

Turkish plural nouns are number-neutral: Experimental data *

Agata Renans¹, George Tsoulas², Raffaella Folli¹, Nihan Ketrez³, Lyn Tieu⁴,
Hanna de Vries², and Jacopo Romoli¹

¹ Ulster University, Belfast, United Kingdom
`renans@ulster.ac.uk`, `folli@ulster.ac.uk`, `romoli@ulster.ac.uk`

² University of York, York, United Kingdom
`george.tsoulas@york.ac.uk`, `hanna.devries@york.ac.uk`

³ Istanbul Bilgi University, Istanbul, Turkey
`nihan.ketrez@bilgi.edu.tr`

⁴ Macquarie University, Sydney, Australia
`lyn.tieu@gmail.com`

Abstract

Across languages, plural marking on a noun typically conveys that there is more than one entity in the denotation of the noun. In English, this ‘more than one’ meaning is generally regarded as an implicature on top of what is considered the ‘semantically unmarked’ number-neutral literal meaning of the plural noun ([8, 11, 13]; though see also [5, 9]). In Turkish, however, it is more controversial whether plural nouns should be analysed as number-neutral or whether they should directly denote strict plurality [2, 12, 6]. This debate is of theoretical significance in that it can shed light on the possible meanings that number marking can have across languages, thereby constraining cross-linguistically adequate theories of the semantics of number. We tested Turkish-speaking adults and 4–6-year-old children on the interpretation of plurals in upward- and downward-entailing contexts, as compared to the ‘not all’ scalar inference of *bazı* ‘some’. The results of our experiment support a theory of plural nouns as number-neutral, when combined with the assumption that bare plurals in Turkish can take scope above negation [3, 2].

1 Introduction

Across languages, plural marking typically conveys multiplicity inference: while (1) is typically interpreted as giving rise to the interpretation that Tiger planted more than one tree, the same sentence with the singular count noun in (2) does not give rise to this interpretation.

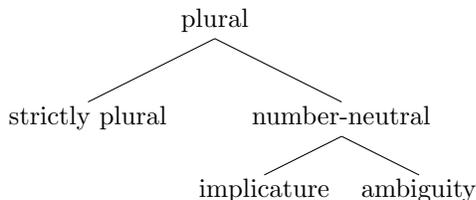
- (1) Tiger planted trees.
 \rightsquigarrow *Tiger planted more than one tree* MULTIPLICITY INFERENCE
- (2) Tiger planted a tree.
 $\not\rightarrow$ *Tiger planted more than one tree*

For English plural, it is generally claimed that the multiplicity inference is not encoded in the literal meaning of plural nouns (see for example [8, 11, 13]). That is, English plural does not encode the strict plurality, as in (3), but rather number-neutrality, as in (4):

- (3) $\llbracket \text{tree-s} \rrbracket = \{a \oplus c, b \oplus c, a \oplus b \oplus c\}$ STRICT PLURAL
- (4) $\llbracket \text{tree-s} \rrbracket = \{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$ NUMBER NEUTRAL

*to be added

Now, however, if the multiplicity is not encoded in the literal meaning of plural, i.e., plural is not strict plural but number-neutral, how does the multiplicity meaning arise? There are two competing proposals in the literature: it arises as an implicature [11, 13, 17] or it is an effect of the ambiguity [5, 9]. Thus, there are the following potential possibilities regarding the interpretation of plural across-languages: either it encodes strict plurality or it is number neutral. If latter, then the multiplicity inference is either an effect of the implicature or arises due to the ambiguity:



Looking at Turkish, there is an ongoing debate whether plural encodes strict plurality [1, 2] or it is number neutral [7, 12]. We conducted an experimental study in order to shed light on this debate, i.e., to find an answer for the following questions: (i) Does the literal meaning of plural denote strict-plurality or is it number neutral in Turkish? and (ii) If the latter, does multiplicity arise as an implicature or through ambiguity? In particular, we tested Turkish-speaking adults and 4-6-year-old children on the interpretation of plural nouns in upward- and downward-entailing contexts and compared them to the ‘not all’ scalar inference of *bazı* ‘some’. The results support a theory of Turkish plural nouns as number-neutral combined with the assumption that they are not scopally-inert [3, 2]. Thus, the results shed light on the possible meanings that plural can have across languages and constrain cross-linguistically adequate theories of the semantics of number.

The outline of this paper is as follows. Section 2 briefly presents the semantics of plural nouns in Turkish. In particular, it discusses the two analyses of bare plural nouns proposed in the literature: strict plurality and number neutrality. Subsequently, Section 3 discusses the predictions of both approaches. In section 4, our experimental study is presented and in Section 5 the results are discussed against the empirical predictions presented in Section 3. Section 6 concludes.

2 Background — two approaches to Turkish plural nouns

As in English, Turkish plural nouns give rise to multiplicity inference, as in (5) [references](#)

- (5) Kaplan ağaç-lar ek-ti.
 tiger tree-PL plant-PAST
 ‘Tiger planted trees.’
 \rightsquigarrow *Tiger planted more than one tree* MULTIPLICITY INFERENCE

There is an ongoing discussion whether in Turkish the multiplicity inference is an effect of being encoded in the semantics of plural or whether plural is number-neutral and the inference is an implicature or arises through the ambiguity.

The situation complicates the observation that plural nouns in Turkish, unlike English ones, are not scopally inert [3, 2]. While in English the plural noun *doctors* can only scope below *want* in (6), it was claimed that in the Turkish counterpart of this sentence *doctors* can take scope either above or below *want*, as in (7) [3, 2]:

	strict plurality	number neutrality
T. planted trees.	×	×
T. didn't plant trees (<i>neg</i> > <i>plural</i>)	✓	×
Tiger didn't plant trees. (<i>plural</i> > <i>neg</i>)	✓	✓

Table 1: Predicted acceptability judgments of positive and negative sentences in the context in which Tiger planted only one tree under strict plural and number neutral approach.

‘Tiger planted trees.’

STRICT PLURALITY: \approx *Tiger planted more than one tree*

NUMBER-NEUTRALITY:² \approx *Tiger planted more than one tree*

Their predictions diverge however in negative cases. Consider first the situation in which plural is in the scope of negation. In that case, the meaning on (10) under the strict plurality approach and number neutrality approach can be paraphrased as below:

- (10) context: Tiger planted only one tree, as depicted in Figure 1.

Kaplan ağaç-lar ek-me-di.

tiger tree-PL plant-NEG-PAST

‘Tiger didn’t plant trees.’

STRICT PLURALITY: \approx *Tiger didn’t plant more than one tree*

NUMBER-NEUTRALITY: \approx *Tiger didn’t plant any tree*

In this situation while the strict plurality approach predicts the sentence in (10) *Tiger didn’t plant trees* to be acceptable in the context in which Tiger planted only one tree (it is true that he didn’t plant more than one tree), the number-neutral approach predicts (10) to be unacceptable in the same context (it is not the case that Tiger planted no tree).

The situation differs however when plural takes a wide scope over negation. In that case, under both approaches the sentence in (11) can be roughly paraphrased as below:

- (11) Kaplan ağaç-lar ek-me-di.

tiger tree-PL plant-NEG-PAST

‘Tiger didn’t plant trees.’

STRICT PLURALITY/ NUMBER-NEUTRALITY \approx *There are trees that Tiger didn’t plant*

Since this interpretation is compatible with the context depicted in Figure 1, both approaches predict (11) to be acceptable in this context.

To sum up, both approaches predict the positive sentence *Tiger planted trees* to be acceptable in the context in which Tiger planted only one tree. However while the strict plural approach predicts the invariable acceptance of negative sentences in the same context, the number neutrality predicts mixed answers depending on the scopal interpretation of plural. The predictions of both approaches are summarized in Table 1.

²Note that by number-neutrality here we understand the number-neutral approach to the plural nouns’ denotation combined with one of the approaches accounting for the multiplicity inferences in that case, i.e., implicature approach or the ambiguity approach.

3.2 Plural vs. implicature

Number-neutral approach combined with the view that the multiplicity inference is a scalar implicature makes further predictions regarding the comparison of adults and children data as well as the behavior of the multiplicity inference with reference to other types of scalar implicatures. In particular, the implicature approach predicts that children would access the ‘more than one’ meaning less than adults do following the general pattern of standard scalar implicatures Yatsushiro et al. 2017, [15, 10]. Moreover, the implicature approach predicts that the behavioral pattern associated with the multiplicity inference should mirror that of other scalar implicatures, i.e., the uniformity prediction of the implicature approach should be borne out [15]. The strict plural approach, on the other hand, makes no predictions with reference to the children vs. adults performance and behavioral patterns connected with the multiplicity inference and scalar implicatures.

4 Our experiment

We examined the predictions of the strict plural approach and the number neutral approach, as discussed above, by testing plural nouns in positive and negative contexts as well as comparing the multiplicity inference to standard scalar implicatures [15, 10].

4.1 Methods

4.1.1 Participants

We tested 45 adults and 22 children ($M = 5;02$, 4 – 6), native speakers of Turkish. 1 child and 3 adults did not pass the control trials and were excluded from the analysis leaving 21 children and 42 adults in total.

4.1.2 Procedure

Children and adult participants saw short animations on a laptop, prepared in a PowerPoint presentation. At the very beginning, each participant was introduced to a puppet with whom they would interact throughout the experiment via a webcam. In reality, however, the puppet and her utterances were prerecorded. Subsequently, an experimenter read a series of short stories that were visualized by the animations. After each story, the experimenter asked a question to the puppet and the puppet responded with the test sentence. A task of the participants was to judge puppet’s utterances by rewarding the puppet with one, two, or three strawberries, depending on her performance. Crucially, the participants were clearly instructed on the different choices of reward: If they thought the puppet didn’t answer well, they were instructed to give her only one strawberry; if they thought she answered well, they were instructed to give her three strawberries; finally, if they thought the puppet’s answer was not perfect but somewhat okay, they were instructed to give her two strawberries.

4.1.3 Materials

We manipulated 3 factors: group (children vs. adults), inference type (multiplicity inference vs. scalar implicature) and polarity within the plural condition (positive vs. negative). The multiplicity and scalar implicature conditions were introduced in blocks and their order was counterbalanced across participants.

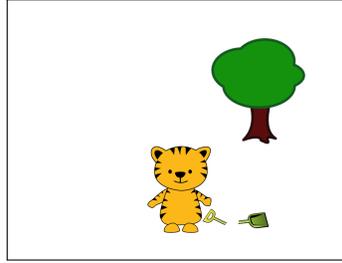


Figure 2: Target image for (12) and (13).

Consider first the multiplicity condition. In this condition, the story made it clear that the multiplicity inference triggered by the plural was not satisfied in the context, as in (12). A corresponding picture is provided in 2.

- (12) MULTIPLICITY INFERENCE: Tiger is helping his grandfather in gardening today. He wants to plant trees and flowers in the garden but they have only a very old shovel. They start with trees. Tiger plants this one tree over here. Now his shovel is broken, so he cannot plant any more trees. So remember, Tiger only planted this one tree here! Now let's see if Ellie's paying attention.

EXP: Okay, Ellie, so Tiger didn't plant any flowers. What about trees?

PUPP: Kaplan ağaç-lar ek-ti.
tiger tree-PL plant-PAST
'Tiger planted trees.'

The targets were presented in the positive, as in (12), and in the negative, as in (13). The respective stories were the same.³

- (13) Kaplan ağaç-lar ek-me-di.
tiger tree-PL plant-NEG-PAST
'Tiger didn't plant trees.'

In the positive targets, both strict plurality and number neutrality predict participants to interpret the targets with the multiplicity inference (i.e. *Tiger planted more than one tree*); given that the multiplicity inference was not satisfied in the context, participants were expected to reward the puppet with either one or two strawberries. Note, however, that while the number neutrality is a pragmatic mechanism, strict plurality is not. Therefore, the former — but not the latter — allows a variation in the participants' response pattern.

For the negative targets, the strict plurality approach predicts participants to invariably access the strict plural interpretation of the noun. Crucially, the strict plural interpretation is compatible with the context, irrespective of the scopal interpretation of plural (*plural > neg* or *neg > plural*). Therefore, the participants were expected to give the puppet a maximal reward. As for the number-neutral approach, a reward given to the puppet depends on the scopal interpretation of plural: when negation scopes over plural (*neg > plural*), the sentence obtains the interpretation which is incompatible with the context (i.e., *Tiger did not plant any tree*) which would predict non-maximal rewards to the puppet for the negative targets in contest like in Figure 2. When plural scopes over negation, on the other hand, the sentence is

³To keep things interesting for children, the stories varied in the positive and negative contexts.

compatible with the context (i.e. *There are trees that Tiger did not plant*) and the participants would therefore give a maximal reward to the puppet in the same context above.

In the scalar implicature condition, adapted from [15, 14], it was made clear in the stories that the action of the protagonist included in some way a whole set of objects introduced in the story. When asked what had happened in the story, the puppet answered using the scalar term *bazı* ‘some’, as in (14) (see Figure 3 for a corresponding picture):

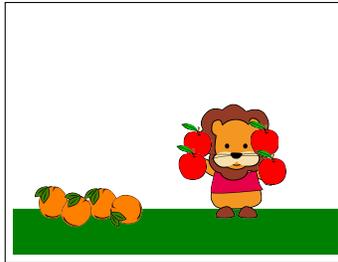


Figure 3: Target figure for (14).

- (14) SCALAR IMPLICATURE: Lion loves to help his mom with the groceries. Lion wants to carry apples and oranges, but they’re very heavy! Lion carries these four apples over here. Now his arms are full, so he does not carry oranges. So remember, Lion only carried these four apples here! Now let’s see if Ellie’s paying attention.
 EXP: Okay, Ellie, so the Lion didn’t carry any oranges. What about the apples?
 PUPP: Aslan elma-lar-ın bazı-lar-ı-nı taşı-dı.
 Lion apple-PL-GEN some-PL-POSS.3SG-ACC carry-PAST
 ‘Lion carried some of the apples.’

If the participants computed the scalar implicature of *some*, i.e., interpreted the sentence as *the lion is carrying some but not all of the apples*, they were expected to reward the puppet with one or two strawberries due to the incompatibility of the puppet’s utterance with the context. If the utterance instead was interpreted literally, which is true in the context, the participants were expected to give the puppet the maximal reward.

Participants also received eight control trials to ensure that they could give minimal and maximal rewards where appropriate. Four plural control trials were clearly true and were expected to elicit the maximal reward, as in (15) and (16):

- (15) POSITIVE CONTROL: Giraffe loves to help his mom in baking. She wants to bake cookies and cakes but they have only a small amount of sugar. Giraffe starts with cookies. Giraffe bakes these four cookies over here. Now the sugar is over, so she does not bake any cake. So remember, Giraffe only baked these four cookies here! Now let’s see if Ellie’s paying attention.
 EXP: Okay, Ellie, so Giraffe didn’t bake any cakes. What about cookies?
 PUP: Zürafa kurabiyeler pişirdi.
 glosses
 ‘Giraffe baked cookies.’
- (16) NEGATIVE CONTROL: Sheep loves to help her mother in baking. She wants to bake many small baklavas and pizzas but she has a very old oven. Sheep bakes these four

pizzas over here. Now the oven is broken so she does not bake any baklava. So remember, Sheep only baked these four pizzas here! Now let's see if Ellie's paying attention.

EXP:Okay, Ellie, so Sheep baked pizzas. What about baklavas?

PUP:Koyun baklavalar pişirmed

glosses

'Sheep didn't bake baklavas!'

Four negation controls trials, on the other hand, involved negative sentences that contained a definite noun phrase instead of a bare plural to ensure that participants could properly interpret negation independently of the plural. These trials could be associated with either a minimal reward target or a maximal reward target; the experimenter selected the appropriate version of the trial depending on how participants were responding to the critical target trials to balance the overall number of minimal and maximal rewards given across the experiment.

- (17) NEGATION CONTROL: Zebra loves to paint pottery. Look at these bowls and vases! Zebra wants to paint the pottery, but he only has a little bit of his favourite green paint. Zebra paints these four vases over here. Now he has no more paint, so he leaves the bowls colorless. So remember, Zebra only painted these four vases here! Now let's see if Ellie's paying attention.

EXP:Ellie, can you tell us something about the story?

PUP':Zebra kaseleri boyamadı!

glosses

Zebra didn't paint the bowls!

PUP'':Zebra vazoları boyamadı!

glosses

Zebra didn't paint the vases!

To sum up, each participant received 2 training items, followed by 18 test trials: 6 critical plural targets (3 positive, 3 negative), 4 scalar implicature targets, 4 clearly true positive/negative plural controls, and 4 clearly true or clearly false negation controls. The plural and scalar implicature targets were presented in blocks, with order counterbalanced across participants. Within the plural block, the test and control trials were pseudorandomized.

4.2 Results

Figure 4 shows the proportion of 1-, 2-, and 3-strawberry responses to the plural positive, plural negative, and scalar implicatures targets. The non-maximal 1- and 2-strawberry responses were interpreted alike, in contrast to the 3-strawberry responses. The reward types were mapped to different readings of the target sentences as follows: for the scalar implicature targets and the positive plural targets, 1- and 2-strawberry responses were interpreted as a measure of the target inference having been computed, while 3-strawberry responses corresponded to a no-inference reading. For the negative plural targets, the opposite would hold: 3-strawberry rewards were interpreted as consistent with the multiplicity inference having been computed (under negation), while 1- and 2-strawberry responses corresponded to a no-inference reading.

Looking at the plural positive targets, the results show that adults mostly rejected a positive sentence in the context incompatible with the multiplicity inference, suggesting that they interpreted the sentence with the multiplicity inference. By contrast, children were ready to accept positive sentences in the same context, suggesting that they interpreted the sentence

without the multiplicity inference. In the plural negative targets, on the other hand, there is a split between the adults participants in giving a maximal or non-maximal reward to the puppet. Children instead tended to give minimal rewards, suggesting that they interpreted the negative sentences along the lines of negated existential statements, that is, without the multiplicity inference.

As for the scalar implicature condition, both adults and children rewarded the puppet with non-maximal reward which suggest that both groups computed the implicature of *bazi* ‘some’.

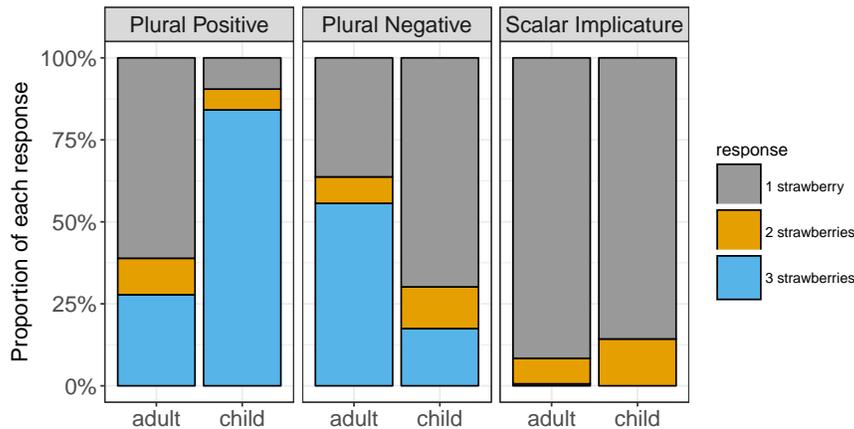


Figure 4: Proportion of 1, 2, and 3 -responses in positive, negative, and scalar implicature targets.

Figure 5 demonstrates the results for the positive and negative plural targets, with the ternary responses recoded in binary terms (1 for inference reading, 0 for no-inference reading). Logistic regression models fitted to these recoded plural data revealed significant effects of Group ($p < .001$). However, there was neither an effect of polarity nor interaction: : adults interpreted plurals as giving rise to the ‘more than one’ meaning more than children did and this difference did not vary across positive vs negative.

Finally, Figure 6 shows the results for the positive multiplicity inference targets and scalar implicature targets with the ternary responses recoded in binary terms (1 for inference-consistent responses, 0 for inference-inconsistent responses), across the two groups. In general, both groups computed more implicatures than ‘more than one’ meanings with a more pronounced difference observed in the children.

To sum up, the results overall show that while adults mostly interpret positive sentences with the multiplicity inference, there is a split in their response pattern in the negative condition. Children, on the other hand, do not interpret sentences as giving rise to the multiplicity inference across both conditions. Moreover, both adults and children computed the scalar implicature of *bazi* ‘some’.

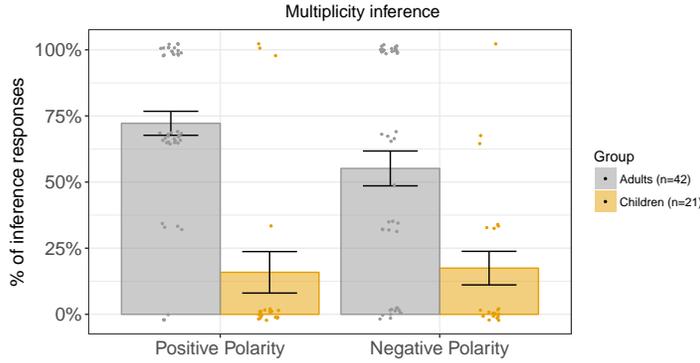


Figure 5: Multiplicity inference computation in positive and negative contexts, after recoding the ternary responses in binary terms (1 for inference reading, 0 for no inference reading). Each dot represents an individual participant’s mean inference rate for the given condition (a horizontal jitter of .1 and vertical jitter of .025 were applied for easier visualization).

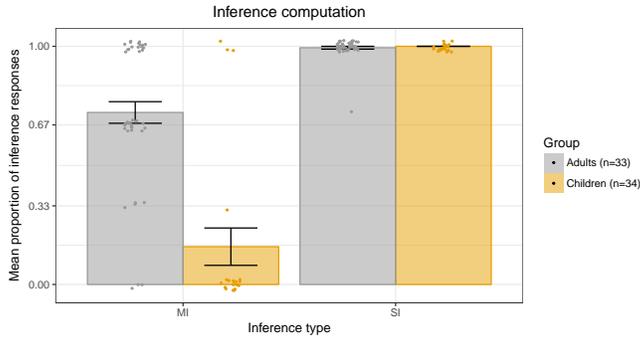


Figure 6: Multiplicity and scalar inference computation in positive contexts, after recoding the ternary responses in binary terms (1 for inference reading, 0 for no-inference reading). Each dot represents an individual participant’s mean inference rate for the given condition (a horizontal jitter of .1 and vertical jitter of .025 were applied for easier visualization)

5 Discussion

5.1 Adults data

Consider first positive plural targets. As predicted by both strict plurality and number neutrality, adults mostly rejected positive plural sentences in contexts in which the ‘more than one’ meaning was not satisfied in the context, replicating the English and Greek findings in [15, 10]. However, while the variance in adults’ responses pose challenges for strict plurality approach, it is compatible with the number neutral approach.

As for negative plural sentences, adults responses were split between acceptance and rejection in negative targets, as predicted by number neutrality but not by strict plurality. This split can be due to a wide or a narrow scope interpretation of plural ($neg < plural$ or $plural < neg$), as discussed in Section 3.

Interestingly also the adults' data differ from those in English [15] and Greek [10]. Unlike the Turkish results, the results of a similar experiment in English and Greek show no split in the adults' response pattern in the negative targets. This difference might be due to the available scopal differences between English/Greek and Turkish. While in Turkish plural can scope both above and below negation, in English and Greek the former is not readily available.

5.2 Children data

The results from positive targets are consistent with the **implicature approach**: children showed a strong preference for the number-neutral interpretation of plural nouns, in contrast to adults. In particular, they interpreted the positive targets on their literal number-neutral meaning, in line with the observation that children tend to derive fewer implicatures at this age (Noveck 2001, Papafragou & Musolino 2003, a.o.).

In the negative targets, on the other hand, children, unlike adults, failed to access a wide scope interpretation of the plural above negation (for discussion of isomorphic preferences in children, see Musolino 1998, Lidz & Musolino 2002, Gualmini et al. 2008, a.o.).

Even though the overall results are compatible with the implicature approach, they also pose challenges for this approach. In particular, the results haven't revealed the same pattern of between-population differences in the multiplicity inference- and scalar implicature-computation: while children didn't compute the multiplicity inference, they did compute a scalar implicature of *bizi* 'some' in 100% of the cases.

6 Conclusion and directions for future research

Overall, our results support a theory of Turkish plural nouns as number-neutral combined with the assumption that they are not scopally-inert [3, 2]. The children's results are in line with an implicature approach. However, the results from scalar implicature condition are challenging and suggest at least a large variability among scalar terms [16]. In future work, we plan to check more directly whether the scope indeed plays a role in the interpretation of Turkish plural.

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