

## A scalar implicature-based account of the inference of pluralized mass (and count) nouns

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### 1 Introduction

That plural marking cannot appear on mass nouns is a widely accepted generalization. In fact, the (in)ability of being pluralized is one of the diagnostics use for deciding whether a noun is mass or count. In English and similar languages, (1) is indeed ungrammatical. This sentence can only be salvaged when the mass term is coerced or reinterpreted as *types of* or *standardized quantity of* (see Chierchia 1998, 2010 among many others).

- (1) \* Waters are dripping from the ceiling.
- (2) As for waters, we offer sparkling, still, and tap water, either in bottles or by the glass.

Recently, however, it has been observed that ‘genuine’ pluralized mass nouns, that is, pluralized mass nouns interpreted without any coercion, are in fact possible in a variety of languages. In Greek, for instance, the equivalent of (1) in (3) is perfectly grammatical (Tsoulas 2009); the same holds for a sentence like (4) from Halkomelem Salish (Wiltschko 2008). Crucially, (3) and (4) are not interpreted as *types of/standardized units of water/snow* (e.g., (3) doesn’t mean that standardized quantities of or types of water dripped from the ceiling).

- (3) Trehoun nera apo to tavani.  
drip.3PL water-PL from the ceiling  
‘water is dripping from the ceiling’
- (4) Tsel kw’éts-l-exw’ te/ye syiqyíq.  
1SG-S see-TRANS-3 DET/DET-PL snow-PL  
‘I have seen snow’

Moreover, and importantly for our purposes, pluralization of these nouns also gives rise to an effect on the interpretation of these sentences. (3) and (4) are associated with an abundance or ‘much’ inference that *much water* dripped from the ceiling and that I have seen *a lot of* snow, respectively; an inference that is not there with their corresponding singular sentences.

Pluralized mass nouns have also been observed in other unrelated languages such as Kuikuro (Franchetto *et al.* 2013) and in the Algonquian languages Innu-aimun (Gillon 2015), Ojibwe (Rhodes 1990, Mathieu 2012) and Blackfoot (Wiltschko 2012). This wide set of unrelated languages suggests that the phenomenon cannot

be easily attributed to idiosyncracies of individual languages, but rather presents an important empirical challenge to current theories of number and the mass-count distinction. In particular, the puzzle of plural on mass nouns raises the two challenges in (A) and (B):

- (A) THE CROSSLINGUISTIC CHALLENGE:  
What distinguishes languages, like Greek, which allow pluralized mass nouns, from those like English which do not?
- (B) THE INFERENCE CHALLENGE:  
How should we account for the abundance inference that pluralized mass nouns give rise to in those languages in which they are allowed?

As for some attempts to address the challenge in (A), see Tsoulas (2009), Alexiadou (2011), Alexopoulou *et al.* (2013), Harbour (2009). In this paper, we focus on the challenge in (B). We develop a suggestion made in Tsoulas (2009) and somewhat further developed in Harbour (2009) that the relevant inference is derived as an implicature. More specifically, we propose that the ‘much’ inference of sentences with pluralized mass nouns is a scalar implicature. In fact, we show that it is the vague counterpart of the ‘multiplicity’ or ‘more than one’ inference, which arises when plural morphology appears on count nouns like *giraffes*, i.e., the inference in (5-b) arising from (5-a) (Chierchia 1998, Spector 2007, Sauerland 2003, Sauerland *et al.* 2005, Zweig 2009, Ivlieva 2013 among others).

- (5) a. John saw giraffes.  
b.  $\rightsquigarrow$  *John saw more than one giraffe*

The purpose of this paper is to provide a *proof of concept* extension of the scalar implicature approach to the *more than one* inference of pluralized count nouns to the *much* inference of pluralized mass ones. While, for concreteness, we adopt the account by Spector (2007), given that our proposal is compatible with any of the other scalar implicature accounts that we know of (Zweig 2009, Ivlieva 2013, Mayr 2015) we will remain agnostic regarding the actual mechanisms involved in the derivation of the implicature. It is in this sense that our account is a *proof of concept*. In this paper we will focus on the Greek data.

It is important to note too that in this paper we are concerned with the existential readings of bare plurals like (5-a) and their mass counterparts in Greek. As is well-known, bare plurals in English can also have generic or kind readings like in (6) and (7). The interpretive options of pluralized mass nouns, at least in Greek, are more restricted. It is not possible to give a complete theory of the grammar of bare nouns and plurals in Greek within the confines of this paper.<sup>1</sup> We therefore restrict our attention to existential readings of bare plurals.

- (6) Giraffes live in Africa.  
(7) Giraffes are widespread.

<sup>1</sup>For relevant commentary, refer to Alexopoulou *et al.* (2013) and references therein.

The rest of this paper is organised as follows. In section 1, we describe the phenomenon of pluralized mass nouns and its ‘much’ inferences in some detail and we argue against a lexical approach to the ‘much’ inference, showing three problems that it faces. In section 2, we put forward our proposal. We discuss some further issues in section 3. We conclude in section 4.

### 1.1 Plural Mass nouns in Greek

In Greek, pluralized mass nouns are possible in cases in which there is no shift in meaning. Witness (8) and (9):

- (8) O Yanis eide kamilopardaleis.  
The John saw-PL giraffe-PL  
‘John saw giraffes’
- (9) O Yanis ehise nera.  
The John spilled-PL water-PL  
‘John spilled waters’

As said, (9) is not interpreted in any of the coerced ways. That is, (9) does not (have to) mean that John spilled standardized portion of water nor does it mean that he spilled types of water. It is also not an idiom.

In addition, importantly, as Tsoulas (2009) discusses, Greek otherwise does distinguish between mass and count nouns: it’s not that all nouns are count, like has been claimed for languages like Yudja (Lima 2014), or Hopi which would explain trivially why you could pluralize them all. For instance, mass nouns, even if pluralized, cannot combine with numerals, as (10) from Tsoulas 2009 shows.

- (10) \*Dio nera trehun apo to tavani.  
two waters run from the ceiling  
‘Two waters dripped from the ceiling.’

That is, Greek pluralized mass nouns behave in the same way as their singular English counterparts with respect to combining with numerals as well as other signature properties of the mass count distinction.

As we pointed out above, pluralized mass nouns, appear to be associated with a ‘much’ inference. That is (11-a), the literal paraphrase of the Greek example above, gives rise to the inference in (11-b).<sup>2</sup>

- (11) a. John spilled waters  
b.  $\rightsquigarrow$  *John spilled much water*

A natural assumption would be to account for the meaning of pluralized mass nouns by encoding it in the meaning of the plural combining with mass nouns. In the next section, we discuss why we think this is problematic.

<sup>2</sup>For ease of exposition, when there is no possibility of confusion we will use rough English paraphrases of the Greek examples (with no grammaticality markings).

## 1.2 A lexical approach and its problems

A straightforward way to account for the ‘much’ inference of sentences with pluralized mass nouns is to assume that this inference is associated with the literal meanings of such sentences (Alexiadou 2011).

- (12) O Yanis ehise nera.  
‘John spilled waters’
- (13) O Yanis ehise pola nera.  
‘John spilled much water’

More concretely, this would mean that the literal meanings of (12) and (13) are equivalent and different from that of (14). That is, both (12) and (13), unlike (14), are incompatible with John spilling little water.

- (14) O Yanis ehise nero.  
‘John spilled water’

There are three important problems for this approach. First, in downward entailing contexts the ‘much’ inference disappears. Second, while the inference is robust in upward entailing contexts, it is nonetheless cancelable. Third, this approach makes the wrong prediction with respect to the interaction between pluralized mass nouns and modifiers like *little*. Let us discuss these three problems in turn.

The first problem is that if the ‘much’ inference was part of the literal meaning of a sentence like (13), then we would expect it to interact with other operators in the same way as (14). So for instance, we would expect (15) and (16) to be equivalent. However they are not: (15) is typically interpreted as John didn’t spill any water, rather than he didn’t spill much water.

- (15) O Yanis den ehise nera  
‘John didn’t spill waters’
- (16) O Yanis den ehise polla nera  
‘John didn’t spill much water’

The same holds for conditionals or questions: the typical interpretation of (17-a) is that we should call somebody even if John spilled little water, unlike for (17-b). Similarly, if John spilled little water we should answer ‘Yes’ to (18-a), unlike for (18-b).

- (17) a. An o Yanis ehise nera, na telefonisume se kapon  
‘If John spilled waters, we should call somebody’
- b. An o Yanis ehise poly nero, na telefonisume se kapon  
‘If John spilled much water, we should call somebody’
- (18) a. Ehise o Yanis nera?  
‘Did John spill waters?’
- b. Ehise o Yanis poly nero?  
Did John spilled much water?

The second problem for the lexical approach is that, while the ‘much’ inference is robust in upward entailing contexts, it can also be cancelled. That is (19) is a felicitous discourse, unlike (20).

- (19) O Yanis ehise nera . . . ala oxi tipota spoudeo  
 ‘The John spilled waters . . . but nothing important’
- (20) O Yanis ehise pola nera . . . ??ala oxi tipota spoudeo  
 ‘The John spilled much water . . . but nothing important’

The third problem is that a modifier like *little* combining with a pluralized mass nouns leads to a felicitous result. However, if ‘waters’ meant ‘much water’ a sentence like (21) should be as contradictory as the English paraphrase in (22).

- (21) O Yanis ehise liga nera.  
 ‘John spilled little waters’
- (22) #John spilled little and much water.

In sum, the lexical approach has three problems: the ‘much’ inference disappears in downward entailing contexts, it can be cancelled and the co-occurrence of pluralized mass nouns and ‘little’ does not incur in contradictions. These facts suggest that we should abandon the lexical approach and point instead to a scalar implicature analysis. Moreover, this ‘much’ inference is intuitively parallel to the ‘more than one’ inference of the plural on count nouns. In the next section, we put forward the proposal that they are both scalar implicatures derived in an analogous way.

## 2 The proposal

We propose that plural morphology on mass (when allowed) and count nouns gives rise to a parallel scalar implicature. This unified approach will account for their disappearance in downward entailing contexts, cancelability, and interaction with elements like *little*. Consider the two inferences again.

- (23) John spilled waters.  
 $\rightsquigarrow$  *John spilled much water*
- (24) John didn’t spill waters.  
 $\not\rightsquigarrow$  *John didn’t spill much water*  
 $\rightsquigarrow$  *John spilled no water*
- (25) John saw giraffes.  
*John saw more than one giraffe*
- (26) John didn’t see giraffes.  
 $\not\rightsquigarrow$  *John didn’t see more than one giraffe*  
 $\rightsquigarrow$  *John didn’t see any giraffe*

The inferences appear parallel. The intuition is that we are in fact dealing with the same inference. The difference would be due to the inherent vagueness of mass nouns (see Chierchia 2010). In this section, we extend Spector’s (2007) account of

the ‘more than one’ inference to the ‘much’ inference. This unified approach will treat the contribution of the plural in the same way.

## 2.1 Background assumptions

### 2.1.1 Semantics of plural and mass nouns

We assume that the domain of individuals  $D_e$  is closed under mereological sum (indicated as ‘ $\oplus$ ’), that is contains atomic individuals and pluralities thereof. For any two individuals  $X$  and  $Y$  there exists an individual  $Z$ , corresponding to  $X \oplus Y$ , such that  $X$  is part of  $Z$  and  $Y$  is part of  $Z$  (indicated as  $X \leq Z$  and  $Y \leq Z$ , respectively).<sup>3</sup> The structure of the domain is that in (27), with atomic individuals corresponding to singular individuals and pluralities to the sums thereof (Link 1983, Landman 1989, Schwarzschild 1996 among others).

$$(27) \quad D_e = \{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$$

Given these assumptions about the ontology, we take singular to denote atomic individuals and plural to denote both singular and plurals. Following Sauerland *et al.* (2005), Spector (2007) among others, we take the singular denotation of nouns like *giraffe* to be true of only atomic individuals. The plural denotation, instead, is true of those individuals and the sums thereof. That is, imagine the atomic individual giraffes are  $a, b, c$ , the denotation of (26) would be as in (28), while that of (27) as in (29).

$$(28) \quad \llbracket \text{SG giraffe} \rrbracket^w = \{a, b, c\}$$

$$(29) \quad \llbracket \text{PL giraffe} \rrbracket^w = \{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$$

For mass nouns, we will follow Chierchia (1998, 2010) and assume that a mass noun like *water* is inherently plural, i.e., it denotes atomic individuals and pluralities thereof. We also assume with Chierchia (2010) that mass nouns have atomic individuals in their denotations, but they differ from count ones in that they are vague. For Chierchia (2010) this is precisely the reason why pluralization of such nouns is blocked in English. Given that the lexical denotation includes already pluralities, the application of PL would be redundant and therefore disallowed.

The Greek data seem to suggest that the idea that plural morphology is barred from mass nouns simply because it is redundant may not be entirely on the right track. Otherwise one will have to abandon the idea that mass and count nouns take their denotations within a single domain. Be that as it may, important though the issue is, our account does not necessarily hinge on it. For now we will just assume that in Greek, unlike English, (30) is possible and is equivalent to (29).

$$(30) \quad \llbracket \text{PL water} \rrbracket^w = \{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$$

Now we want to show that bare plurals in episodic contexts like (31-a) and (31-b) are predicted to be literally equivalent in the same way as (32-a) and (32-b) are.

$$(31) \quad \text{a. John spilled water.}$$

<sup>3</sup>Following Mayr (2015) and others, we use capital letters like  $X$  to denote atomic and non-atomic individual variables, while we reserve non-capital letters like  $x$  for only atomic ones.

- b. John spilled waters.
- (32) a. John saw a giraffe.  
b. John saw giraffes.

Starting from the count nouns, consider first now what this predicts for a sentence like (32-a). We assume that the singular indefinite *a* has the semantics in (33) (defined only over singular individuals), so that when it combines with *giraffe* and then with the rest of the sentence in (32-a), it gives rise to the meaning in (34). Notice that (34) is compatible with John seeing one or more individual giraffe.

- (33)  $\llbracket \mathbf{a/n} \rrbracket^w = \lambda P_{\langle e,t \rangle} \lambda Q_{\langle e,t \rangle} \exists x [P_w(x) \wedge Q_w(x)]$   
 (34)  $\exists x [\mathbf{giraffe}_w(x) \wedge \mathbf{saw}_w(j, x)]$

Let us turn now to the plural counterpart of (32-a) in (32-b). For simplicity here, we will assume that bare plurals are headed by a null plural indefinite *A* parallel to its singular counterpart *a/an*, which introduces existential quantification in sentences like (32-b): there is one or more individual giraffe or group of giraffes which John saw.<sup>4</sup>

- (35)  $\llbracket \mathbf{John\ saw\ A\ PL\ giraffe} \rrbracket^w =$   
 $\exists X [\mathbf{giraffe}_w(X) \wedge \mathbf{saw}_w(j, X)]$

Given that *saw* is a distributive predicate, (35) is equivalent to (36): there is one or more group of giraffes such that John saw each member of the group.

- (36)  $\exists X [\mathbf{giraffe}_w(X) \wedge \forall x [x \leq X \rightarrow \mathbf{saw}_w(j, x)]]$

Given the semantics above, we can now show that (32-b) and (32-a) have equivalent literal meanings. This is because (32-a) entails (32-b) - if there is at least one atomic giraffe that John saw then it is clear that (36) is true. However, more surprisingly and as Sauerland *et al.* (2005), Spector (2007) and others discuss, also (32-b) entails (32-a): if John saw a group of giraffes - that is if (32-b) is true - she saw each atomic individual of that group and therefore there is at least one atomic individual giraffe that she saw; that is, (32-a) is also true.

Turning to mass nouns now, given that we are assuming that *water* and *waters* are equivalent in their denotation, it is less surprising that we predict the sentences in (31-a) and (31-b) to be equivalent as well. In particular, the meanings predicted for (31-a) and (31-b) are in (37) and (38), respectively. It is straightforward to see that these entail each other.

- (37)  $\llbracket \mathbf{John\ spilled\ water} \rrbracket^w =$   
 $\exists x [\mathbf{water}_w(x) \wedge \mathbf{spilled}_w(j, x)]$   
 (38)  $\llbracket \mathbf{John\ spilled\ A\ PL\ water} \rrbracket^w =$   
 $\exists X [\mathbf{water}_w(X) \wedge \forall x [x \leq X \rightarrow \mathbf{spilled}_w(j, X)]]$

<sup>4</sup>This assumption is problematic as it is well-known, given the different scopal properties between bare plurals and their corresponding indefinite plurals (Carlson 1977). This is tangential to our purposes, so we will ignore this complication here.

If these singular and plural sentences are literally equivalent, however, how do we derive an inference for the latter by competition with the former? We will see in the following that the proposal by Spector (2007) gives us a way to model these inferences. But first let us turn to some background on scalar implicatures.

### 2.1.2 Scalar Implicatures

For the purposes of this paper it will suffice to just give a sketch of how scalar implicatures are derived and extend it to the inferences of pluralized count and mass nouns, while remaining neutral with respect to certain theoretical issues. For concreteness, we will assume a theory of scalar implicatures based on an exhaustification process EXH, following van Rooij & Schulz (2004), Fox (2007), Spector (2007), Chierchia *et al.* (2012) among others. EXH takes a sentence as argument and affirms it while negating an excludable subset of its alternatives. The excludable alternatives are defined in (40) and have two characteristics: (a) they are not entailed by the assertion and (b) their negation (together with the assertion) does not entail another alternative.

$$(39) \quad \llbracket \text{EXH } p \rrbracket^w = \llbracket p \rrbracket^w \wedge \forall q \in \text{EXCL}(p, \text{Alt}(p)) [\neg \llbracket q \rrbracket^w]$$

$$(40) \quad \text{EXCL}(p, X) = \{q \in X : p \not\subseteq q \wedge \neg \exists r [(p \wedge \neg q) \subseteq r]\}$$

Consider how (39) can be used to derive a classical scalar implicature like that in (41-b) from a sentence like (41-a), and how it explains why such inferences disappear in downward entailing contexts like negation.<sup>5</sup>

- (41) a. John ate an apple or a pear.  
       b.  $\rightsquigarrow$  *John didn't eat both*
- (42) a. John didn't eat an apple or a pear  
       b.  $\not\rightsquigarrow$  *John didn't eat an apple or a pear but not both*

Starting from the positive case. We assume that the alternatives for (41) are the ones in (43) (Sauerland 2004, among many others). If we apply exhaustification to (41) given the alternatives in (43) it is clear we obtain (44).

$$(43) \quad \text{Alt}(41\text{-a}) = \left\{ \begin{array}{l} \text{John ate an apple or a pear} \\ \text{John ate an apple} \\ \text{John ate a pear} \\ \text{John ate an apple and a pear} \end{array} \right\}$$

$$(44) \quad \llbracket \text{EXH} \rrbracket^w(41\text{-a}) = \llbracket \text{John ate an apple or a pear} \rrbracket^w \\ \wedge \neg \llbracket \text{John ate an apple and a pear} \rrbracket^w$$

One question at this point is how we derive the alternatives in (43). The standard answer in the literature since Horn (1972) is that certain words like *or* and *and* are

<sup>5</sup>If the inference were there in (42-a), this would be interpreted as true in a situation in which John ate both an apple and a pear. This reading is a possible reading, as is well known, but it requires a special intonation, as in (i).

(i) John didn't eat an apple OR a pear, he ate both!

associated with each other in the lexicon, and to obtain a competitor we can substitute one of these words with its associates. In the case of (43-a) we substitute *or* for *and* and we obtain (44). In other words, there is an assumption about competitors as in (45): *or* and *and* are associates.

(45) **Competitors:** {or, and}

In the negative case in (42-a), however, the alternatives become those in (46). As it is easy to verify, none of the alternatives in (46) is excludable and thereby exhausting (42-a) correctly results in no inference.

(46) Alt(41-a) =  $\left\{ \begin{array}{l} \text{John didn't eat an apple or a pear} \\ \text{John didn't eat an apple} \\ \text{John didn't eat a pear} \\ \text{John didn't eat an apple and a pear} \end{array} \right\}$

In sum, given theory of scalar implicatures like the above and assumptions about what the alternatives of a sentence are, we can derive the pattern associated with the scalar implicature of disjunctive sentences like (41-a) and (42-a). In the next subsection, we move to show how this theory of scalar implicatures can be adapted to account for the ‘more than one’ inference of pluralized count nouns.

## 2.2 More than one inference

Consider the data again from sentences with pluralized count nouns. The observation is that, in parallel with scalar implicatures, they arise in upward entailing contexts, and disappear in downward entailing ones, as shown by (47) and (48), respectively.

(47) John saw giraffes  
 $\rightsquigarrow$  *John saw more than one giraffe*

(48) John didn't see giraffes  
 $\not\rightsquigarrow$  *John didn't see more than one giraffe*  
 $\rightsquigarrow$  *John didn't see any giraffe*

Consider now how applying the algorithm above with some further assumptions about competitors can derive the ‘more than one’ inference as a scalar implicature. We rather simplify Spector's (2007) account focusing on aspects relevant for our purposes.

First, we add the following assumptions about competitors: plural and singular are competitors and singular and *more than one* are also competitors.<sup>6</sup>

(49) **competitors:** {or, and}; {PL, SG}; {SG, more than one}

As seen above, with respect to their literal meanings, a sentence like (50-a) is equivalent to that in (50-b) and both are compatible with John seeing just one giraffe.

(50) a. John saw a giraffe.

<sup>6</sup>Spector (2007) actually assumes that singular is in competition with *several*, we use *more than one* just for ease of exposition.

- b. John saw giraffes.

However, when the singular sentence in (50-a) is exhaustified, it is compared to the alternatives in (51) and the result is the implicature in (52).

$$(51) \quad \text{Alt}(50\text{-a}) = \left\{ \begin{array}{l} \text{John saw a giraffe} \\ \text{John saw more than one giraffe} \end{array} \right\}$$

$$(52) \quad \begin{aligned} \llbracket \text{EXH} \rrbracket^w(50\text{-a}) &= \llbracket \text{John saw a giraffe} \rrbracket^w \\ \wedge \neg \llbracket \text{John saw more than one giraffe} \rrbracket^w &= \\ \llbracket \text{John saw exactly one giraffe} \rrbracket^w & \end{aligned}$$

Finally, and this is the main idea, the plural sentence is doubly exhaustified as in (53). The consequence of this is that the alternatives are themselves exhaustified, which in turn means that the second exhaustification results in negating the singular alternatives as enriched with its inference (=John saw exactly one giraffe). The negation of the latter, together with the assertion results in the multiplicity inference that John saw more the one giraffe.

$$(53) \quad \begin{aligned} \llbracket \text{EXH} \rrbracket^w(\llbracket \text{EXH} \rrbracket^w(50\text{-b})) &= \llbracket \text{John saw giraffes} \rrbracket^w \\ \wedge \neg \llbracket \text{John saw exactly one giraffe} \rrbracket^w &= \\ \llbracket \text{John saw more than one giraffe} \rrbracket^w & \end{aligned}$$

$$(54) \quad \begin{aligned} \text{Alt}(\text{EXH}[\text{John saw giraffes}]) &= \\ \left\{ \begin{array}{l} \text{EXH}[\text{John saw giraffes}] = \text{John saw giraffes} \\ \text{EXH}[\text{John saw a giraffe}] = \text{John saw exactly one giraffe} \end{array} \right\} & \end{aligned}$$

Under negation, on the other hand, (55-b) is compared to (55-a), which is weaker and therefore not excludable, hence no inference arises from exhaustifying the singular sentence in (55-a).

- (55) a. John didn't see a (single) giraffe.  
b. John didn't see more than one giraffe.

In turn, the exhaustified singular remains equivalent to the plural in (56), therefore it is correctly predicted that no inference arise from (56) either, even if doubly exhaustified.

- (56) John didn't see giraffes.

In sum, Spector's scalar implicature approach can account for how 'more than one' inferences arise and can account for their disappearance under negation. We turn now to show how the 'much' inference of mass nouns is an implicature derived in the same way. Instead of the 'more than one' inference that is seen with count nouns, the 'much' inference is observed when plural morphology appears on a mass noun.

### 2.3 The *Much* inference

Let us go back to cases like (57) and (58), which is the English paraphrase of the Greek examples. As before, we observe the inference arising in upward entailing

contexts and disappearing in downward entailing ones.

- (57) John spilled waters.  
 $\rightsquigarrow$  *John spilled much water*
- (58) John didn't spill waters.  
 $\not\rightsquigarrow$  *John didn't spill much water*  
 $\rightsquigarrow$  *John didn't spill any water*

Consider now how extending Spector's proposal we can predict the pattern in (57) and (58) and its parallelism with the 'more than one' inference above.

First, we enrich our assumptions about competitors: singular combining with count nouns compete with *more than one*, while the singular combining with mass nouns competes with *much*.

- (59) **competitors:** {PL, SG}; {SG<sub>count</sub>, more than one}; {SG<sub>mass</sub>, much}

As above, we assume that the literal meaning of a sentence like (60-a) is equivalent to that of (60-b).

- (60) a. John spilled waters.  
 b. John spilled water.

And the singular, but not the plural, has (61) as alternatives. Therefore the enriched singular is (62).

- (61)  $\text{Alt}(60\text{-b}) = \left\{ \begin{array}{l} \text{John spilled water} \\ \text{John spilled much water} \end{array} \right\}$
- (62)  $\llbracket \text{EXH} \rrbracket^w(60\text{-b}) = \llbracket \text{John spilled water} \rrbracket^w$   
 $\wedge \neg \llbracket \text{John spilled much water} \rrbracket^w =$   
 $\llbracket \text{John spilled little water} \rrbracket^w$

The plural sentence in (60-a) is doubly exhaustified as above and therefore compared to the exhaustified alternatives in (63). The result of recursive exhaustification is therefore the negation of the exhaustified singular alternative that John spilled little water, which, together with the assertion gives us the wanted much-inference that John spilled much water.

- (63)  $\text{Alt}(\text{EXH}[\text{John spilled waters}]) =$   
 $\left\{ \begin{array}{l} \text{EXH}[\text{John spilled waters}] = \text{John spilled waters} \\ \text{EXH}[\text{John spilled water}] = \text{John spilled little water} \end{array} \right\}$
- (64)  $\llbracket \text{EXH} \rrbracket^w(\llbracket \text{EXH} \rrbracket^w(60\text{-a})) = \llbracket \text{John spilled waters} \rrbracket^w$   
 $\wedge \neg \llbracket \text{John spilled little water} \rrbracket^w =$   
 $\llbracket \text{John spilled much water} \rrbracket^w$

With negation (65-b) is weaker than (65-a) and therefore not excludable, so no enrichment of the singular results from exhaustification and in turn no enrichment of the plural once the latter is recursively exhaustified.

- (65) a. John didn't spill water.

b. John didn't spill much water.

In sum, extending Spector's scalar implicature approach can account for how 'much' inferences arise and can account for their disappearance under negation. Moreover, it can account for the similarities between the 'more than one' inference and the 'much' inference, as they are derived in exactly the same way.

Before closing this subsection, let us discuss how the scalar implicature above can account also for the other two properties of the inference of pluralized mass nouns, namely cancellation and the interaction with *little*.

Starting from cancellation, it is clear that a scalar implicature approach expects that the 'much' inference could be cancelled like other scalar implicatures. For instance, the implicature above of a simple disjunction can be cancelled as in (66). And indeed we saw that this is possible also for the 'much' inference: the equivalent of (67) is a felicitous discourse in English. In the approach above, this could be captured simply assuming that in these cases, (66) and (67) are not exhaustified and therefore no inference arises, which in turn explains why the continuations are felicitous.

(66) John ate an apple or a pear . . . and in fact he might even ate both.

(67) John spilled waters . . . but nothing serious.

Moving on to the interaction with *little*, which we saw was a problem for the lexical approach. We show now that this does not pose a problem under our approach because *little* ends up blocking the implicature of the plural. We correctly predict that (68-a) (the literal paraphrase of the Greek example above) has no 'much' inference and hence a non-contradictory meaning. In fact, we predict it to be equivalent to (68-b)

(68) a. John spilled little waters.

b. John spilled little water.

Given the assumption above that SG and PL are competitors, (68-a) and (68-b) are alternatives to each other. The question, however, is what are the alternatives of (68-b)? A natural assumption would be that *little* and *much* are competitors so that (68-b) is compared to (69) (in the same way its counterpart without *little* is).

(69) John spilled much water.

However, if this is the case, the exhaustification of (68-b) will end up negating (69), but the negation of the latter (John didn't spill much water) is already entailed by (68-b). Therefore no inference is predicted for (68-b) and in turn no inference is predicted for (68-a), when recursively exhaustified as above.

In sum, we treat the inference of plural on mass nouns as a scalar implicature. The 'more than one' inference of plural on count nouns is parallel to the 'much' inference of plural on mass nouns. This provides a unified account where the contribution of the plural is the same across mass and count nouns.

### 3 Further Discussion

#### 3.1 Cancellation

We saw that the ‘more than one’ inference and the ‘much’ inference have a parallel behavior. In particular, they both disappear in downward entailing contexts. The ‘much’ inference also has two other properties that our scalar implicature approach can explain naturally: cancellation and the interaction with modifiers like *little*. It is not clear that the ‘more than one’ inference is completely parallel on those, however. Let us consider them in turn.

First, while a scalar implicature approach expects that the ‘more than one’ inference would be cancelable, (70) appears instead quite degraded.

(70) John saw giraffes. . . #in fact he saw only one.

In response to the data point in (70), Spector 2007 introduces the notion of ‘obligatory’ scalar implicatures. The idea is that while the ‘more than one’ inference is a scalar implicature. This would be an obligatory scalar implicature, which cannot be cancelled, and this is the reason for the infelicity of (70). In the approach to scalar implicatures we assumed above, this would mean that a sentence like (70) is obligatorily exhaustified (see also Ivlieva 2013 and Mayr 2015).

When we compare the ‘more than one’ and the ‘much’ inference on this, the latter appears easier to cancel, as we saw above. The question is whether we could capture this difference by postulating that while the ‘more than one’ inference is an obligatory scalar implicature, the ‘much’ inference, while parallel otherwise, is a more regular ‘optional’ scalar implicature. That is, a sentence with pluralized count nouns is obligatorily exhaustified, while a sentence with pluralized mass nouns need not be.

#### 3.2 Interaction with *little* and *exactly one*

We saw that pluralized mass can co-occur with ‘little’ and we could account for that in our approach. The corresponding case for count nouns, however, would be something like (71), which is quite degraded instead.

(71) #John saw exactly one giraffes.

The problem is that we could have a parallel explanation for (71) and (72), repeated from above, in our scalar implicature approach: (71) would be compared to (73), which in turn could be compared to (74). The negation of (74) would however be already entailed by (73) and therefore no inference is predicted for the latter and no inference is predicted for (71).

(72) John spilled little water.

(73) John saw exactly one giraffe.

(74) John saw more than one giraffe.

If (71) has no ‘more than one’ inference, however, its infelicity cannot arise from an incompatibility between such inference and the meaning of ‘exactly one,’ as one might have hoped, but rather it would need to come from some other source. It could be that *exactly one* syntactically requires singular agreement. We leave a

more thorough investigation of this difference between the ‘much’ and ‘more than one’ inference for further research.

#### 4 Conclusion

In this paper, we discussed the *abundance inference* associated with plural mass nouns in Greek. We have proposed that the relevant inference should be derived as a scalar implicature in the same way as the similar *multiplicity inference* of their count counterparts. More specifically, we have taken the analysis by Spector (2007) of the latter and extended it to the former. This unified approach to the contribution of plural marking across noun types fully accounts for the inference pattern of pluralized mass nouns in a way that keeps the semantic contribution of the plural constant across mass and count. Finally, we have discussed the similarities and differences between the two inferences and how our account interacts with approaches to the puzzle of how pluralized mass nouns are possible in the first place. In the course of the argument we have raised a number of more general issues which go to the root of our understanding of the mass-count distinction and more specifically the denotations of mass nouns. It bears reminding that the theory proposed here can be implemented with somewhat differing sets of assumptions. The core, however, remains that the interpretation of pluralized mass nouns must be derived in a way similar to their count counterparts. A welcome result. Finally, presumably, at least a subset of the account presented here extends to languages other than Greek that allow plural mass nouns, though a detailed investigation must be left for further research.

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