

## Turkish plural nouns are number-neutral: Experimental data

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## 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 a ‘semantically unmarked’/number-neutral literal meaning of the plural noun ([10, 18, 20]; see also [5, 12]). In Turkish, however, it is controversial whether plural nouns should be analysed as number-neutral or whether they should directly denote strict plurality [2, 19, 6]. This debate is important as it can shed light on the meanings 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 *bazi* ‘some’. The results of our experiment support a theory of plural nouns which includes a number-neutral interpretation.

## 1 Introduction

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

(1) Tiger planted trees.  
~~ *Tiger planted more than one tree* MULTIPLICITY INFERENCE (MI)

(2) Tiger planted a tree.  
~*Tiger planted more than one tree*

In the case of English, the MI is generally claimed not to be encoded in the literal meaning of the plural noun (see, for example, [10, 18, 20]). That is, the plural in English would not encode 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

Under the number neutrality approach, it remains to be explained how the MI arises. There are two competing proposals in the literature: according to the first, the MI arises as an implicature

[18, 20], while on the second approach, the MI corresponds to one of the possible meanings of an ambiguous plural [5, 12]. In other words, the relevant theoretical options regarding the interpretation of the plural across languages are as follows: either the plural directly encodes multiplicity via strict plurality or it includes a number-neutral denotation. If the latter, then the MI is either an implicature or it arises through an ambiguity in the meaning of the plural.<sup>1,2</sup> The general consensus is that the possible interpretations of plural nouns in English include a number-neutral reading.

Compared to English, the nature of the plural in Turkish is more controversial, with existing arguments for strict plurality on the one hand [1, 2] and for number neutrality on the other [8, 19].<sup>3</sup> We conducted an experimental study in order to contribute to this debate. 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 *bazi* ‘some’. When combined with the assumption that Turkish plural nouns are not scopally inert [3, 2], the experimental results support a number-neutral theory of Turkish plural nouns. We argue that our results support an analysis of the Turkish plural that is very similar to what has been assumed for the English plural, and suggest that the source of observed differences can be found in different scope possibilities associated with bare plurals in the two languages.

The rest of the paper is structured as follows. Section 2 presents the semantics of plural nouns in Turkish. In particular, we discuss the two main approaches proposed in the literature: strict plurality and number neutrality. In Section 3, we discuss the predictions of the two approaches. We present our experimental study in Section 4, and discuss the results in the context of the theoretical predictions in Section 5. Section 6 concludes the paper.

## 2 Background: Two approaches to Turkish plural nouns

As in English, Turkish plural nouns give rise to a multiplicity inference, as in (5):

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

As mentioned, there is still controversy as to whether Turkish plural nouns should denote strict plurality directly or whether they should be associated with a number-neutral interpretation, with the MI arising as an implicature or through ambiguity.

The situation is complicated by the fact that bare plural nouns in Turkish, unlike in English, have been argued not to be scopally inert [3, 2]. That is, while in English a bare plural noun like *doctors* can only scope below *want* in (6) [4], it is claimed that in the Turkish counterpart of this sentence, *doktorlar* ‘doctors’ can take scope either above or below *want*, as in (7) [3, 2]:

(6) Mary wants to meet doctors. [from 3, p.51]  
 $\approx$  *Mary wants to meet some doctors or other.* *want > doctors* (narrow scope)  
 (7) Mary doktor-lar bul-mak ist-iyor.  
 Mary doctor-PL meet-INF want-PROG.3

<sup>1</sup>In other words, the plural is number-neutral under the implicature approach, while it is ambiguous between a number-neutral version and a strictly plural one in the ambiguity approach. Since under both approaches number-neutrality is among the possible denotations of the plural, we refer to both as *number-neutral* approaches.

<sup>2</sup>There is a third type of approach based on homogeneity [11]. We leave to future research a thorough evaluation of the homogeneity account against our data.

<sup>3</sup>[1, 2] actually focus on Western Armenian but claim that their analysis would extend to Turkish.

‘Mary wants to meet doctors.’	[from 3, p.51]
$\approx$ <i>Mary wants to meet some doctors or other</i>	<i>want &gt; doctors</i> (narrow scope)
$\approx$ <i>There are some doctors that Mary wants to meet</i>	<i>doctors &gt; want</i> (wide scope)

This suggests that a negative sentence containing a bare plural in Turkish, such as (8), might also in principle give rise to two interpretations depending on the scopal relation between the plural and negation.<sup>4</sup>

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

a.  $\approx$  *It’s not true that Tiger planted trees* (NEG > PL)  
 b.  $\approx$  *There are some trees that Tiger didn’t plant* (PL > NEG)

### 3 Predictions

#### 3.1 The effect of polarity

Both the strict plural and number-neutral approaches, combined with the assumption that bare plurals in Turkish can take wide scope over negation, make clear predictions regarding the acceptability of sentences with plural nouns in positive vs. negative contexts. Consider first a positive sentence such as the one in (9). Both the strict plurality and number neutrality predict (9) to be unacceptable in the described context in which Tiger planted only one tree.<sup>5,6</sup>

(9) **Context:** Tiger planted only one tree.  
 Kaplan ağaç-lar ek-ti.  
 tiger tree-PL plant-PAST  
 ‘Tiger planted trees.’

STRICT PLURALITY APPROACH:  $\approx$  *Tiger planted more than one tree*  
 NUMBER NEUTRALITY APPROACH:  $\approx$  *Tiger planted more than one tree*

However, the predictions of the two approaches diverge in the case of negation. Consider first the interpretation on which the plural scopes under negation. In this case, the meaning of (10) under both approaches can be paraphrased as in (10-a) and (10-b):

(10) **Context:** Tiger planted only one tree.  
 Kaplan ağaç-lar ek-me-di.  
 tiger tree-PL plant-NEG-PAST  
 ‘Tiger didn’t plant trees.’

a. STRICT PLURALITY:  $\approx$  *Tiger didn’t plant more than one tree* (NEG>PL)  
 b. NUMBER NEUTRALITY:  $\approx$  *Tiger didn’t plant any tree* (NEG>PL)  
 c. BOTH APPROACHES:  $\approx$  *There are trees that Tiger didn’t plant* (PL>NEG)

<sup>4</sup>Note however that the intuition that bare plurals can get a wide scope interpretation with respect to negation is not shared by all Turkish native speakers.

<sup>5</sup>As mentioned above, when we refer to the number neutrality approach, we mean an account that includes a number-neutral interpretation among the possible readings of the plural, combined with either an implicature or an ambiguity approach to explain the presence of the MI.

<sup>6</sup>The number-neutral approach actually predicts the two readings in both the positive and negative condition. One of the two reading is assumed to be preferred by a principle which favours the strongest reading in each case.

	STRICT PLURALITY	NUMBER NEUTRALITY
Tiger planted trees.	✗	✗
Tiger didn't plant trees. (NEG>PL)	✓	✗
Tiger didn't plant trees. (PL>NEG)	✓	✓

Table 1: Predicted acceptability of positive and negative sentences in a context in which Tiger planted only one tree, according to the strict plural and number-neutral approaches.

As is clear from the paraphrases, while the strict plurality approach predicts the sentence in (10) to be acceptable as a true description of the described context (it is true that Tiger didn't plant more than one tree), the number-neutral approach predicts (10) to be judged false in the same context (it is false that Tiger didn't plant any trees). The situation differs, however, when the plural takes wide scope over negation. In this case, under both approaches, the sentence in (10) can be roughly paraphrased as in (10-c). Since this interpretation is compatible with the described context, both approaches predict (10) to be acceptable in this context.

To sum up, both approaches predict the positive sentence *Tiger planted trees* to be judged false in a context in which Tiger planted only one tree. However, while the strict plural approach predicts invariable acceptance of negative sentences in the same context, the number-neutral approach makes different predictions depending on the scopal interaction between the plural and negation. The predictions of the two approaches are summarized in Table 1.

### 3.2 Multiplicity inferences vs. standard implicatures

The number-neutral approach, combined with the view that the MI is a scalar implicature (SI), makes further predictions regarding the relationship between the MI and other SIs, and in particular in relation to whether children are expected to compute these inferences, compared to adults. Specifically, the implicature approach predicts that children should access the ‘more than one’ meaning less than adults do, mirroring the behavioral pattern associated with standard lexical-scale-based implicatures (for relevant discussion, see [21, 22, 17, 25]). The strict plurality approach, on the other hand, makes no particular predictions with respect to the comparison between the MI and other SIs, in children vs. adults.

## 4 Experiment

We tested the predictions of the strict plurality and number neutrality approaches discussed above by investigating Turkish speakers’ interpretations of plural nouns in positive and negative contexts, as well as comparing the MI in Turkish to the SI of *bazi* (‘some’) [22, 17].

### 4.1 Methods

**Participants** We tested 45 adult native speakers of Turkish and 22 Turkish-speaking children (age range 4-6 years, mean age 5;02). One child and three adults were excluded from the analysis for failing to pass the control trials, leaving a total of 42 adults and 21 children.

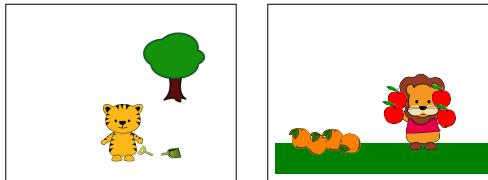


Figure 1: *Left:* image for the MI targets in (11)/(11); *Right:* image for the SI target in (12).

**Procedure** Participants listened to short stories presented through a PowerPoint presentation on a laptop computer. Participants were introduced to a puppet with whom they interacted throughout the experiment via webcam (in reality, through pre-recorded videoclips). After each story, the experimenter asked a question to the puppet and the puppet responded with the test sentence. The participants' task was to judge the puppet's utterances by rewarding her with one, two, or three strawberries, depending on her performance [9, 23]. Participants were instructed to give the puppet one strawberry if they thought the puppet didn't answer well, three strawberries if she answered well, and two strawberries if the puppet's answer was somewhere in the middle – not perfect, but somewhat okay.

**Materials** We manipulated three factors: Group (child vs. adult), Inference Type (MI vs. SI), and Polarity within the plural condition (positive vs. negative). The MI and SI conditions were introduced in blocks and their order was counterbalanced across participants. To illustrate, consider first an example of a positive and a negative MI target, in (11). The story made it clear that the MI triggered by the plural was not satisfied in the context. The corresponding picture is provided in Figure 1.<sup>7</sup>

(11) **Context:** Tiger only planted this one tree and no flowers. MI target  
 EXP: Okay, Ellie, so Tiger didn't plant any flowers. What about trees?  
 a. Kaplan ağaç-lar ek-ti. b. Kaplan ağaç-lar ek-me-di.  
 tiger tree-PL plant-PAST tiger tree-PL plant-NEG-PAST  
 'Tiger planted trees.' 'Tiger didn't plant trees.'

On both the strict plurality and number neutrality approaches, participants were expected to interpret the positive targets with the MI (i.e. *Tiger planted more than one tree*); given that the MI was not satisfied in the context, participants were expected to reward the puppet with either one or two strawberries. Note that the number-neutral approach allows for a number-neutral reading without the MI, while the strict plural approach does not; the former, but not the latter, would therefore allow for variation in participants' responses to the positive targets.

Moving on to the negative targets, the strict plurality approach predicts that participants should invariably access the strict plural interpretation of the noun. Crucially, this interpretation is compatible with the given context, irrespective of the scopal interaction of the plural and negation. Therefore, participants were expected to give the puppet the maximal reward. As for the number-neutral approach, the expected reward would depend on the scope of the plural: the interpretation on which negation scopes over the plural is incompatible with the context, which would lead to non-maximal rewards in contexts like that in Figure 1. The interpretation on which the plural scopes over negation, on the other hand, is compatible with the context

<sup>7</sup>To keep things interesting for the child participants, the characters and objects varied from one item to the next.

and participants were therefore expected to select the maximal reward.

In the SI condition, borrowed from [21, 22], it was made clear in the stories that the action of the protagonist involved the whole set of pictured objects. When asked what had happened in the story, the puppet answered using the scalar term *bazi* ‘some’, as in (12) (see Figure 1 for the corresponding picture):

(12) **Context:** Lion took no oranges and all of the apples. SI target  
 EXP: Okay, Ellie, so the Lion didn’t carry any oranges. What about the apples?  
 PUP: Aslan elma-lar-in bazi-lar-i-ni taşı-di.  
 Lion apple-PL-GEN some-PL-POSS.3SG-ACC carry-PAST  
 ‘Lion carried some of the apples.’

If participants computed the SI of *bazi* ‘some’, i.e. *the lion didn’t carry all of the apples*, they were expected to reward the puppet with one or two strawberries. If the utterance instead was interpreted literally, 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 of the controls corresponded to clearly true plural sentences that were expected to elicit the maximal reward, as in (13) and (14):

(13) **Context:** Giraffe did not bake any cakes but she baked four cookies.  
 EXP: Okay, Ellie, so Giraffe didn’t bake any cakes. What about cookies?  
 PUP: Zürafa kurabiye-ler pişir-di.  
 Giraffe cookie-PL cook-PAST  
 ‘Giraffe baked cookies.’ Positive control

(14) **Context:** Sheep baked four pizzas but no baklavas.  
 EXP: Okay, Ellie, so Sheep baked pizzas. What about baklavas?  
 PUP: Koyun baklava-lar pişir-me-di  
 Sheep baklava-PL cook-NEG-PAST  
 ‘Sheep didn’t bake baklavas.’ Negative control

Four other controls corresponded to clearly true or clearly false negative sentences that contained a definite noun phrase instead of a bare plural, which allowed us to check that participants could correctly interpret negation independently of the plural. These trials could be associated with either a minimal or a maximal reward target; the experimenter selected the appropriate version of the trial depending on how participants responded to the critical target trials, balancing the overall number of minimal and maximal rewards given across the experiment.

(15) **Context:** Zebra painted four vases and no bowls. Negation control  
 EXP: Ellie, can you tell us something about the story?  
 PUP: Zebra kase-ler-i boyama-di! PUP: Zebra vazo-lar-i boyama-di!  
 Zebra bowl-PL-ACC paint-NEG-PAST Zebra vase-PL-ACC paint-NEG-PAST  
 ‘Zebra didn’t paint the bowls!’ ‘Zebra didn’t paint the vases!’

In sum, each participant received two training items followed by 18 test trials: 6 critical plural targets (3 positive, 3 negative), 4 SI targets, 4 clearly true positive and negative plural controls, and 4 clearly true or clearly false negation controls. The MI and SI targets were presented in blocks, counterbalanced across participants, and the test and control trials within the plural block were pseudo-randomized.

## 4.2 Results

Figure 2 displays the proportion of 1-, 2-, and 3-strawberry responses to the positive, negative, and scalar implicatures targets. As a first step, we collapsed the ‘non-maximal’ 1- and 2-strawberry responses. For the SI and positive MI 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 reading without the relevant inference. For the negative plural targets, 3-strawberry rewards were interpreted as consistent with the MI having been computed (under negation), while 1- and 2-strawberries corresponded to a reading without the MI.

Focusing on the plural positive targets, we observe that adults mostly rejected the positive sentences in contexts that were incompatible with the MI, indicating they had computed the inference. By contrast, children tended to accept the positive sentences in the same contexts, suggesting they hadn’t computed the MI. On the plural negative targets, on the other hand, adults appeared to split between selecting the maximal and the non-maximal rewards. Children instead tended to give minimal rewards only, suggesting that they interpreted the plural under negation without the MI. As for the SI condition, both groups generally selected non-maximal rewards, indicating they computed the implicature of *bazi* ‘some’.

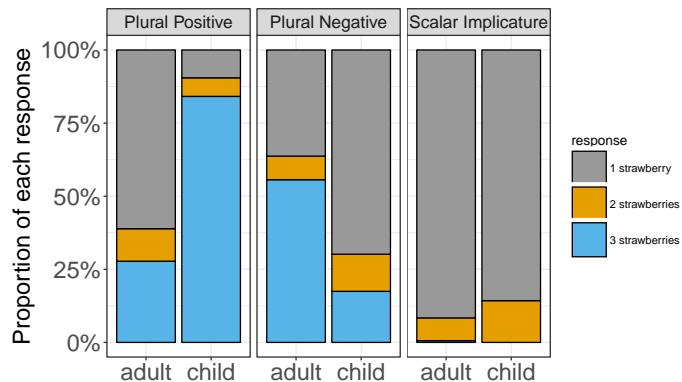


Figure 2: Proportion of 1-, 2-, and 3-strawberry responses across conditions.

Figure 3 presents the results for the positive and negative plural targets, with the ternary responses recoded in binary terms. Logistic regression models fitted to these recoded plural data revealed a significant effect of Group ( $\chi^2 = 29.2$ ,  $p < .001$ ) but no effect of Polarity or Group:Polarity interaction. Finally, in Figure 3 we also compare the positive MI targets with the SI targets, across the two groups (with ternary responses recoded in binary terms). Both groups generally computed more implicatures than ‘more than one’ meanings, with adults computing more multiplicity inferences than children ( $\chi^2 = 29.1$ ,  $p < .001$ ).

To sum up, the results indicate that while adults mostly computed MIs from positive plural sentences, they were split in their interpretation of plural negative sentences. Children, on the other hand, did not interpret the plural sentences as giving rise to MIs in either condition. Finally, both adults and children computed the scalar implicature of *bazi* ‘some’.

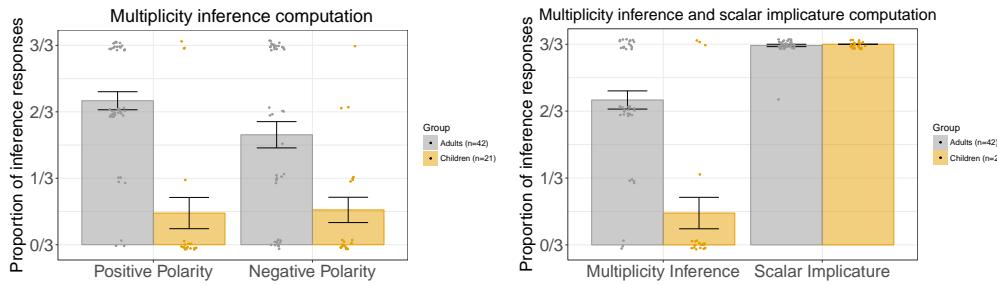


Figure 3: Multiplicity inference computation in positive and negative contexts (left) and multiplicity and scalar inference computation (right) in positive contexts, after recoding the ternary responses in binary terms (1 for inference reading, 0 for no inference reading). Each dot represents an individual participant’s mean inference rate for the given condition.

## 5 Discussion

**Adult data** As predicted by both the strict plurality and number neutrality approaches, adults mostly rejected positive plural sentences in contexts in which the ‘more than one’ meaning was falsified, replicating the English and Greek findings reported in [22] and [17]. Moreover, while the variance in adults’ responses pose a challenge for the strict plurality approach, it is nevertheless in line with the number-neutral approach.

As for negative plural sentences, adult participants were split between acceptance and rejection of the negative targets, as predicted by the number neutrality approach but not by the strict plurality approach. The split we observe among participants could be due to their accessing different scopal interpretations of the plural with respect to negation ( $PL > NEG$  or  $PL < NEG$ ), as discussed in Section 3. In this respect, the adults’ data differed from those reported for English [22] and Greek [17], where participants tended to overwhelmingly reject the negative target sentences. Put differently, the results of similar experiments in English and Greek reveal a much larger proportion of number-neutral interpretations under negation. This difference, we argue, could be due to the differences in scopal possibilities in English and Greek compared to Turkish: while in Turkish the plural is able to scope either below or above negation, in English and Greek only the former option is available.

**Child data** The results from the 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, the child participants interpreted the positive targets on their number-neutral meaning, in line with the observation that they tend to derive fewer implicatures at this age [15, 16, a.o.]. On the negative targets, on the other hand, children, unlike adults, failed to access a wide scope interpretation of the plural above negation, which is also in line with some existing literature that indicates children in this age range have a preference for isomorphic interpretations of scopally ambiguous sentences [14, 13, 7]).

While the overall results are in line with the implicature approach, the results in the SI condition are surprising for this approach. In particular, participants did not treat the MI and SI targets alike: children generally did not compute MIs but they always computed the SI of *bazi* ‘some’, like adults. While variation among scalar terms has been observed in adults [24],

such an extreme difference between the MI and SI conditions warrants further investigation.<sup>8</sup>

## 6 Conclusion and future directions

The present study examined whether plural nouns in Turkish denote strict plurality or are number-neutral given the existence of competing view in the theoretical literature on Turkish. We tested adults and 4-6-year-old children on the interpretation of bare plural nouns in upward- and downward-entailing contexts, and compared this to the scalar implicature of *bazi* ‘some’. Overall, when combined with the assumption that bare plurals in Turkish are not scopally inert [3, 2], our results support a theory of Turkish plurals as number-neutral. Moreover, both the adults’ and children’s results are in line with an implicature approach. However, the results from the scalar implicature condition are challenging for this approach, even when we consider that there is reported variability among scalar terms in adults [24]. Future work could test whether scope is indeed a factor in the interpretation of Turkish plural nouns, by directly manipulating whether the potential wide-scope reading of the bare plural is made true in the context.

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<sup>8</sup>The calculation of SI by children could also be influenced by the genitive partitive construction used in the SI targets. We will investigate it further in future research.

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