowych.
many persons die in accidents car.ADJECTIVE
'Many people die in car accidents.'

Given this ambiguity, it is clear that in the fully acceptable corpus examples involving PO + WIELE, the meaning of WIELE is "contextual cardinal", in Partee's terms. The sets of times/instances, hours, weeks, years and kilometers are infinite, so any sufficiently large proportion of such a set would also have to be infinite,[13] and it is clear that in all of the examples (27)–(29), the set referred to may be contextually large (e.g., people normally go to the cinema to see a given film just once), but definitely finite.

On the other hand, in (26b), the set (total or contextually defined) of apples is finite, so such examples are genuinly semantically ambiguous, which may explain their degraded acceptability. It seems, thus, that WIELE 'many', puzzling at first, in fact supports the main thesis of this article.

4.4 Potential Problems

In this section we mention one non-problem which, however, should be taken into account in an exhaustive analysis of the distributive PO, and one true potential problem, which turns out to be a possible problem also for the standard account of the English ET construction in terms of intersective quantifiers.

[13] One of the results of the search in the full IPI PAN Corpus, whose fragment is given in (i) below, does not fit this description.

(i) ...znają często po wiele języków...
know-they often PO many languages
'...they often know many languages each...'

To our ears, this example is less fully acceptable than (27)–(29), it is more on par with (26b), although, admittedly, this might be a case of a subconsciously theory-driven judgment. Again, any differences in acceptability judgements between (26b) and (i) on the one hand, and (27)–(29) on the other, should be investigated in more experimental settings.

4.4.1 Bare Nominal Phrases

The first issue is this: given the acceptability of PO with singular nouns, as in (1) above, why is it unacceptable with plural nouns, as in (32a) below? Just as the singular number seems to implicitly express a cardinal quantifier (true just in case the cardinality of the intersection of the two sets is one; let us call this quantifier '1'), also the plural number may be claimed to implicitly express a cardinal quantifier (true just in case the cardinality is greater than one; let us call this quantifier '≥ 1').

(32) Dałem im / każdemu po...
gave-I them / each PO

a. *...jabłkach.
apples

b. ?...perfumach.
perfumes

This is a non-problem for the thesis at hand, as the account proposed here argues for the existence of a semantic constraint on arguments of PO, but it does not preclude the existence of additional such constraints, which may make some expressions of cardinal quantifiers infelicitous with the distributive PO.

Nevertheless, the unacceptability of sentences such as (32a) is intriguing and should be explained. One possible explanation could be that, actually, neither the singular number expresses the quantifier 1, nor does the plural express ≥ 1, and what matters for the acceptability of such bare (i.e., quantifierless) nominal phrases with PO is whether they refer to a singular entity. When they do, the quantifier 1 is supplied contextually, and the utterance satisfies the semantic restrictions on arguments of PO. On the other hand, when a bare nominal phrase refers to a plural entity, it is not clear what quantifier should be supplied, so it could be claimed that such plural nominal phrases without an overt quantifier lack any quantificational force and, hence, are ill formed with the distributive PO, whose argument should express a cardinal quantifier (together with its restrictor).

This idea is corroborated by the relative well-formedness of PO with *plurale tantum* nouns, when they are understood as referring to singleton entities, as in (3)–(4) and, on the relevant reading, (32b). If the acceptability of such *plurale tantum* cases seems somewhat degraded, this may be due to the inherent ambiguity of *plurale tantum* nominal phrases between the implicitly quantified singular reading and the quantifierless plural reading, similarly to the degraded acceptability of some ambiguous WIELE expressions discussed in §4.3.

4.4.2 Proportional Quantifiers?

The second issue is a real potential problem: although, according to the account proposed here, the distributive PO should be incompatible with non-cardinal quantifiers, it may in fact occur with expressions usually assumed to denote proportional quantifiers, such as percentage expressions in the following attested examples:

(33) ...politycy PZPR dostawali po 90% (i więcej!) głosów...
politicians PZPR got PO 90% and more votes
'...the politicians of the PZPR party used to get 90% (and more!) of the votes...'

(34) Obydwa pakiety stanowiły po 33% akcji każdej ze spółek.
both packages constituted PO 33% actions each.GEN of companies
'Either of the two packages constituted 33% of actions of each company.'

In fact, many such examples may be found in the IPI PAN Corpus.

Note, however, that such percentage expressions are problematic for the thesis defended in this article only if their sole meaning is that of a proportional quantifier. But in such a case, analogous English expressions are equally problematic for the standard analysis of existential *there* constructions in terms of intersective (or conservative on the second argument) quantifiers which would predict that all of the following attested examples should be ruled out:

(35) Worldwide, *there are 10 percent of the fish left.*
`http://www.windowsonmaine.org/results_list.aspx?search=2&type=MovingImage&page=23`

(36) The reason you get different results is that *there are 10 percent of the people who are absolutely against abortion*, except maybe to save the mother's life, and 30 percent who are for abortion on demand, and that leaves 60 percent who swing back and forth conditionally, depending on what trimester and what circumstances you're talking about.
`http://query.nytimes.com/gst/fullpage.html?res=950DE0DC113BF931A15752C0A96F948260&sec=&spon=&pagewanted=print`

(37) But as with any average, *there are 50 percent of the people on either side of the mean.*
`http://www.washingtonpost.com/wp-dyn/articles/A54228-2005Mar21.html`

(38) *There are 25 percent to 30 percent minority students in the parish.*
(`www.ed.gov/pubs/techinvest/chap3b.html`)

(39) She said *there are 85 percent residential homes in the area that the Township wants to rezone...*
(`http://www.planning.co.medina.oh.us/mcpc_minutes/2005/June%201%202005%20MCPC%20Minutes.pdf`)

Our line of defence would be to say that such percentage expressions may behave as cardinal quantifiers quantifying over percentage points. That is, just as in *90 kilo mąki* '90 kilograms of flour' *90* expresses a cardinal quantifier and the restrictor set consists of kilograms of flour, in *90% głosów* '90% of the votes' *90* may be the same cardinal quantifier and the restrictor set would consist of percentage points of votes. This is a controversial idea, as percentage expressions are commonly treated as denoting proportional quantifiers (e.g., recently, Sailer 2007). However, working out this idea, or disproving it, is left for future work.

5 Conclusion

There are two contributions of this paper to the linguistic theory which are — to the best of our knowledge — novel. First, this is the first attempt at a formal characterisation of the so far puzzling semantic constraints on arguments of the Polish distributive preposition PO. Second, and more generally, this is also possibly the first description of a context characteristic for the class of cardinal quantifiers.

One possible flaw in the analysis proposed here concerns the behaviour of percentage expressions, usually treated as expressing proportional quantifiers only: in case of the distribution of arguments of PO, they team with expressions of cardinal quantifiers. However, a conclusive solution of this puzzle is a topic for another article.

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