

Abundance inferences are scalar implicatures: Evidence from child and adult Greek

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Summary: Some languages that exhibit a mass-count distinction allow pluralisation of mass nouns. In Greek, plural marking can appear on mass nouns in existential contexts, giving rise to an *abundance inference* indicating that there is a large quantity of the mass/stuff that is being talked about. This inference has recently been analysed as a scalar implicature, in parallel with the multiplicity inference of pluralised count nouns (Kane et al. 2016). We tested Greek-speaking 4–5-year-olds and adults on the abundance inference in upward- and downward-entailing contexts, and on the scalar inference of ‘some’. The results provide support for an implicature analysis: children and adults computed more abundance inferences in upward-entailing contexts than in downward-entailing contexts, and children computed fewer of both inferences than adults did.

Theoretical background: In many languages, including English, plural marking cannot appear on mass nouns. (1) is unacceptable, unless the mass term is reinterpreted as referring to *types of* or *standardized quantities of* water (e.g., Chierchia 1998, 2011). Recently, it has been observed that pluralised mass nouns are attested in a variety of languages, e.g., Greek (Tsoulas 2008), Innu-Aimun (Gillon 2015), Yudja (Lima 2015), Nez Perce (Deal 2016), and can be interpreted without coercion. In Greek, for example, the equivalent of (1) in (2) is acceptable, and crucially is not interpreted as types/standardized units of water (Tsoulas 2008). In addition, although mass nouns in Greek can be pluralised, they retain their mass properties; for example, they cannot directly combine with numerals, as shown in (3).

- (1) *Waters are dripping from the ceiling. English
- (2) Trehun ner-a apo to tavani. Greek
drip.3PL water-PL from DET ceiling
‘Water is dripping from the ceiling’
- (3) *Dio ner-a trehun apo to tovani.
two water-PL drip.3PL from DET ceiling
‘Two waters are dripping from the ceiling’ [from Tsoulas 2008, p. 135]

Most relevantly for us, the pluralised mass noun in Greek (2) triggers an abundance inference (4) that is not present for the corresponding singular (Tsoulas 2008).

- (4) \rightsquigarrow *Much water is dripping from the ceiling.*

Following suggestions in Tsoulas (2008) and Harbour (2008), Kane et al. (2016) analyse this abundance inference as a scalar implicature, extending the account of the multiplicity inference of pluralised count nouns from Spector (2007). They argue that the abundance inference of (2) is simply the vague/context-dependent counterpart of multiplicity inferences like (5b), which arises from (5a) (Chierchia 1998, Spector 2007, Sauerland 2003, Zweig 2009, Ivlieva 2013).

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

Experimental background: Despite considerable variation in reported rates of implicature calculation in children (Chierchia et al., 2001; Gualmini et al., 2001; Papafragou & Musolino, 2003, a.o.), a robust finding is that without extra facilitation, 4–6-year-old children typically compute fewer scalar implicatures than adults. Against this background, Tieu et al. (2014, 2016), following previous work by Sauerland et al. (2005), conducted a truth value judgment task experiment to test the hypothesis that the multiplicity inference of pluralised count nouns is an implicature. Their

results support the implicature analysis in two ways. First, children and adults computed the inference more often in upward- than in downward-entailing contexts. Second, children computed the inference less than adults did, following the general pattern found with scalar implicatures.

Present study: We designed an experiment to test the proposal that the abundance inference of pluralised mass nouns is a scalar implicature, along the lines of the multiplicity inference triggered by count nouns (Kane et al. 2015, Tsoulas 2008, Harbour 2008). We adapted Tieu et. al’s paradigm, using an adapted version of Katsos & Bishop’s (2011) ternary judgment task, originally designed to test children on scalar inferences. Participants were presented with short animations on a laptop. An experimenter read a short experimental context and asked questions of a puppet, who responded with the test sentences (through pre-recorded videoclips). Participants were instructed to judge the puppet’s sentences by rewarding the puppet with 1 strawberry, 2 strawberries, or 3 strawberries. On the critical targets, sentences containing pluralised mass nouns were uttered in contexts in which the abundance inference was clearly not satisfied (e.g., (6), Fig. 1):

- (6) EXP: Tiger wants to build a sand castle with a moat around it but he only has this one small bucket with him. Tiger takes just **a small amount of water** there. Now he has no more space in his bucket, so he doesn’t take any sand. Okay, Ellie, so Tiger didn’t take any sand. What about waters?
 PUPPET: **I tigrì pire nera!** ‘The tiger took waters!’

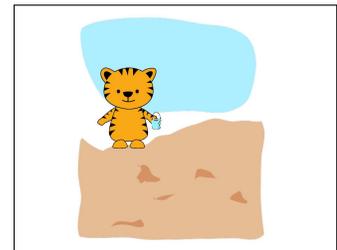


Figure 1: Target image for (6).

On the critical scalar implicature trials, Ellie uttered sentences containing ‘some’ in contexts in which the corresponding ‘all’-sentences were true. In total, participants saw 3 positive plural targets, 3 negative plural targets (e.g., *The tiger didn’t take waters*), and 4 ‘some’ targets. 28 children (19 females, mean age 4;06) and 27 adult native speakers of Greek (14 females, mean age 29) participated in the experiment. 12 participants were excluded for scoring fewer than 5/7 correct on controls, leaving a total of 21 adults and 22 children.

Results from the target conditions are provided in Fig. 2-3. Consider first the plural targets. Neither group computed any abundance inferences in the Negative condition. Logistic regression models fitted to responses to the positive targets revealed a significant effect of Group ($\chi^2(1) = 21.4, p < .001$), with adults computing more abundance inferences from the positive targets than children. Logit models fitted to responses to the positive plural targets and ‘some’ targets revealed significant effects of Inference Type ($\chi^2(1) = 15.5, p < .001$) and Group ($\chi^2(1) = 23.8, p < .001$), and no significant interaction between Inference Type and Group ($p > .05$).

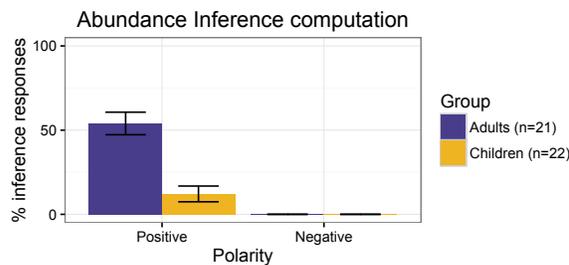


Figure 2: Mass noun targets.

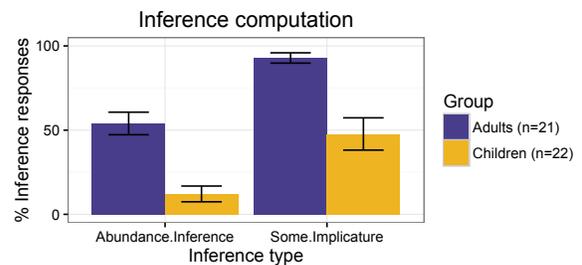


Figure 3: Mass noun vs. Some targets.

Discussion: Our results reveal that participants computed more abundance inferences in upward-entailing than downward-entailing contexts, consistent with the signature pattern of classical scalar implicatures. In addition, children computed fewer abundance inferences than adults, in parallel with their behavior on the ‘some’ implicature. It is worth noting, however, that both groups computed more ‘some’ implicatures than abundance inferences, suggesting the latter is a relatively weaker inference. This is presumably due to its context dependency with respect to what counts as

a small/large amount in the context. On the whole, our results support the implicature account of the abundance inference of pluralised mass nouns, paving the way for a unification of the inferences of plural morphology across the mass/count divide.