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The Plural is Unmarked: Evidence from Turkish, Hungarian and German

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Quantity distinctions are morphologically indicated in the majority of languages. However, the marking of these distinctions exhibits a high degree of cross-linguistic variation with respect to the number of quantity categories, their agreement properties, and the morphemes themselves. Furthermore, number marking on numerically quantified nouns varies across languages: for instance, while German and English use plural number marking with numerals other than “one” (for example, “two books”), Turkish and Hungarian use singular number marking with all numerals. Recent work has discussed how to explain number marking with numerals. In particular, Bale and Khanjian (2014) propose that the quantity concepts of the two types of languages vary semantically. We present novel evidence from a cross-linguistic study of Hungarian, Turkish and German child language, and argue that the quantity concepts do not vary, and the variation between languages must have a morphosyntactic explanation.

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1 Introduction

Non-human animals as well as pre-linguistic infants seem capable of discriminating different quantities (Dehaene 1997). What humans frequently do in language is mark the distinction between single and multiple objects through morphology, often in surprisingly variable ways (Corbett 2000; Harbour 2014 and others). Many languages exhibit a singular/plural distinction, and many also show further number categories such as the dual, trial, paucal, and others that restrict the number of referents to a subset of all pluralities. In this paper, we are primarily interested in the *number-neutral* use of nouns, where the noun doesn't semantically exclude referents of any numerosity. When nouns are number-neutral—or semantically unmarked for number—in a language, they are compatible with both singleton and multiple referents.¹ In languages like Japanese, which is without number morphology, all nouns are number-neutral (Nakanishi & Tomioka 2004). The sentence in (1) does not imply either singularity or plurality of tomatoes.

- (1) Lina-ga tomato-o totta.
 Lina-NOM tomato-ACC took.PST
 'Lina took a tomato/tomatoes.'

Languages like English, on the other hand, draw a binary distinction in number morphology between singular and plural. At first glance, it also seems to hold semantically. For adult speakers of English, the sentence in (2a) implies that Lina picked a single tomato, whereas the example in (2b) is perceived to mean that Lina picked two or more tomatoes.

- (2) a. Lina picked a tomato.
 b. Lina picked (some) tomatoes.

Unlike in Japanese, the English noun *tomato* seems to be compatible only with a singleton referent, and *tomatoes*, with multiple referents. However, semantic research has found that even in languages with number marking on nouns, there are environments where plural expressions are neutral with respect to numerosity (van Eijck 1983; Hoeksema 1983; Sauerland 2003; Sauerland et al. 2005; Farkas & de Swart 2010; Saĝ 2019; 2022, and others). Such number-neutral uses have been explained by the assumption that one member of the singular-plural opposition is semantically unmarked (i.e. number-neutral), but its use can be blocked by the marked member. The unmarked form can also emerge as number-neutral in cases where the use of the marked form is blocked by factors other than numerosity. On the basis of adult language,

¹ In this paper, we will discuss the semantic *markedness* of number features, and hence, will refer to the plural as being unmarked for number. Expressions also used in the literature are number-general and number-neutral. Both morphological and semantic markedness are defined in the next section.

different proposals have been made for different languages as to whether the singular or the plural is unmarked (Bale et al. 2010; Farkas & de Swart 2010; Sauerland et al. 2005; Sağ 2022; Scontras 2022 and others). In this paper, we present evidence that plural number is semantically unmarked in Turkish, Hungarian and German, using data from child language.

The basic assumption behind this study is as follows. Since the work of Noveck (2001), many researchers have investigated children's understanding of pragmatic phenomena, especially scalar implicatures. One of the repeated findings is that, given two alternative expressions where one is stronger than the other, children frequently allow the use of weaker alternatives in wider contexts than adults do. We hypothesize that singular and plural form an opposition, and that the plural is weak/semantically unmarked, while the singular is strong/semantically marked. This makes a direct, testable hypothesis, shown in (3), assuming that the plural is the weaker alternative across languages:

- (3) Children across languages should uniformly understand the plural, the weaker expression, as semantically unmarked for number in all environments.

There have been some studies on the acquisition of semantic markedness of number morphology in English (Sauerland et al. 2005; Tieu et al. 2014; 2020), German (Yatsushiro et al. 2017), and Turkish (Renans et al. 2020), observing that children interpret plural expressions as semantically unmarked in these languages. Our results partially replicate and corroborate the findings by Renans et al. (2020), using two different experimental methods.

This paper is organized as follows: In section 2, we discuss previous studies and semantic analyses of plural morphology; in section 3, we review previous experimental studies that investigated adult comprehension and child language acquisition; in section 4, we present our experiments; and section 5 is a discussion of our findings and of the implications of our study for theories of number markedness.

2 Background: Morphological vs. Semantic markedness

In many languages with a singular-plural distinction in morphological forms, the plural form is derived by adding an additional morpheme (for example, prefix, suffix, or reduplication of the singular form) to the singular form.² In English, for example, a suffix [s], [z], or [əz] is added to the singular form of many common nouns that can be pluralized, as in *girl*–*girls*. English contrasts with languages like Latin, which use different suffixes for both the singular and the plural, e.g.

² Among the 1066 languages listed on the World Atlas of Language Structures Online on the chapter regarding plural marking, 126 languages use prefixes, 513 use suffixes, 6 use stem changes, 4 use tones, 8 use reduplication, 60 use mixed morphological cues, 170 have separate lexical entries for plural and singular, 81 use plural clitics, and 98 do not have plural forms (Dryer 2013). (Available online at <http://wals.info/chapter/33>, Accessed on 2021-06-22.)

equ-us ('horse-SG') and *equ-i* ('horse-PL'). In this paper, we define morphological markedness as follows, following Greenberg (1966: p. 26):

- (4) Feature A is morphologically more marked than feature B, when there is an opposition between two morphemes, and feature B uses zero expression.

According to this definition, English and many other languages that make singular-plural distinctions have a morphologically unmarked singular: singular nouns are not marked by a morpheme with phonological content, whereas plural nouns are.

Semantic markedness, on the other hand, is defined in terms of asymmetric logical entailment (Sauerland 2008). Because two features A and B do not always semantically correspond to propositions, we presuppose the extended sense of entailment based on the stipulation that function *F* entails *G* if and only if for any possible value *x* of *F* and *G* it holds that *F*(*x*) entails *G*(*x*). Specifically, we define semantic markedness as follows:

- (5) Feature A is semantically more marked than feature B from the same morphological paradigm when the semantic interpretation of feature A entails that of feature B, and not vice versa.

Under this definition, the semantically unmarked feature is predicted to be logically true in a broader set of contexts than the more marked feature. But the relationship between logical truth and whether a feature can be used is not direct due to the phenomenon of implicature. Informally speaking, implicature says that if both features A and B are true in a context, only the more marked one can be used because it is more informative. This predicts A and B to be in complementary distribution when a markedness relation between the two holds (Sauerland 2008).

The semantic markedness of number is therefore debated. Three main approaches towards the semantic markedness of number can be summarised as follows:

- (6) a. *Singular-unmarked* approaches: The singular is semantically unmarked while the plural has one or more meanings that entails the singular (Farkas & de Swart 2010; Kiparsky & Tonhauser 2012).
 b. *Plural-unmarked* approaches: The plural is semantically unmarked and the singular has a meaning that entails that of the plural (Hoeksema 1983; van Eijck 1983; Krifka 1989; Sauerland 2003; Sauerland et al. 2005; Spector 2007; Mayr 2015; Sağ 2022 and others).
 c. *parametrized-markedness* approach: The markedness of singular and plural number varies between languages (Bale & Khanjian 2014).

We briefly outline the three approaches, relying in particular on the formulations of Farkas & de Swart (2010), Mayr (2015), and Bale & Khanjian (2014). To do so, we will present how the

three accounts analyze the sentences in (7). In the two positive sentences, (7a) and (7b), the difference between singular and plural marking has a clear semantic effect—only (7b) entails that Lina picked more than a single tomato. The central issue for all theories, however, is that there is no comparable semantic difference between the two corresponding negative sentences, (7c) and (7d).³ Specifically, the plural variant in (7d) is judged false even if Lina picked exactly one tomato, akin to the entailment of (7b). This means that (7d) cannot be interpreted as the logical negation of (7b).

- (7)
- a. Lina picked a tomato.
 - b. Lina picked some tomatoes.
 - c. Lina didn't pick a tomato.
 - d. Lina didn't pick tomatoes.

For the singular-unmarked approaches, the account of (7b) is straightforward: the logical meaning of the plural requires the number of tomatoes to be greater than one, and (7b) thus entails that Lina picked multiple tomatoes. Similarly, the account for (7a) comes directly from the lexical meaning of the singular which includes the possibility of a single tomato. (7c) is also accounted for by the assumption that the singular is unmarked: the singular negated proposition therefore contradicts both the singular (7a) and the plural (7b) positive propositions. The fourth example, (7d), is, however, more difficult to account for within a singular-unmarked approach. Singular-unmarked approaches correctly predict (7d) to be false in case Lina ate two or more tomatoes, but the critical case is one of a single tomato. If the plural has only a semantically strong interpretation requiring a plurality of entities, (7d) is predicted to be true if Lina ate one tomato. But this prediction is false for English. The singular-unmarked approach of Farkas & de Swart (2010) avoids this false prediction by postulating that the plural is polysemous between two interpretations: one interpretation that requires numerosity greater than one, but another that is essentially unmarked.⁴

³ Spector (2007) points out that (7d) has an inference that it would have been possible for Lina to pick multiple tomatoes, while the singular variant doesn't entail such a possibility. We put aside how to account for these inferences here, but see Spector (2007) and Ahn et al. (2021) for discussion.

⁴ Specifically, Farkas & de Swart (2010: p. 23) propose the two interpretations in (i), where x is an individual and $*P$ the number-neutral property provided by the head noun marked as plural. They assume that the domain of individuals contains two non-overlapping subsets, the set of atoms, *Atom*, and the set of non-trivial sums of atoms, *Sum*. In contrast, Farkas & de Swart (2010: p. 22) propose that '*singular nominals have no explicit number feature*'. For ease of exposition we can represent the semantic effect of the singular as (ii), but note that Farkas & de Swart would not assume a 'singular' morpheme unlike what (ii) suggests.

- (i)
- a. $\llbracket \text{plural} \rrbracket = \lambda x \lambda *P [x \in \text{Sum} \cup \text{Atom} \ \& \ *P(x)]$
 - b. $\llbracket \text{plural} \rrbracket = \lambda x \lambda *P [x \in \text{Sum} \ \& \ *P(x)]$
- (ii) $\llbracket \text{singular} \rrbracket = \lambda x \lambda *P *P(x)$

Farkas & de Swart argue that it is through a bidirectional pragmatic optimization process that the singular is restricted to *Atom* reference and the polysemy is resolved by the Strongest Meaning Hypothesis (SMH) of Dalrymple et al. (1998). The SMH requires that ambiguity must be resolved towards the logically strongest meaning of the matrix sentence.⁵ The SMH hence predicts that in a positive sentence (7b) and generally in isotone environments,⁶ the strong interpretation of the plural which excludes the singular should be required. But in the negative sentences (7d) and generally in antitone environments, the SMH predicts that only the weaker interpretation of the plural, which includes singular reference, is available. As a consequence, the singular-unmarked approach of Farkas & de Swart (2010) accounts for the fact that the singular and plural sentences in (7c) and (7d) are nearly synonymous.

In the second type of approach (plural-unmarked approaches), the singular is specified for a singleton referent, while the plural is unmarked for number. According to this approach, the observation that the plural often excludes singleton reference is derived as an implicature. We present an implementation of the idea by Mayr (2015) within the grammatical account of implicature (Chierchia et al. 2012). On this account, implicatures are derived from the silent semantic exhaustification operator **exh** (or \mathcal{O}). The formulation of **exh** by Mayr (2015) is shown in (8), where **Excl** indicates the set of excludable alternative properties to P . We will not define **Excl** in general (see for example Fox 2007; Katzir 2007; Trinh & Haida 2014; Trinh 2019), but we assume that the singular counterpart is always an excludable alternative for a plural predicate.

$$(8) \quad \mathbf{exh} = \lambda P \in D_{est} \lambda x \in D_e \lambda w \in D_s . P(x)(w) = 1 \wedge \forall Q \in \mathbf{Excl}(\text{Alt}, P) Q(x)(w) = 0$$

Furthermore, Mayr (2015) assumes that singular and plural express the concepts in (9).⁷ Note that while the singular concept requires atom (singleton) reference, the plural concept is unspecified and specifically includes atoms because any atom x would stand in the \sqsubseteq -relation to itself. In this sense, the plural in (9b) ends up being neutral for number.

$$(9) \quad \begin{array}{l} \text{a. SINGULAR} = \lambda P \in D_{et} \lambda X \in D_e . \text{atom}(X) \wedge P(x) \\ \text{b. PLURAL} = \lambda P \in D_{et} \lambda X \in D_e . \forall x \sqsubseteq X (\text{atom}(x) \rightarrow P(x)) \end{array}$$

⁵ The assumption that the matrix sentence's strength always matters is problematic in some cases (Sauerland 2012), but we put this aside for the present discussion.

⁶ Recall that *isotone* environments are those that preserve the direction of entailment relations, while *antitone* ones reverse entailment relations. We use the order-theoretic terms *isotone* and *antitone* of, for example, Birkhoff (1940) instead of the terms *upward* and *downward monotone* of elementary calculus, which are more popular in the linguistics literature.

⁷ The definitions assume a standard, mereological ontology – formally, a *semilattice* – where \sqsubseteq is the part-of relation and atom is true of objects that do not have non-null parts.

The plural-unmarked analysis accounts for the paradigm in (7) by assuming that **exh** must apply obligatorily only in isotone environments (Fox & Spector 2018).⁸ As such, in the positive cases (8a) and (8b), **exh** must apply. For the singular indefinite in (8a), however, **exh** has no effect, and the account predicts that a singular tomato referent is required because of the meaning of the singular. For the plural in (8b), the requirement of multiple referents is derived by the application of **exh** in the structure (10). Because the alternative [SG tomato] is excluded by **exh**, the plural indefinite requires that Lina harvested a multiplicity of tomatoes.

(10) Lina picked some **exh** [PL tomatoes]

Finally, the variants with *no*, (11), are predicted to be synonymous: the application of **exh** is not obligatory in the restriction of the negative indefinite because it is an antitone environment.

- (11) a. Lina picked no tomato.
b. Lina picked no tomatoes.

In sum, we have seen that both the singular-unmarked and the plural-unmarked approach can account for the basic English paradigm in (7). Our main interest in this paper is whether the number markedness pattern is the same across all languages. To the extent that they address this question, the singular-unmarked and the plural-unmarked approach both assume that the number markedness pattern is indeed crosslinguistically uniform. However, in the parametrized-markedness approach, where the evidence for parametric variation is necessarily cross-linguistic, number-markedness patterns are not assumed to be uniform across languages. We introduce this approach in the next subsection.

2.1 Prior evidence for the parametrized-markedness approach

While a parametrized-markedness approach could take different forms, we focus on the proposal by Bale & Khanjian (2014). They assume a distinction between Type I and Type II languages with respect to number markedness. Examples of Type I languages are English and German. In Type I languages, the plural is unmarked and includes the singular meaning. In other words, they agree with the plural-unmarked approaches for English, but not for the Type II languages. Examples of Type II languages are Western Armenian and Turkish. In Type II languages, the plural is not the unmarked form; instead, the singular is also compatible with a plural interpretation.

According to Bale & Khanjian (2014), the unmarkedness parameter accounts for three differences between Type I and Type II languages. One argument is based on the number

⁸ We adopt this assumption for the sake of concreteness here. See Ahn et al. (2021), Bassi et al. (2021), Magri (2009) for relevant discussion of the obligatoriness of exhaustification and alternative conceptions.

morphology used with numerically quantified nouns, the second argument relates directly to the data point (7d) above with a plural indefinite in an antitone environment, and a third argument relates to bound plural definites. Consider first how nouns combine with numerals. In English, the singular form is used only when a noun is combined with a numeral *one*. The plural form is used when a noun combines with *zero*, *two*, or a numeral higher than *two*. German has exactly the same number distribution as English, as shown in (13).

- (12) a. zero *tomato / tomatoes
 b. one tomato / *tomatoes
 c. two *tomato / tomatoes
- (13) a. null *Tomate / Tomato-n
 zero tomato / tomato-PL
 b. eine Tomate / *Tomate-n
 one tomato / *tomato-PL
 c. zwei *Tomaten / Tomato-n
 two tomato / tomato-PL

In Turkish and Hungarian, on the other hand, numerals that indicate plurality combine with the singular form, as shown in (14) and (15), respectively.

- (14) iki çocuk / *çocuk-LAR
 two child / child-PL
 ‘two children’
- (15) hét virág / *virág-ok
 seven flower / flower-PL
 ‘seven flowers’

One way to account for the difference in number marking with numerals between Type I and Type II languages is to assume that the unmarked number—i.e. the singular—is used with all numerals in Type II languages. This assumption motivates both the account of Farkas & de Swart (2010) and that of Bale & Khanjian (2014): both assume that the singular form can be used with numbers other than *one* in Type II languages because the singular form is unmarked.⁹ Other research has reached different conclusions and does not relate the number marking with numerals to number markedness. But for the present discussion, let us pursue the hypothesis that Farkas & de Swart (2010) and Bale & Khanjian (2014) are correct on the account of Type II languages, and turn to Type I languages.

⁹ These accounts predict the plural to be also possible which is the case in Western Armenian as we discuss in the following. To block this plural in other Type II languages requires an additional assumption.

The account of Type I language differs between Farkas & de Swart (2010) and Bale & Khanjian (2014). As discussed above, Farkas & de Swart (2010) assume that the singular is unmarked in Type I languages as well. Bale & Khanjian (2014), however, point to a second difference between Type I and Type II languages to arrive at the conclusion that the plural is unmarked in Type I languages. The relevant data come from Western Armenian. Bale & Khanjian (2014) observe that in Western Armenian, numerals like *two* can combine with either singular or plural marking.

- (16) a. Yergu dəgha vaze-ts.
 two boy.SG run-PST
 ‘Two boys ran.’
 b. Yergu dəgha-ner vaze-ts-in.
 two boy-PL run-PST-3PL
 ‘Two boys ran.’

The Western Armenian pattern is different from Turkish and Hungarian where only the singular is compatible with numerals as we saw in (14) and (15). But the Western Armenian pattern is actually more straightforwardly accounted for by the assumption that the singular is unmarked in Western Armenian. Namely, if the singular is unmarked in Type II languages, we expect both, that (i) a singular noun, being semantically unmarked for number, can combine with any numeral, and (ii) a plural form, semantically marked for plurality, can combine with numerals greater than 1.¹⁰ Therefore, Western Armenian is analyzed as a Type II language by Bale & Khanjian (2014). The second important data point for Bale & Khanjian (2014) is (17):¹¹ They report that Western Armenian differs from English and other Type I languages with respect to the judgments on structures like (7d). For Western Armenian, Bale & Khanjian (2014: p. 4) provide (17) as evidence that it differs from Type I languages. Specifically, the plural noun *bəzdig-ner* (‘children’) is reported to receive a strong interpretation paraphrasable as *two or more* even in an antitone environment:

- (17) ʔAmen mart vor bəzdig-ner uner vodk-i gajne-tsav.
 all person that child-PL had foot-DAT stand.up-PST
 ‘Everyone that had two or more children stood up.’

The strong interpretation of the plural in (17) is surprising because it occurs in the restrictor of a universal quantifier in (17), which is an antitone environment.¹² We saw above that a plural in

¹⁰ The prediction as stated here would not arise if exhaustification obligatorily applied in the scope of the numeral and when applied to a singular noun would necessarily exclude the plural.

¹¹ Bale et al. (2011) present further relevant data from two other antitone environments (a polar question and the antecedent of a conditional).

¹² We put aside here that the restrictor of a natural language universal quantifier is generally not actually antitone because it presupposes that the restrictor is non-empty. For example, Gajewski (2011) utilizes this type of difference

an antitone environment in English is interpreted as number general. In (7d), a plural indefinite occurs in the scope of negation, but the same point holds for the restrictor of universal quantifiers: (18) is judged false in English in a scenario where people with one child didn't stand up.

(18) Everyone who has children stood up.

The difference between (17) and (18) is expected, however, by the proposal of Bale & Khanjian (2014): The plural in Western Armenian has a strong semantic meaning excluding numerosity one, which it retains in antitone contexts. The English plural, on the other hand, has a weaker meaning including all numerosities, and this meaning is available in antitone contexts.

A third argument by Bale & Khanjian (2014) is based on a similar difference in interpretation of the plural between English and Western Armenian. Following up on an argument of Sauerland et al. (2005) for the plural unmarkedness in English, Bale & Khanjian (2014: p. 7) present the contrast between English (19) and Western Armenian (20).

(19) Every boy bought his books.

(20) Amen dəgha ir kirk-ər-ə kənadz e
 every boy 3SG.HUMAN.GEN book-PL-DEF buy.PERF be.3SG
 'Every boy has bought his (two or more) books.'

Bale & Khanjian (2014) report that the English (19) presupposes that each boy has at least one book and that one boy has more than one. But the Western Armenian counterpart (20) presupposes that every boy has at least two books. The interpretation of (20) follows straightforwardly from the strong meaning of the plural that requires two or more books. Note also, however, that many accounts that assume a weak meaning of the plural *kirk-ər/books* can account for the strong interpretation of Western Armenian (20). For example, Mayr (2015) predicts a strong meaning for (19) and (20) if **exh** applies within the scope of the definite marker (i.e. the **exh**[book-PL of him]). At the same time, the weak interpretation of the plural can be accounted for on a weak theory of plurality in a variety of ways (see Sauerland et al. 2005; Singh 2011; Elliott & Sauerland 2019; Elliott et al. 2022); the relevant consideration for the current paper from this approach is that the weak interpretation can be tied to the unmarked meaning of the plural.¹³ Bale & Khanjian's parametrized-markedness account therefore provides a systematic account of

in antitonicity to account for the distribution of strong negative polarity items such as English *in weeks*, in particular the impossibility to license these items in the restrictor of a universal.

¹³ It is though also possible to account for (19) on the basis that a strong meaning of the plural is available. For example, Farkas & de Swart (2010) account for the English judgment on (19) on the basis of their ambiguity theory of the plural by assuming that the SMH can be overridden in cases with presuppositions such as (19). But Bale & Khanjian (2014) do not adopt this aspect of Farkas & de Swart's theory.

the difference in interpretation between English (19) and Western Armenian (20). Namely, the weaker presupposition of (19) is the result of the semantic unmarkedness of the plural in English, while the stronger presupposition of (20) follows from the marked, strong meaning of the plural. Bale & Khanjian (2014) therefore propose an elegant account of three differences between Type I and Type II languages with respect to number interpretation.

Nevertheless, we see some reasons to remain open-minded about the choice of theory. The first reason is that it is not clear whether data point (17) with a plural in an antitone environment generalizes to other potential Type II languages and even to other examples within Western Armenian. Other potentially relevant Type II languages are Turkish and Hungarian, as they both behave differently from English with respect to number marking with numerals as we showed above in (14) and (15). But the available data concerning the interpretation of the plural in antitone environments indicates that both Turkish and Hungarian differ from Western Armenian. For Turkish, Sağ (2019; 2022) argues that the *one-or-more*-interpretation for bare plurals is present in antitone contexts, such as the antecedents of conditionals, as in (21a), and the restrictors of universal quantifiers, as in (21b) (Sağ 2019: p. 27), similar to English-type languages.

- (21) a. Eđer erkek-ler tarafından aldatıldıysan sen de biz-e katıl-abil-ir-sin
 if man-PL by were.cheated you also we-DAT join-ABIL-AOR-2SG
 ‘If you have been cheated by men, you can join us.’ (one or more men)
- b. Erkek-ler tarafından aldatılan herkes biz-e katıl-abil-ir.
 man-PL by was.cheated everybody we-DAT join-ABIL-AOR.
 ‘Everyone who has been cheated by men can join us.’ (one or more men)

As for Hungarian, it also allows for the inclusion of singleton referents of bare plurals when they appear in an antitone environment (Farkas & de Swart 2010). The examples in (22) show that Hungarian and English pattern together in allowing for the use of plural form with an atom reference. Hungarian and English speakers with one child would raise their hand upon hearing the sentences in (22). If plural excludes singular in Hungarian, this is unexpected.

- (22) a. If you have children, please raise your hand.
 b. Ha van-nak gyerek-e-i, emel-j-e fel a kez-é-t.
 if be.3PL child-POSS-PL raise-SBJ3SG up the hand-POSS-ACC
 ‘If you have children, raise your hand.’

Even for Western Armenian, Sağ (2019: p. 144) argues that the structures in (23) with a plural in an antitone environment exhibit only a weak plural interpretation.

- (23) a. turs-ə manug-ner tʃ-en xaɣ-ar-gor
 outside-DEF child-PL NEG-PRES.3PL play-NEG.PART-PROG
 ‘No children are playing outside.’
- b. jete gin-er-e tavaʒan-v-etsar, gərnas mer xump-i-n mijanal
 if woman-PL-ABL betray-PASS-2SG.PST can.2SG.PRES our group-DAT join-INF
 ‘If you are betrayed by women, you can join our group.’ (one of more women)

To explain the difference between (17) where only the strong plural interpretation is possible and (23), (Sağ 2019: fn. 17) points to the presence of the copula *uni* (‘have’) in the data of Bale & Khanjian (2014).¹⁴

The second potential weakness of the parametrized-markedness account is that properties of number marking with numerals across languages are complex and analyses other than the parametrized-markedness account have been argued for. To begin with, number marking with numerals occurs also with measure nouns (also called *pseudo-partitive* structures) and displays substantial variation in this domain, which is not captured by the parametrized-markedness account. For instance, the number marking on the measure noun depends on the measure noun in both English (24a) and German (24b), but in a different way: in English, only the proportional measure noun *percent* shows no plural number marking; in German the abstract measure *liter* and the container noun *glass* do not show plural number marking either (see Ahn & Sauerland 2017; Pasternak & Sauerland 2022 and others).

- (24) a. ten percent / liter-s / glass-es of the wine
 b. zehn Prozent / Liter / Glass von dem Wein
 ten percent.SG / liter.SG / glass.SG of the wine

While (24) shows number marking variability internal to Type I languages, we already observed some variation internal to Type II languages above. Namely, only Western Armenian generally allows both singular and plural number with numerals greater than one as shown by (16), while Turkish (14) and Hungarian (15) do not.¹⁵ Finally, languages such as Finnish and Estonian do not

¹⁴ We think Sağ’s suggestion matches well with the established observation that, even in English, implicatures become available in antitone environments if the implicature trigger is focused (Fox & Spector 2018; Bassi et al. 2021). In our judgment this also holds for the plural as illustrated by (i). If in Western Armenian data such as (17) focus on the plural is obligatory, this would explain the judgment Bale & Khanjian (2014) report.

(i) Everyone who has CHILDREN please stand up.

¹⁵ Turkish allows plural markers to appear in the presence of numerals in certain contexts such as (i) to mark definiteness.

(i) Kırk Harami-ler
 forty thief-PL
 ‘The Forty Thieves’
 (from the Ali Baba legends, Underhill 1976: p. 125)

fit neatly into either Type I or Type II because the number marking with numerals interacts with case (Csirmaz 2012; Norris 2018): For example, Estonian in nominative contexts permits both numeral + noun phrases like (25a) with singular number and partitive case on the noun as well as numeral + noun phrases with plural number and nominative case, as in (25b).

- (25) a. *kaks inimes-t*
 2.SG.NOM person-SG.PAR
 ‘two people’
- b. *kahe-d kangastelje-d*
 2-PL.NOM loom-PL.NOM
 ‘two looms’

The preceding discussion shows that the parametrized-markedness approach accounts only partially for the complex empirical picture of number marking with numerals. A number of other approaches have been proposed in the literature that would be compatible with the singular-unmarked or plural-unmarked proposal.

One such alternative approach takes number marking on nouns with numerals to be determined not by reference to meaning, but entirely by morphosyntax. For example, Bayırlı (2017) assume that crosslinguistic variation as in (14) and (15) reflects a morpho-syntactic difference with respect to concord (see also Ionin & Matushansky 2018; Ortmann 2000). Alexiadou (2019), summarizing much recent work on this issue, concludes that just as there are languages with and without subject-verb agreement, there are languages with and without plural agreement of nouns with numerals. If this approach is correct, the occurrence of singular forms in non-singular numeral-noun and measurement structures would require that the singular form in these contexts receives the unmarked interpretation. The unmarked interpretation of the singular form, in turn, could be due to either the presence of silent plurality (Sigler 1997; Kalomoiros 2021) or the possibility of a third numberless form of the noun that also has the unmarked interpretation (Pires de Oliveira & Rothstein 2011; Ahn et al. 2021, and others). In a second, quite different family of approaches, Borer (2005), Scontras (2013) and others propose that structural differences between numeral-noun structures account for the differences in number marking while the interpretation of number marking remains uniform. Specifically, Borer (2005) proposes that the semantic contribution of plural morphology is to divide up an unstructured whole rather than to act as a counting function. She assumes that languages such as Hungarian and Turkish differ from English in that their numerals are both counters and dividers and therefore render plural marking redundant and as a result, plural marking is blocked with numerals. While Borer’s approach relies on a different semantics of number than the one we adopt, Scontras (2022) develops a semantic account of number marking with numerals that is fully compatible with the plural-unmarked number semantics. He proposes that the formal property *atom* that

underlies the singular semantics can be construed relative to a possibly complex predicate.¹⁶ For the predicates *one boy* and *two boys*, then, different entities are atoms: while individual boys *a* and *b* are atoms for *one boy* and also for the bare noun *boy*, the predicate *two boys* is false of an individual boy such as *a*. Scontras (2022) proposes that Type I languages such as English invoke the count-measure derived from the minimal nominal predicate, for example, *boy*, and determine the number marking of a noun in a numeral-noun structure accordingly as possibly plural. Type II languages (specifically Turkish), however, invoke the count-measure based on an entire numeral-noun structure, for example *two boys*, and therefore the number marking of a noun in a numeral-noun structure is obligatorily singular.

As we discussed in this section, all three approaches we mentioned in (6) above are viable for the adult data from both types of languages, categorized as Type I and Type II by Bale & Khanjian. We argue that data from children provide new support for the proposal that number markedness is not parametrized.

3 Previous Experimental Studies on the Plural

There are a few experimental studies on the plural, testing adults' processing and children's acquisition. Most studies have focused on English-type languages, except for two studies.

Sauerland et al. (2005) is the first experimental investigation that we are aware of that experimentally tested whether the plural is semantically marked. Sauerland et al. used a task in which both child and adult participants were asked a question that contained a plural expression with a singleton referent, like in (26a) in English.¹⁷ The expected response from adults was “no” because of the implicature: *exh* applies to *tails*, and *exh* must exclude the singular alternative (26b) because of our assumption about excludability. Sauerland et al. hypothesized that if children accept the use of the unmarked form in wider contexts than adults do, they may accept the use of the plural with a singleton referent.

- (26) a. Does a dog have tails? (expected adult response: no)
 b. Does a dog have a tail?

With adult speakers, Sauerland et al. (2005) compared the acceptance and rejection rates for the following types of questions, on the one hand, and the reaction time to give the expected response, on the other.

¹⁶ Recall that *atom* is defined a minimal non-null element of a lattice structure $\langle L, \sqsubseteq \rangle$. In other terms, $\text{atom}(a) \Leftrightarrow \forall b \in L \setminus \{\perp\} (b \sqsubseteq a \Rightarrow a \sqsubseteq b)$ where \perp is the null element of the lattice.

¹⁷ Sauerland et al. (2005) follow the analysis in Sauerland (2003) and assume an analysis using *Maximize Presupposition*. In what follows, however, we rephrase their analysis, using *exh*, as discussed in the previous section. What is crucial for the discussion below is that in both of these accounts, the plural in languages like English and German is unmarked, and hence, is compatible with singleton referent contexts.

- | | | |
|------|--|----------------------|
| (27) | a. Plural without a numeral
<i>Does a dog have tails?</i> | (singleton referent) |
| | b. Plural with a numeral
<i>Does a dog have two tails?</i> | (singleton referent) |
| | c. Plural without a numeral
<i>Does a goat have horns?</i> | (multiple referents) |
| | d. Plural with a numeral (two)
<i>Does a goat have two horns?</i> | (multiple referents) |

They found that adult speakers responded with the expected response (*no* in this case) to the item type shown in (27b), a plural expression with a numeral, 85% of the time, compared to the items in (27a), (27c), and (27d), to which adults responded as expected above 90% of the time. The difference in the rate of target responses was found significant.

Furthermore, the time it took to respond *no* to the target question with a plural but without a numeral, as in (27a), was significantly longer than for the question with a plural and a numeral, as in (27b). Sauerland et al. observed that a significant difference in response time was obtained when the two alternative questions — the singular and the plural questions — have different truth values or expected responses. One possibility is that this difference have caused processing difficulties for adult speakers. They argue that when a speaker hears a bare plural as in (26a), they must compare it to its alternative, which requires extra processing resources.

As for children, Sauerland et al. tested 14 monolingual English speaking children (3;4 to 5;9), using what we will call in this paper the “Question task”. Participants were asked a series of questions, consisting of target questions (*Does a dog have tails?*), control-yes questions (*Does a father have ears?*), and control-no questions (*Does a fish have legs?*). The list of questions can be found in the Appendix A of the supplementary material. Sauerland et al. found that children rejected the use of the plural form in the atom reference context only 4% of the time, whereas they responded in an adult-like manner 97% of the time to control questions, showing that children’s responses differ from that of adults’ specifically for the target questions (see the result reported above).

Pearson et al. (2010) tested the unmarkedness of the English plural with English speaking adults, using a version of the hidden box paradigm (Huang et al. 2013). With this task, participants were presented with three cards: two open cards where the pictures were visible and one covered where the picture was hidden. The participants’ task was to choose the card that matched the sentence they heard. When there was no card with a picture that matched the sentence, they were instructed to choose the covered card. There were two lists: one where singular nouns were used, and another where plural nouns were used. For example, for a sentence with a plural noun as in (28a) in their experiment 1, and (29a) in their experiment 2, participants saw card

1 that showed Big Bird holding a kite, card 2 that showed Big Bird not holding anything, and card 3 that was covered. With a singular noun as in (28b) in their experiment 1, and (29b) in their experiment 2, participants saw card 1 that showed Big Bird holding many kites, card 2 that showed Big Bird not holding anything, and card 3 that was covered. They predicted that if the plural meaning includes a singleton referent, speakers should choose card 1 with a single kite when the experimental sentence contained a plural. If the plural meaning does not include the singular meaning, on the other hand, participants should always choose the covered card (experiment 1).

The crucial contrast between experiment 1 and 2 was the insertion of *only* in experiment 2. When the sentence contains *only*, the implicature may not be obligatory, and as a result, participants may choose the card that contains a singleton referent even when the sentence contains a plural expression.

This does not apply to the singular counterpart, and as a result, diverging patterns are predicted for experiment 2.

- (28) a. Point to the card where Big Bird has kites.
 b. Point to the card where Big Bird has a kite.
- (29) a. Point to the card where Big Bird only has kites.
 b. Point to the card where Big Bird only has a kite.

Pearson et al. found that participants in experiment 1 chose the covered card on 96% of the trials, and there was no significant difference between singular and plural sentences: participants chose the covered card irrespective of whether the stimuli they heard had a singular or a plural expression.

In experiment 2, however, they found that participants who were tested with singular expressions chose the covered card 96% of the time, as in experiment 1, whereas the participants who were tested with plural expressions did so 35% of the time. These two experiments together, they propose, lend support to the unmarkedness analysis of plurals, and in addition, argue for the analysis in which the multiple-referent interpretation of plural is derived by implicatures.

Further support can be found in Patson et al. (2014). Patson et al. conducted a reaction time experiment, also with English speaking adults, using three types of sentences:

- (30) a. with a definite singular DP (*the crayon*)
 b. with a definite plural DP (*the crayons*)
 c. with a definite plural DP with the numeral 'two' (*the two crayons*)

The visual cues provided were (i) an atom object, (ii) multiple objects, or (iii) two objects. The participants first read the written stimuli, which was replaced by a picture. The participants' task was to press "Y" or "N", depending on whether they judged the picture to have been mentioned in the sentence or not.

Patson et al. found that when the participants read the sentence with a singular DP, their reaction time was fastest after seeing an atomic object picture, compared to the multiple object or the two object pictures. When they read a sentence with a plural DP, on the other hand, the reaction time did not differ across the three pictures. Patson et al. conclude that their results support the semantically unmarked analysis of plural: plural expressions are compatible with both singleton and multiple referent scenarios.

Extending Patson (2014), Patson (2016) further provides evidence that speakers' response to a singleton referent picture does not differ from that to pictures with multiple-referents; and the responses are also not affected by predicates that imply plurality in different ways. Comparing three types of sentences as in (31), two of which used predicates that necessarily implicate the existence of multiple referents, such as *scatter*, Patson measured the reaction time of English speakers to pictures with a singleton referent vs. multiple referents. They found that speakers respond as accurately and as fast (or faster) in a condition where the plural expression is used with a singleton referent in the visual stimuli, regardless of the type of predicate used.

- (31) a. The gardener raked up the leaves. (implied: spatially gathered)
 b. The breeze scattered the leaves. (implied: spatially scattered)
 c. Thomas was confused by the shape of the leaves. (neutral)

Patson argues that even when the linguistic cue triggers the participants to create a representation with multiple referents, a representation with a singleton referent is also activated, supporting the previous studies.

Yatsushiro et al. (2017) extended the study by Sauerland et al. (2005) to German, presenting data from three experiments.¹⁸ Two experiments, which were tested only in German using the

¹⁸ In one study, Yatsushiro et al. analyze the type and frequencies of errors children made during a wh-question comprehension experiment across 18 languages (392 children, 4;10–6;0, from 19 countries), using the picture-selection task. The languages represented in this study were Estonian, Finnish, Maltese, Hebrew, Cypriot Greek, Modern/Mainland Greek, Lithuanian, Croatian, Serbian, Polish, English, German (Austrian and German varieties), Dutch, Danish, French, Italian, European Portuguese, and Romanian. The results of the experiment on wh-questions can be found in Sauerland et al. (2016).

Two of the pictures always contrasted in number for either the subject or the object. For example, for the verb *feed*, one picture showed one queen feeding a princess, and another showed one queen feeding two princesses. The prediction was that, if children accept the use of the plural in singleton referent contexts, children across languages should be able to choose both the picture with a queen feeding just one princess and the picture of the queen feed-

question task from Sauerland et al. (2005) and the covered-card task, adapted from Pearson et al. (2010), are specifically relevant for the present paper. In the question task, Yatsushiro et al. tested 42 monolingual German speaking children (3;6–8;6, $M = 5;10$) and 10 monolingual German speaking adults, and found that adult participants rejected the use of the plural in a singleton referent context around 83% of the time by answering “no”, whereas children responded “no” only around 26% of the time. In the covered-card task, German children chose the covered card 26.9% of the time when they heard audio stimuli with a plural expression while the visible card showed a singleton referent, whereas adults chose the visible card with a singleton referent 82.9% of the time. These findings support the hypothesis that the plural is unmarked for number in German. Note, however, that none of the languages that Yatsushiro et al. (2017) discussed were of the Turkish-Hungarian type that Bale et al. (2010) and Bale & Khanjian (2014) discuss.

Most recently, Tieu and her colleagues have investigated the way children and adults interpret plural expressions in English (Tieu et al. 2014; 2020), Greek (Renans et al. 2018), and Turkish (Renans et al. 2020), in a series of studies. Tieu et al. (2014) tested whether English speaking children accept the use of the plural in singleton referent contexts using the truth-value judgment task. They tested 28 child (4;01–5;04, $M = 4;11$) and 43 adult native speakers of English. Their goal was to test whether children accept the use of plural expressions with a singleton referent in a declarative sentence in isotone or antitone environments, such as the following. With plural expressions in the isotone environment, as in (32a), the expected response is to reject the sentence if participants calculate the plurality inference. In the antitone environment, on the other hand, the expected response is to accept the sentence because the inference would be cancelled.

- (32) Isotone environment: Context–Emily fed one pig
- | | |
|-----------------------------------|--------------------|
| a. Emily fed pigs! (target: NO) | PLURAL CONDITION |
| b. Emily fed a pig! (target: YES) | SINGULAR CONDITION |
- (33) Antitone environment: Context–Emily fed one giraffe
- | | |
|--|--------------------|
| a. Emily didn’t feed giraffes! (target: NO) | PLURAL CONDITION |
| b. Emily didn’t feed a giraffe! (target: NO) | SINGULAR CONDITION |

Tieu et al. found that (i) adult speakers derived plurality inferences more frequently than child speakers, and (ii) both adult and child speakers derived more plurality inferences in isotone environments than in antitone environments. Overall, their findings support the hypothesis that the plural is semantically unmarked, and hence, is compatible with singleton referent contexts.

ing two princesses. And in fact, they found that around 10 to 50% of all the responses (depending on the language) corresponded to the picture with a single referent, supporting the unmarked plural analysis. Crucially, however, Hungarian-Turkish-type languages were not among the languages tested in this experiment.

To our knowledge, Renans et al. (2020) were the first to experimentally investigate a language that is analyzed as having a singular that is weaker than the plural. They adapted the experimental design from Tieu et al. (2014), changing it to a ternary judgment task similar to Katsos & Bishop (2011), to investigate whether the singular in these languages is semantically unmarked for number. Ternary judgment tasks are designed to find out whether participants are sensitive to pragmatic infelicity: the participants are expected to select the small reward when the puppet doesn't respond well, the big reward when the puppet responds well, and the middle reward when the puppet's statement is not perfect but also not bad— somewhere in the middle.¹⁹ Their prediction is that if the Turkish plural is not semantically unmarked like in English and German, and the *more-than-one* interpretation of the plural stems from the lexical meaning of the plural rather than being derived as an implicature, both children and adults should reject the use of the plural form in the singleton referent contexts in the isotone environment. In the antitone contexts, on the other hand, both adults and children should accept the use of the plural in either null referent or singleton referent contexts. If the Turkish plural is semantically unmarked, on the other hand, we should observe that children derive fewer multiplicity implications of the plural, and should thus accept the use of the plural form in the singleton referent contexts more frequently than adults do.

Renans et al. (2020) tested 21 child (4–6-year-olds, $M = 5;2$) and 42 adult native speakers of Turkish. Renans et al. divided the responses as follows: when a participant gave 3 strawberries, the plural expression was interpreted as being compatible with atoms in the isotone condition, but not compatible in the antitone condition. Their data from experiment 1 show that Turkish speaking adults gave 1 or 2 strawberries as a reward a majority of the time for the positive examples. Adults' responses were split when tested with negative sentences, showing that there may be some speaker variation.²⁰ Overall, they show that the interpretation of the plural does not always exclude the singular meaning, as, for example, the approach proposed by Bale & Khanjian (2014) might predict.

Children, on the other hand, accepted the use of the plural for the singleton referent contexts in both isotone and antitone environments, suggesting that for Turkish speaking children, the plural is not incompatible with a singular interpretation. This shows a pattern similar to English and German.

¹⁹ As a reward to choose from, representing the three choices, Katsos & Bishop (2011) varied the size of the strawberry (small, large, huge), depending on how well the response matched the contexts, whereas Renans et al. (2020) varied the number of strawberries (1, 2, 3 strawberries).

²⁰ Renans et al. 2020 suspected that the speaker variation may be due to the use of polar questions in the stimuli, and switched to declarative sentences in experiment 2, conducted only with adult speakers. They report that the participants interpreted plurals as compatible with atoms more frequently under negation than in experiment 1 overall, and they do not report speaker variation in experiment 2.

- (34) a. Positive sentences
 Kaplan ağaç-lar ek-ti
 tiger tree-PL plant-PST
 ‘Tiger planted trees.’
- b. Negative sentences
 Kaplan ağaç-lar ek-me-di.
 tiger tree-PL plant-NEG-PST
 ‘Tiger didn’t plant trees.’

Their findings were similar to the results from experiment 3 of Tieu et al. (2020), where a ternary judgment task was used to test English speaking adults. In Tieu et al., adult speakers chose the maximum reward around 80% of the time when the plural expression was in an isotone environment, whereas they chose the minimum reward around 50% of the time when the plural expression was in an antitone environment. The similarity in the results between these two languages supports the hypothesis that the quantity concepts of these two languages may not vary semantically.

These data suggest that children speaking languages that have been proposed to have an unmarked singular/a marked plural seem to interpret plurals in a similar fashion as children speaking English/German-type languages. In the next section, we present new experimental data, building on Renans et al. and others’ studies by adding another language that has been proposed to have semantically marked plurals.

4 Experiments

We conducted two experiments in Turkish and Hungarian. We adopted the experimental design of Yatsushiro et al. (2017) in order to compare the results across languages. The predictions tested are as follows:

- (35) a. If/Where the plural is semantically unmarked, the plural is compatible with an atom set, and only a pragmatic computation blocks its use. Children should accept the use of the plural in singleton reference contexts.
- b. If/Where the plural is semantically marked, the plural is never compatible with a singleton referent because the singular meaning is not included in the plural meaning. Children are predicted not to accept the use of the plural in singleton referent contexts because the singular is not part of the meaning of the plural.

4.1 Participants

The same group of participants took part in both experiments. 32 monolingual Turkish speaking children (4;6 to 6;3, $M = 5;0$) recruited from a daycare center in Izmir, Turkey, 11 monolingual

Turkish speaking adults, 25 monolingual Hungarian speaking children (3;3 to 6;8, $M = 5;5$) recruited from a daycare center in Budapest, Hungary, and 10 monolingual Hungarian speaking adults, participated in this study. All participants volunteered their time to participate, and the Turkish children received a sticker for their participation.

All the participants were tested individually. The child participants were tested in a quiet room at their day care center/kindergarten.

We used the data from all 29 German speaking children tested in Yatsushiro et al. (2017) who were younger than 7;0 (3;7–6;9, $M = 4.11$). There was no significant difference in age between the German and Turkish children ($p = .6696$), between the Turkish and Hungarian children ($p = .1276$), and between the Hungarian and German children ($p = .1019$).

4.2 Experiment 1: Question Task

4.2.1 Procedure

In this experiment, participants were asked a series of yes/no questions about a person/animal in a picture. Each question contained a plural expression, as in (36), in Turkish, Hungarian, and German.²¹

(36) Does this boy have tongues?

All of the audio stimuli were pre-recorded by a native speaker, without adopting any specific intonation that may (or may not) affect the interpretation (such as stress). The experiment was conducted using a presentation software (Keynote (Apple)/PowerPoint). The recorded clips were embedded in a slide to play from a computer in order for all participants to receive the same audio stimuli.

²¹ The experimental material was adapted from the experiment by Sauerland et al. 2005, originally conducted in English. The original version used a generic sentence, as in *Does a cat have tails?*, and relied on the world knowledge of the participants. The task was modified slightly to avoid some potential complications, as follows:

- i. The questions were about people and animals that were depicted in pictures shown to them, rather than about generic, world knowledge.
- ii. Some of the items were changed so that they are easily identifiable in pictures.
- iii. The demonstrative was used, rather than an indefinite for the subject.

Sauerland et al. distinguished two types of polar questions, information seeking and exam type questions. Both types of questions seem to license NPIs, however, and it is possible that the effect that they found may be due to factors other than the plural being unmarked. Yatsushiro et al. 2017, which used the two tasks we used in this paper, showed that participants' reactions were similar across experiments, however, and hence, we decided to use both of their methods/materials in order to compare the German data from their experiments with the Hungarian and Turkish data in this paper.

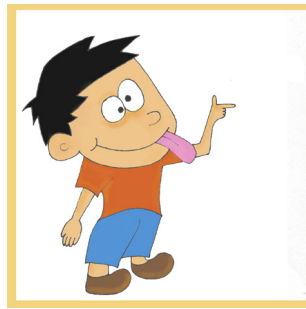
4.2.2 Materials

There were three types of items: target, control-yes, and control-no. In all three conditions, plural expressions were used in each of the experimental sentences.²² In the target condition, there was a picture with a singleton referent of the plural form used in the experimental sentence. In the control-yes condition, a picture with multiple referents (for example, a cat with paws) was shown, and the expected response was “yes”. The control-no items showed a picture of an animal/person without a referent of the plural expression mentioned in the audio stimuli (for example, a fish without legs), and as such, the expected response was “no”.

Each sentence was matched with a picture shown on the computer screen. There were 3 items in the target condition, 3 in the control-yes condition, and 7 in the control-no condition for a total of 13 items per participant.

Target condition: 3 items

A picture with a singleton referent (for example, a boy with a single tongue):

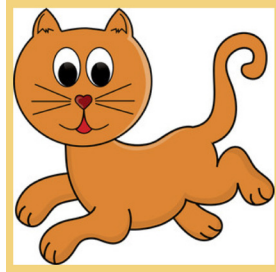


- (37) a. Turkish
 Bu çocuğun dilleri var mı?
 this child.GEN tongue.PL.POSS exist Q
 ‘Does this boy have tongues?’
- b. Hungarian
 Vannak ennek a fiúnak nyelvei?
 Have-3SG this the boy.DAT tongue.PL.POSS
 ‘Does this boy have tongues?’
- c. German
 Hat dieser Junge Zungen?
 have.3SG this.NOM boy tongue.PL
 ‘Does this boy have tongues?’

²² The list of questions and the order of the items are shown in the Appendix B of the supplementary material. Pictures that were used are shared at the repository at [osf https://doi.org/10.17605/OSF.IO/ZB8TG](https://doi.org/10.17605/OSF.IO/ZB8TG).

Control-yes: 3 items

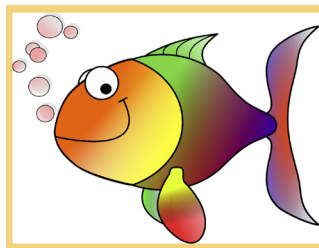
A picture with multiple referents (for example, a cat with four paws).



- (38) a. Turkish
 Bu kedinin patileri var mı?
 this cat.GEN paw.PL.POSS exist Q
 ‘Does this cat have paws?’
- b. Hungarian
 Vannak ennek a macskának mancsai?
 Have-3SG this the cat.DAT paw.PL.POSS
 ‘Does this cat have paws?’
- c. German
 Hat diese Katze Pfoten?
 have.3SG this cat paw.PL?
 ‘Does this cat have paws?’

Control-no: 7 items

A picture without a referent (for example, a fish with no legs)



- (39) a. Turkish
 Bu balığın bacakları var mı?
 this fish.GEN leg.PL.POSS exist Q
 ‘Does this fish have legs?’

- b. Hungarian
 Vannak ennek a halnak lábai?
 Have-3SG this the fish.DAT leg.PL.POSS
 ‘Does this fish have legs?’
- c. German
 Hat dieser Fisch Beine?
 have.3SG this fish leg.PL?
 ‘Does this fish have legs?’

There was only one order of items across languages and participants. We pseudo-randomized the items by creating a random order amongst non-target items, followed by placing the target items such that they had three or four other items between them.

4.2.3 Results

The dataset and the script used for the analysis below are available in an OSF repository.

Among the Turkish speakers, one child participant was excluded because they responded ‘no’ to every item, including the control-yes items. We discuss data from the remaining 31 children below. Among the Hungarian speakers, none of the participants were excluded from the analysis.

There were three target items to check whether participants accepted the use of the plural in singleton-referent contexts. **Table 1** shows the number of times the use of the plural was accepted in the target context with a singleton-referent, divided by age group (children vs. adults).

	CHILDREN	ADULTS
TURKISH	88 (out of 93)	13 (out of 33)
HUNGARIAN	71 (out of 75)	0 (out of 30)
GERMAN	79 (out of 87)	5 (out of 30)

Table 1: Number of yes responses (the question task).

The comparison between the two age groups is visualized in **Figures 1** and **2**. Most of the children accepted the use of a plural expression in singleton-referent contexts, whereas most (if not all, as is the case of Hungarian) adult participants rejected the use of a plural expression in singleton referent contexts.

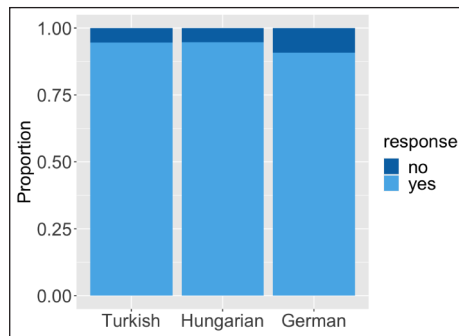


Figure 1: Proportion of *yes* and *no* responses for the question task: Child data.

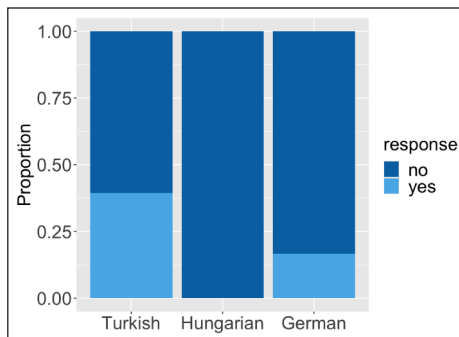


Figure 2: Proportion of *yes* and *no* responses for the question task: Adult data.

We separated participants according to age group (child vs. adult) and language (Turkish, Hungarian, and German), and checked whether the response to the critical test items was at chance using binomial test, which tests whether the obtained probability deviates from the expected probability. The probability was set as 0.5, as there were two possible responses (“yes/agree” vs. “no/disagree”). If the participants were responding randomly, they can be expected to respond “yes” and “no” around 50% of the items each. In all three languages, child participants **accepted** the use of the plural above chance (Binomial test: $p < .01$), and the adult participants either responded at chance (in Turkish, Binomial test: $p = .2962$) or rejected above chance (in German and Hungarian: Binomial test: $p < .01$). We compared the proportion of *accept* responses between child and adult speakers for each language separately using Fisher’s exact test with a 2×2 contingency table. In all three languages, the ratios of accept and reject responses between child participants and adults participants were independent of each other (Turkish: $p < .05$; Hungarian and German: $p < .01$).

Looking into individual data, we observe that most of the children accepted the target condition consistently across the three items. In **Tables 2** and **3**, we show the frequencies of participants rejecting the critical test items with a plural expression in a singleton referent context. “0” indicates that the participant accepted the use of the plural with a singleton referent picture all three times, and “3” indicates that the participant rejected in the same condition all three times. Most of the child participants accepted the use of the plural in the target condition all three times, while adult participants rejected it.

language	0	1	2	3
TURKISH	26	5	0	0
HUNGARIAN	21	4	0	0
GERMAN	24	3	1	1

Table 2: Child data.

language	0	1	2	3
TURKISH	2	2	3	4
HUNGARIAN	0	0	0	10
GERMAN	1	1	0	8

Table 3: Adult data.

We used generalized mixed-effects models (glmer, using lme4 package, Bates et al. 2015) to see whether the language (Turkish, Hungarian, or German) and age group (children or adults) affect the way participants responded to the target condition. In all the models, the dependent variable was the response (*yes/1* or *no/0*). First, we fitted a model with the language (Turkish, Hungarian, or German) and age group (children or adults) as fixed effects and participant and items as random effects.²³ We found that there was no effect of language (Hungarian: z-value: -0.244 , $p = .80706$, Turkish: z-value: 1.059 , $p = .28973$), but there was a significant effect of age group (z-value: 4.227 , $p < .01$).²⁴ We then separated the age groups

²³ A model with an interaction did not converge due to complete separation, and therefore, it is not reported in this paper.

²⁴ The model results in a singular fit, and therefore, we built two more models, one just with the participant as random effect and the other just with the items as random effect. With the first model, languages were not significant effect (Hungarian: z-value: -0.244 , $p = .8070$, Turkish: z-value: 1.059 , $p = .2897$) but the age group was (z-value: 4.229 ,

and fitted generalized mixed-effect models with the language as a fixed effect and participant and items as random effects. Language did not have a significant effect among child participants (Hungarian z -value = 0.200, p = .841609; Turkish z -value = 0.206, p = .837088). Among adult participants, effect of language was significant between Hungarian and German speakers (z = -22.531, p < .01) but not between Turkish and German speakers (z = 0.245, p = 0.8066).

4.3 Interim Discussion

Recall our assumption that if the plural does not include the singular meaning, it cannot be used in singleton-referent contexts. For adult speakers of, for example, German, the use of the plural in a singleton-referent context is not allowed because of an *implicature*, in contrast to child speakers. If the plural in Turkish and/or Hungarian is marked and does not contain the singular meaning, on the other hand, the plural form cannot be used in singleton-referent contexts because they are not compatible. For Turkish and Hungarian speaking children, we predicted that the use of the plural in singleton-referent contexts should be unacceptable because the plural in these languages does not include the singular meaning. We predicted to find a difference between German, on the one hand, and Turkish and Hungarian, on the other, among child participants.

We did not find an effect of language for children. The results of the experiment thus indicate that children speaking Turkish and Hungarian accept the use of the plural in singleton-referent contexts, similar to the pattern observed in German speaking children. This is contrary to expectations that would follow from the plural being incompatible with singleton referent contexts in Hungarian and Turkish, namely, that Turkish and Hungarian speaking children should reject the use of the plural in singleton-referent contexts, because the plural is not an unmarked alternative in Turkish and Hungarian.

4.4 Experiment 2: covered-card task

The second task, the covered-card task, was adapted from Pearson et al. (2010).

4.4.1 Procedure and material

The covered-card task in Hungarian and Turkish was identical to the task used in Yatsushiro et al. (2017), with one modification: two additional conditions with singular nouns were included. Participants always saw two open cards and one covered card on a (tablet) computer. The participants heard a pre-recorded sentence of the form “Show me the card with X (Hungarian and German)/the card that has X (Turkish)”, where X is filled by either a plural or a singular expression.

p < .01). With the second model, on the other hand, Turkish was significantly different from German (z -value: 2.337, p < .05), although Hungarian was not (z -value: -0.467, p = .6402), and age group remained a significant predictor (z -value: 10.543, p < .01).

The experimental session always started with the participant and the experimenter sitting next to each other at a table, with a computer in front of the child. All the visual stimuli were shown on the computer, using a presentation software (Keynote (Apple)/PowerPoint (Microsoft)). Each audio stimulus was associated with a slide, and was played when the tablet was tapped, either by the experimenter or the participant. Audio stimuli were pre-recorded and played from the computer. The participants heard the audio stimuli once.

The experiment consisted of 8 warm-up/familiarization items, 24 target experimental items, and 18 filler items, resulting in 42 items. The 8 warm-up items were divided into two blocks. For the first block (four items), the cover was removed each time after the participant selected a card, regardless of whether that was the card the participant chose. The open card was the target in two of the first four warm-up items, and the covered card was the target in the other two. The purpose of these items was to show the participant that (i) there is a picture below the cover, and (ii) there is only one picture that matches the sentence. For the first four warm-up items, the experimenter and the participant revisited what the sentence was, and whether there really was only one card that matched the audio stimulus, after the picture was revealed. After checking all three cards, the experimenter showed the next item/slide.

Before the second set of practice items, the experimenter explained to the participant that the cover would not be removed from then on, but the set-up would still be the same as before: only one card would match the audio. If one of the open cards matched the audio, participants should choose that card because there is no other card that matches the audio. If neither of the open cards matched the audio, then participants should choose the covered card. After the practice items, the experimenter directly continued to the experimental items. The experimenter reminded the participant throughout the experiment that there was only one card that would match what they heard.

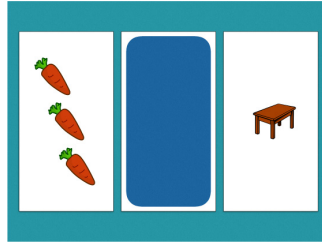
There were 6 items for the plural target condition, 6 items for the plural control condition, 5 items for the singular target condition, and 7 items for the singular control condition.²⁵ The rationale behind adding these singular items was the following: If the meaning of the singular is not restricted to singleton referents but the observed restriction is derived by pragmatics, adults should not accept the use of the singular in multiple referent contexts, but children might.

In addition, there were 6 filler items in which the correct response was to choose the covered card, and 12 items from another unrelated experiment, used as fillers. The position of the covered card was balanced across three positions for the target items. All the filler items used plural expressions. The items were pseudo-randomized by making six blocks with one item per condition plus filler items assigned to each block. The order of the items within each block was randomized. There was only one order of items for both Turkish and Hungarian.

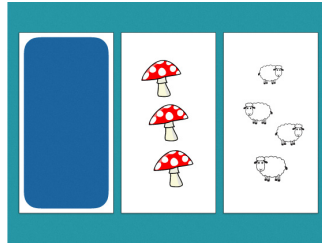
²⁵ There was an error in one of the open cards of the singular target condition, hence the singular condition contained one fewer than the plural target condition items.

Below are the illustrations of the four conditions used in this experiment.²⁶

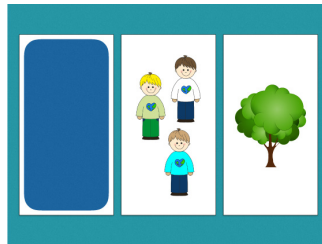
- (40) a. **Plural target:** Sentence with a plural expression with a visible singleton referent
An example: Show me the card with **tables**.



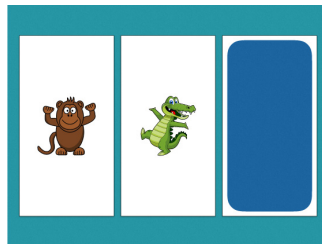
- b. **Plural control:** Sentences with a plural expression, and a visible plural referent
An example: Show me the card with **mushrooms**.



- c. **Singular target:** Sentence with a singular expression with a visible plural referent
An example: Show me the card with a **boy**.



- d. **Singular control:** Sentence with a singular expression with a visible singleton referent
An example: Show me the card with a **monkey**.



²⁶ The Turkish and Hungarian sentences are listed in the Appendix C of the supplementary material.

4.4.2 Results

The target condition involved presenting a picture of a singleton referent (for example, *a table*) when the audio stimulus used a plural expression. The expected response was to choose the covered card if the plural expression was not compatible with a singleton referent context. **Table 4** shows the number of times child and adult participants overall chose the open card that showed the singleton referent.

LANGUAGE	CHILDREN	ADULTS
Turkish	186 (out of 186 trials)	21 (out of 66 trials)
Hungarian	147 (out of 150 trials)	8 (out of 60 trials)
German	192 (out of 203 trials)	12 (out of 70 trials)

Table 4: The number of times participants chose the singleton referent card.

Figures 3 and **4** illustrate the proportion of trials in which participants chose the target (covered) or non-target (open) cards. **Figure 3** shows that children mostly chose open cards with a singleton referent, while **Figure 4** shows that adults mostly chose covered cards. We checked whether the response patterns were at chance using a binomial test, for each age group within each of the languages, and found that none of the response patterns were at chance (Binomial test with probability set as 0.5, given that the third card shows an irrelevant object: $p < .01$ for all three languages). Furthermore, the proportions of adult participants choosing the open and covered cards and those of child participants doing so were significantly different for each language (Fisher's exact test: $p < .01$ for all three languages).

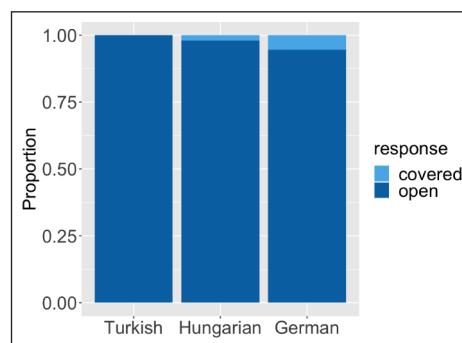


Figure 3: Proportion of choosing **covered** or **open** cards: Child data.

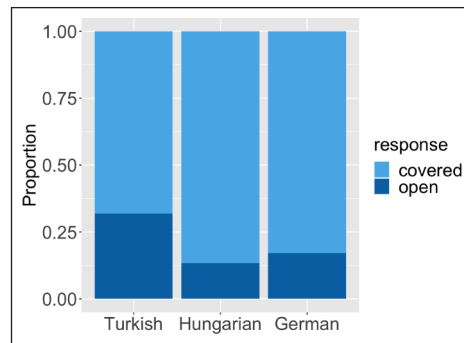


Figure 4: Proportion of choosing **covered** or **open** cards: Adult data.

Consider now the bar-graphs in **Figures 5** and **6**, which show the distribution of participants, based on how many times they chose the covered card. Lightness in color corresponds to more frequent selection of the covered cards. It is notable how consistently participants responded: among the child participants, there was one German child who consistently chose the covered card, while the rest of the children across the three languages consistently chose the open cards.²⁷ Among the adult participants, speakers were split between consistently choosing the covered card and consistently choosing the open card, although Turkish speakers seem to show some variation.²⁸

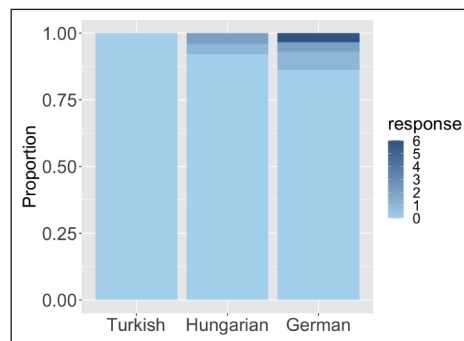


Figure 5: The number of times participants chose the **covered** cards: Child data.

²⁷ There were 6 trials of the target plural condition (used with an open card showing a singleton referent picture), and hence, a participant who chooses one type of card on 6 out of 6 trials can be considered not to be responding randomly.

²⁸ Sağ (2022) discusses the fact that bare plurals in Turkish with a definite interpretation obligatorily have a two-or-more interpretation. But the variation found in the Turkish adult data cannot be due to this property of Turkish because it would lead us to expect more choices of the covered card in Turkish than in German, which is not the case. Our statistical analysis below shows that the three languages do not differ significantly.

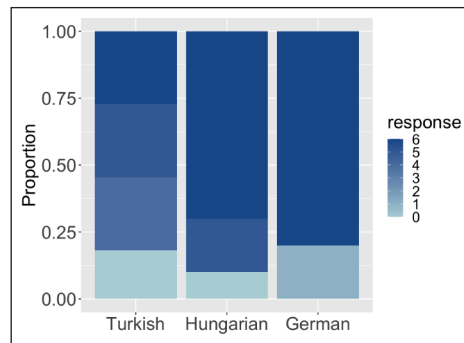


Figure 6: The number of times participants chose the **covered** cards: Adult data.

We analyzed the data using the generalized mixed-effect models (glmer) with the lme4 package in R for the critical target test items with plural expressions. In all the models, the dependent variable was whether the participant selected the covered card (yes/1) or the open card (no/0). We first fitted a model with age group and language as fixed effects, and participant and item as random effects. The model shows that the age group (children vs. adults) had an effect on the responses (z-value: -6.100 , $p < .01$). There was a significant difference between Turkish and German (z-value: -2.066 , $p < .05$) but not between Hungarian and German (z-value: -0.424 , $p < .6715$).

A comparison between the Turkish and Hungarian data did not result in a significant difference between the languages (z-value: -1.793 , $p = .07299$), although age group remained a significant predictor (z = value: -4.166 , $p < .01$).

We then separated the data based on age group. Among the child data, there was no effect of language (Hungarian: z-value: -0.094 , $p = .9254$, Turkish: z-value: 0.000 , $p = .9999$). Among the adult data, there was no significant difference between Hungarian and German (z-value: -0.229 , $p = .81890$), although the effect was approaching significance between Turkish and German (z-value: -1.918 , $p = .05514$).

4.5 Items with singular expressions

In addition to the items with plural expressions, we tested how compatible a singular expression is with multiple referents for Turkish and Hungarian. As far as we can tell, the three theories in (6) do not make different predictions for this case; namely, they all predict a child-adult difference in this case because the adult rejection of the plural referent is analyzed as a scalar implicature,²⁹ which in other cases shows a child-adult contrast (Noveck 2001 and others). The test of singular forms is nevertheless important for further language comparisons with, for

²⁹ The text is not entirely accurate as a description of Farkas & de Swart (2010) because they appeal to bidirectional optimization rather than scalar implicature. But because bidirectional optimization can be seen as an extension of scalar implicature, we think the prediction of a child-adult difference is nevertheless shared.

example, Bangla (Dayal 2014), Korean (Kim 2005), and Brazilian Portuguese (Ferreira 2010) which are described as generally allowing singular forms with plural reference. Ahn et al. (2021) suggest that such languages may in fact have two distinct forms without an overt number affix: a singular form with a phonologically null, but semantically contentful singular affix; and a bare form without a number affix that is number general just like the plural— we might call the latter a *fake singular*. They derive from this proposal that plurals should be blocked from antitone environments in such languages, and present some evidence from Bangla and Korean in favor of this conclusion. Turkish and Hungarian, according to the account here, are different because they do not allow fake singulars to occur in the syntactic environments we are considering, and only the semantically contentful singular is thus available.

Therefore, we constructed a condition in which a singular expression was used when the open card showed a plural referent of the expression (singular test items). If the singular expression is incompatible with the multiple-referent context, participants should choose the covered card. If the singular expression is unmarked for number, and as a result, is compatible with the multiple referent context, participants should choose the open card.

Turkish children chose the covered card once out of 155 trials, and Hungarian children did so 6 times out of 125 trials. Both performance are significantly above chance (Binomial test, probability set at 0.5; $p < .01$ for both languages.)

What about the adult speakers? Hungarian adult participants chose the open card 7 times, and chose the covered card 43 times for the singular test condition (out of 50 trials). Turkish adult participants chose the open card 19 times, and the covered card 36 times (out of 55 trials). The results in both languages show that adult speakers chose the covered card significantly above chance (Binomial test: $p < .01$ for Hungarian and $p < .05$ for Turkish).

The following **Table 5** summarizes the results from children and adults. The numbers show the number of times each group chose open cards (multiple referents) or covered cards (singleton referent).

	CHILDREN		ADULTS	
	TURKISH	HUNGARIAN	TURKISH	HUNGARIAN
OPEN CARD	154	119	19	7
COVERED CARD	1	5	36	43

Table 5: The number of times participants chose the multiple-referent cards.

The bar-graphs in **Figures 7** and **8** show the distribution of participants, depending on how many times they chose the covered card. As can be seen, child participants chose the open card with multiple referents quite consistently. Only five participants chose the covered card once or twice.

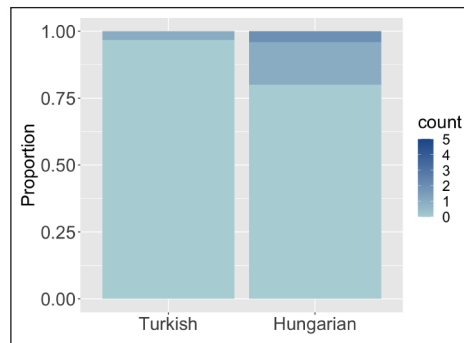


Figure 7: The number of times participants chose the **covered** cards: Child data.

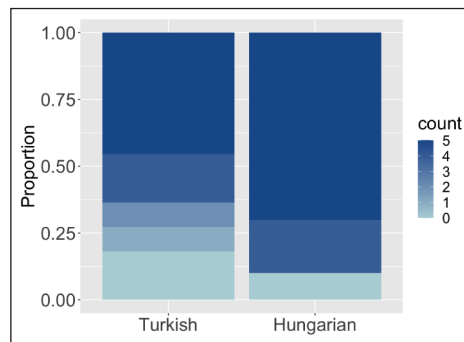


Figure 8: The number of times participants chose the **covered** cards: Adult data.

Adult participants, on the other hand, were consistent in the opposite direction. Among the Hungarian participants, there was one participant who chose the open card with multiple referents on all 5 trials, two participants chose the open card once out of 5 trials, and seven participants chose the covered card on all 5 trials. As for the Turkish participants, there were two participants who chose the open card with multiple referents on all 5 trials, one participant who chose the open card 4 times, one participant who chose the open card 3 times, two participants chose the open card once out of 5 trials, and five participants chose the covered card on all 5 trials.

The individual data shows that the adult behavior is more varied than the child behavior, although most individual adult speakers were quite consistent with respect to which type of card they chose. The result is predicted, though, once we consider the role of implicature in the task with singular expressions. Note that the singular description is logically true for the open card: for example, the card with three boys logically fits the description *the card with a boy*. The reasoning underlying the rejection of the overt card is that the card with three boys is described even more informatively as *the card with boys*. Hence our finding is in line with the empirical data on scalar implicatures reported for children and adults. Noveck (2001), Foppolo et al. (2021), and many others report that children frequently fail to compute scalar implicatures at the same rate as adults. At the same time, the rate of scalar implicature has been found to vary amongst individual adults (Bott & Noveck 2004, and others) and between different scalar triggers (van Tiel et al. 2016, and others). Our data indicate that singulars in

both Hungarian and Turkish fit into this spectrum as an implicature trigger of intermediate strength and with some variation amongst individual participants. Finally, we note that there is a numerical difference between Hungarian and Turkish adults that we did not analyze further, because the adults sampled were not controlled for across the two languages to make such a comparison meaningful. In sum, a clear difference between children and adults emerges, corroborating our assumption that scalar implicature blocks the use of the singular form in multiple-referent contexts.

4.6 Comparison of Experiments

All of our participants participated in both studies. We created scatter plots by placing every participant on the graph according to how they responded to each task, as shown in **Figures 9, 10** and **11**. The y-axis shows how many times a participant said *yes* to the questions using a plural expression, with a singleton referent (experiment 1). The x-axis shows the number of times a participant chose the open card with a singleton referent, when the audio stimuli contained a plural expression (experiment 2). As a result, a dot placed at the top right corner represents an individual who consistently accepted the use of plural expressions to refer to a singular reference.

A dot placed at the bottom left corner, on the other hand, represents an individual who consistently rejected the use of plural expressions to refer to a singleton reference. The light blue dots are child participants and the dark blue dots are adult participants. As can be seen, the distribution of children seems quite similar across the three languages. Most children are concentrated at the top right corner in all three languages. Adult speakers, on the other hand, tended to cluster at the bottom left corner of the graphs.

These graphs help us make the following observations: (i) most participants, both adults and children, either accept the use of the plural in singleton referent contexts (children) or reject them (adults), and (ii) this was observed irrespective of the task that was used. This is why most of the dots that we see are either at the top right corner or the bottom left corner. The correlation between the two tasks is weakest for Turkish adults who frequently interpret the plural as two-or-more in the question task. As an anonymous reviewer suggests, this finding corroborates the observation of Sağ (2022: fn. 14) that the plural in existential copular constructions in Turkish exhibits exceptional behavior.

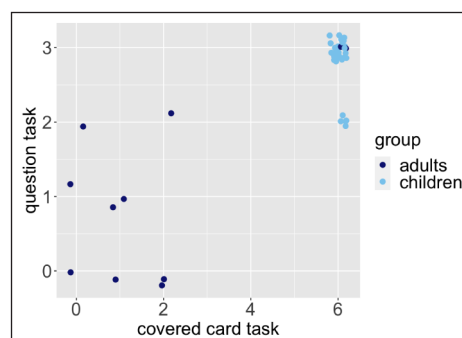


Figure 9: Combining the question task (y-axis) and the covered-card task (x-axis): Turkish.

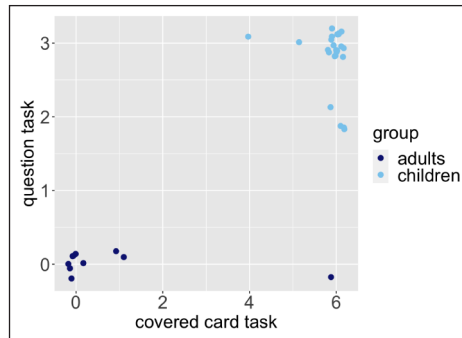


Figure 10: Combining the question task (y-axis) and the covered-card task (x-axis): Hungarian.

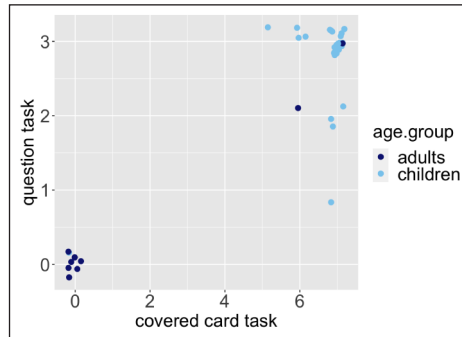


Figure 11: Combining the question task (y-axis) and the covered-card task (x-axis): German.

5 Conclusion

The hypothesis we had set out to test was the following: Children across languages should uniformly understand the plural as semantically unmarked for number in all environments. We tested this hypothesis experimentally in this paper. We identified three types of semantic analyses of plural (unmarked, marked, parametrized), and investigated two languages that have been proposed to support the parametrization and singular-unmarked analyses, respectively. We hypothesized that, if the plural in these languages differs semantically from German, we should observe that children do not accept the use of the plural in singleton-referent contexts as frequently as German speaking children do.

The morpho-syntactic variation between languages motivated the singular-unmarked account of Farkas & de Swart (2010) and the parametrized-markedness account of Bale & Khanjian (2014), but the set of data we discussed in this paper show that number marking in Hungarian and Turkish behaves the same as number marking in English and German in several other environments. Our results show that the predictions the parametrized-markedness account makes are not borne out. On the other hand, our results are clearly consistent with the predictions of the plural-unmarked

account. As for the singular-unmarked account, the predictions are not fully determined as far as we can see. At least the version of Farkas & de Swart (2010) has two components— the bidirectional optimization and the strongest meaning hypothesis— the acquisition profiles of which we do not have independent evidence for. Because the predictions are underspecified, our results are consistent with the singular-unmarked account.

Our study, comparing data from three languages, did not reveal diverging results from previously investigated English/German-type languages. Specifically, our results showed that while there is a significant difference between adult and child speakers with respect to how frequently they accept the use of plural expressions in the singleton-referent context, language did not have an effect.³⁰

This is interesting, given that the theoretical literature is divided because of the different behaviors observed in languages like English and German, on the one hand, and Turkish and Hungarian, on the other, when numerals combine with a noun. At the moment it is not clear to us that our experimental data lead us to a particular choice between the various competing analyses of these combinations. We mentioned some open issues in our summary in section 2.1, specifically concerning the interpretation of the plural in antitone environments in Western Armenian ((17) and (23)) and distinguishing the different accounts of number marking on numeral-noun sequences ((24) and (25)). Two further avenues to pursue in the future might be, on the one hand, cross-linguistic comparisons of adult processing following the work of Pearson et al. (2010) and Patson (2014; 2016) on English. On the other hand, a further investigation of languages that seem to allow fake singular forms as mentioned in section 4.5 above or even have a number-general form distinct from both singular and plural such as Bayso (Corbett & Hayward 1987) might provide important insights— in such systems, the number general form and the unmarked number should exhibit pragmatic competition.

³⁰ An anonymous reviewer points out that, the number of participants is relatively small in our study, as language acquisition research often are (31 Turkish speaking children and 25 Hungarian speaking children). This was because we had set the minimum number of child participants as 24 because one previous study (Pearson et al. 2010) tested similar number of adult participants. But future work should take this into consideration.

Abbreviations

ACC = accusative, DAT = dative, NOM = nominative, GEN = genitive, POSS = possessive, SBJ subject, PASS = passive, INF = infinitive, = partitive, PL = plural, SG = singular, PST = past, DEF = definite, PERF = perfect.

Data availability

All supplementary materials (including the test items we used for each of the experiments), data, and R-codes for analysis and creating Figures are available at the Open Science Framework: DOI: <https://doi.org/10.17605/OSF.IO/ZB8TG>

Ethics and consent

Ethical evaluation of the experiments was obtained from the Ethics commission of the Deutsche Gesellschaft für Sprachwissenschaft (DGfS) for testing in Germany, from the Ethics commission of Hungarian Research center for Linguistics for testing in Hungary (Reg. nr.:1/65/2023), and the Ethics commission of Izmir Demokrasi University for testing in Turkey (Protocol no: 2023/01).

All the adult participants were informed that their participation was not obligatory and they could stop at any point of the experiment, and signed their consent to participate. Parents and/or legal guardians of the child participants were informed that their child's participation was not obligatory and that the experimenter would ask their children whether they would like to participate before the session started, and had signed consent forms.

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Competing interests

The authors have no competing interests to declare.

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