A typology of proportional quantifiers: Evidence from Polish partitives

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Introduction. Since the early years of formal semantics a lot of research has been dedicated to the study of quantifiers. Yet, despite many important results certain properties of the class of proportional quantifiers (PQs) have not achieved enough attenation so far (with a notable exception of Hackl 2009). In this paper, I investigate the syntactic and semantic properties of different classes of PQs in Polish. Though some quirks in their behavior have been recognized and analyzed (see Przepiórkowski 2006, Dziubała-Szrejbrowska 2016 for a syntactic analysis and Wągiel 2019 for a semantic treatment), they remain surprisingly understudied. The main aim of this paper is to give firmer empirical footing for the study of the expressions in question. The data call for combining degree semantics with a mereotopological approach to nominals.

Corpus study. In order to determine the distribution of PQs in Polish, I have conducted a corpus study based on the National Corpus of Polish (NCP). I have examined syntactic environments and collocations of the following expressions: *część*, *cząstka* (both 'part'), *ćwierć*, *ćwiartka* (both 'quarter'), *pół*, *połowa*, *połówka* (all 'half') and *większość* ('most'). Based on the corpus data, the syntactic properties of different types of Polish PQs are the following. First of all, of all of the examined quantifiers only *ćwierć* and *pół* can and often do co-occur with measure terms and numeral phrases, see (1). On the other hand, morphologically complex PQs derived with the suffix *-k-*, i.e., *cząstka*, *ćwiartka* and *połówka*, as well as *część* are incompatible with degree modifiers such as *prawie* ('almost'), *niemal* ('nearly') and *ponad* ('above'), see (2). Finally, while *część*, *połowa* and *większość* can combine with cumulative predicates such as plurals and mass nouns, *cząstka*, *ćwierć*, *ćwiartka*, *pół* and *połówka* cannot, see (3). The constraint does not seem to be a grammatical one since all of the above can appear with pluralia tantum. The results are summarized in Table 1.

(1)　　a.　　… wiedzą, co　znaczy **ćwierć tony**　　trotylu　w rękach amatora.
　　　　　　　they-know what means　quarter$_1$ tonne.GEN TNT.GEN in hands　amateur.GEN
　　　　　　　'… they know what a quarter ton of TNT in the hands of an amateur means.'　　　　NCP
　　　　b.　#Wiedzą,　co　znaczy **ćwiartka tony**　　trotylu　w rękach amatora.
　　　　　　　they-know what means　quarter$_2$　tonne.GEN TNT.GEN in hands　amateur.GEN

(2)　　a.　　… obie miały okulary　automobilowe zakrywające **niemal pół** twarzy…
　　　　　　　both　had　eyeglasses automobile.ADJ covering　　nearly half$_1$ face.GEN
　　　　　　　'… they both had car goggles covering nearly half of the face…'　　　　NCP
　　　　b.　#Obie miały okulary　automobilowe zakrywające **niemal połówkę** twarzy.
　　　　　　　both　had　eyeglasses automobile.ADJ covering　　nearly half$_3$　face.GEN

(3)　　a.　　… wywinął　tylko ciupagą i　**połowa napastników** padła na ziemię.
　　　　　　　he-brandished only　axe　　and half$_2$　aggressors.GEN fell　on ground
　　　　　　　'… he only brandished an axe and half of the agressors hit the ground.'　　　　NCP
　　　　b.　#Wywinął　　tylko ciupagą i　**pół napastników** padło na ziemię.
　　　　　　　he-brandished only axe　　and half$_1$ aggressors.GEN fell　on ground

Table 1: Distributional properties of Polish proportional quantifiers

	ćwierć 'quarter'	*pół* 'half'	*połowa* 'half'	*większość* 'most'	*część* 'part'	*cząstka* 'part'	*połówka* 'half'	*ćwiartka* 'quarter'
measure terms	✓	✓	*	*	*	*	*	*
degree modifiers	✓	✓	✓	✓	*	*	*	*
cumulative pred.	*	*	✓	✓	✓	*	*	*

Physical and informational objects. Another data set concerns nominals that are ambiguous between a phy-

sical object sense and an informational object sense such as *book* (e.g., Pustejovsky 1995, Gotham 2017). But first, let us consider Hungarian which allows for optional classifiers (Csirmaz & Dékány 2014). Recently, it has been reported that the use of a classifier gives rise to a non-trivial intepretative effect in QPs containing nouns such as *book*. Constructions with a classifier disambiguate otherwise polysemous nouns and force a physical object sense, see (4) (Schvarcz & Wohlmuth 2020). Interestingly, a similar effect is observed with Polish PQs derived with the suffix *-k-*. Specifically, while (5-a) is a normal sentence, (5-b) is weird since it forces a physical object interpretation of the the whole phrase which is incompatible with a reading scenario.

(4)   a.   három **könyv**   (5)   a.   Jadzia przeczytała **pół książki**.
           three   book   Jadzia read   half book.GEN
           'three books'   ✓PHYS, ✓INFO   'Jadzia read half a book.'
     b.   három **darab könyv**   b.   #Jadzia przeczytała **połówkę książki**.
           three   CL   book   Jadzia read   half   book.GEN
           'three books'   ✓PHYS, # INFO

Analysis. I propose that the typology in Table 1 results from an interaction between degree semantics and mereotopology. First, I assume that phrases with the PQs *ćwierć* and *pół* underlyingly are simply measures, i.e., denote sets of degrees (Kotek 2011). That is why they naturally combine with measure terms, see (6). On the other hand, other PQs designate parts within an encoded part-whole structure, i.e., entities making up a whole, see (7) for a definite plural where μ is a generalized context-dependent measure function which gives different measures for different DPs, e.g., volume for singulars and number for plurals (Bale & Barner 2009). However, when *ćwierć* and *pół* combine with individual-denoting nominals, the denotation of the whole partitive is shifted to the domain of entities via a special operation, a phenomenon known as the polysemy of measurement (Rett 2014), see (8). Second, following Grimm (2012) I assume that referents of concrete count nouns are properly modeled in terms of mereotopological notions such as connectedness and integrity. Formally, this is achieved by the MSSC operation (Casati & Varzi 1999). The PQs derived with *-k-* introduce MSSC as a restriction on the interpretation of the phrase, see (9), which explains the effect in (5). In addition, *-k-* PQs as well as *ćwierć* and *pół* when combining with individual-denoting nouns require their complements to refer to MSSC entities via a special presupposition: this excludes cumulative predicates. Finally, the incompatibility with modifiers such as *niemal* ('nearly') can be explained in terms of scalar alternatives (Penka 2005). The composition fails if no scale is available, as in the case of PQs derived with *-k-*, or when there is no true scalar alternative, i.e., the case of *część*, a case similar to *#almost some books*. To conclude, the combination of degree-semantic and mereotopological factors given in Table 2 explains the properties summarized in Table 1.

(6) $[\![\text{ćwierć tony}]\!] = \lambda d[d = 1 \text{ tonne} \times 0.25]$

(7) $[\![\text{połowa książek}]\!] = \lambda x[x \sqsubset \text{MAX}([\![\text{books}]\!]) \wedge \mu(x) = \mu(\text{MAX}([\![\text{books}]\!])) \times 0.5]$

(8) $[\![\text{ćwierć książki}]\!] = \lambda x[x \sqsubset \text{MAX}([\![\text{book}]\!]) \wedge \mu(x) = \mu(\text{MAX}([\![\text{book}]\!])) \times 0.25]$

(9) $[\![\text{połówka książki}]\!] = \lambda x[\text{MSSC}(x \sqsubset \text{MAX}([\![\text{book}]\!]) \wedge \mu(x) = \mu(\text{MAX}([\![\text{book}]\!])) \times 0.5)]$

Table 2: Semantic properties of Polish proportional quantifiers

	ćwierć 'quarter'	*pół* 'half'	*połowa* 'half'	*większość* 'most'	*część* 'part'	*cząstka* 'part'	*połówka* 'half'	*ćwiartka* 'quarter'
degree semantics	yes	yes	no	no	no	no	no	no
introduces MSSC	no	no	no	no	no	yes	yes	yes
weaker scalar alternatives	yes	yes	yes	yes	no	no	yes	yes
presupposes MSSC	yes	yes	no	no	no	yes	yes	yes

References. Bale & Barner (2009) *The interpretation of functional heads* ● Casati & Varzi (1999) *Parts and Places* ● Csirmaz & Dékány (2014) *Hungarian is a classifier language* ● Dziubała-Szrejbrowska (2016) *Aspects of Morphosyntactic Constraints on Quantification in English and Polish* ● Gotham (2017) *Composing criteria of individuation in copredication* ● Grimm (2012) *Number and*

Individuation • Hackl (2009) *On the grammar and processing of proportional quantifiers* • Kotek (2011) *Degree relatives, definiteness and shifted reference* • Penka (2005) *Almost: A test?* • Przepiórkowski (2006) *O inherentnej liczbie mnogiej liczebników 'ćwierć', 'pół' i 'półtora'* • Pustejovsky (1995) *The Generative Lexicon* • Rett (2014) *The polysemy of measurement* • Schvarcz & Wohlmuth (2020) *An* MSSC-*approach to Hungarian classifiers* • Wągiel (2019) *Partitives, multipliers and subatomic quantification*