1. Introduction

The acquisition of the distinction between singular and plural number has been studied from many perspectives of language acquisition (Marcus et al., 1993; Wood et al., 2009; Li et al., 2009; Tieu et al., 2014). One focus has been the relation between the linguistic concept of markedness and the acquisition of the semantics of number. Sauerland et al. (2005) argue that number marking exhibits a contrast between morphological and semantic markedness, and that language acquisition data provides evidence for semantic markedness. The concept of morphological markedness is discussed by Greenberg (1966) who uses number as one of the paradigm examples. Specifically, he shows that across languages, the plural form is morphologically derived from the singular form and therefore marked. For example, the plural in many languages has an overt morphological mark like -s in English that the singular forms lack. Semantic markedness describes a situation where the marked meaning X is more specific than the unmarked meaning. Semantic markedness generally seems to correspond to morphological markedness, but number is an exception: van Eijck (1983); Hoeksema (1983); Krifka (1989); Schwarzschild (1996); Beck & Sauerland (2000); Sauerland (2003); Sauerland et al. (2005); Spector (2007); Zweig (2008); Bale et al. (2011); Mayr (2015) and others argue that the singular is more specific than the plural, i.e. the plural is the unmarked number.¹

Consider first how semantic markedness can be established in the adult grammar. Since the meanings of the number morphemes aren’t directly accessible to intuition, they can only be derived from speakers’ interpretations of sentences. A general condition on the interpretation of sentences, however, is that if there are two morphemes, X and Y, where the meaning of X is strictly more specific than

¹But see also the views of Kiparsky & Tonhauser 2012 and Farkas & de Swart 2010. We cannot address these in this paper for reasons of space.
that of Y, then the more specific morpheme X ought to be used. The competition between X and Y entails that the two morphemes will be used complementarily even if actually the specification of one is more specific than that of the other. The argument for a meaning of the plural that includes the singular comes though from slightly more complex examples where a plural noun phrase can be seen to include singular entities in the compositional interpretation. Two types of such examples are exemplified in (1) (see Sauerland 2008 for a more detailed discussion): (1-a) is judged false if John has a single child, which only follows if the plural *any children* includes the singular in its interpretation. And the plural *her children* in the scope of a universal quantifier in (1-b) would also include mothers who have only one child.

(1)  
   a. John doesn’t have any children.  
   b. Every mother who came to the party brought her children. (Bale et al., 2011)  
      (vs. Every mother who came to the party brought her child.)

Semantic markedness makes predictions for both adult processing and for language acquisition. Sauerland et al. (2005) were the first to confirm these predictions experimentally. Later work has generally confirmed their findings. While we discuss primarily acquisition data here, Patson (2014, 2016) and Pearson et al. (2011) have confirmed the predictions of semantic markedness in adult processing for English.

Most of the existing work on semantic markedness discusses primarily English data. But, Bale & Khanjian (2014) argue that it varies crosslinguistically whether singular or plural number is semantically unmarked. In this paper, we explore the acquisition of number crosslinguistically. To this end, we present three experiments in what follows: one covers 18 European languages, and two others are presently only on German, but can be used to explore other languages.

2. Experiment 1

In Experiment 1, we analyzed the type and frequencies of the errors made by 5-year-old children during a wh-question comprehension experiment².

2.1. Methods

The experiment tested the comprehension of object and subject extraction with wh-question. 392 children (4;10-6;0) from 19 countries, speaking one of 18 languages, participated in this study. Children were tested individually in a quiet room at the school/daycare center that they attended.

²The main finding of the study, related to the comprehension of wh-questions (subject vs. object extraction and who vs. which-type wh-questions) is presented by Sauerland et al. (2016).
The experiment was a picture matching task, in which the participant had to choose one picture (out of four pictures) that contains the answer to the question. The picture depicted were (i) Target, (ii) Theta-role reversal, (iii) Number error, and (iv) Semantic error. There were 12 items to test for the comprehension of who-questions (half of which involve subject extraction) and 12 items to test for the comprehension of which-type questions (half of which involve subject extraction).

Let us illustrate the experiment with a concrete example. Consider the question in (2). For the example in (2), four types of pictures were shown, described as in (2-a) to (2-d).

(2) Which grandma are the fairies pushing?
   a. Target: two fairies are pushing one of the grandmas
   b. Theta-role reversal: one grandma is pushing two fairies
   c. Number error: one fairy is pushing one of the grandmas
   d. Semantic error: a wrong verb as an answer to the question

In (2), the subject is the fairies and the object is the wh-phrase. The target response for (2), hence, is the picture in which two fairies are pushing one of the grandmothers. More accurately, one of the grandmothers in the bottom right picture, who is being pushed by two fairies.

There were three types of errors. One is the theta-role reversal error, in which the subject of the question is comprehended to be the object, and the object, as the subject. In the example in (2), for example, the participant may understand which grandma to be asking for the identity of the subject/agent of pushing, rather than the object. This type of error was identified by the participant, choosing the top right picture in (2). The second type of error was the number error. In the number error, the participant would not comprehend the object as being the subject, but rather, chooses the picture with a single fairy pushing the grandma. The third error type is the semantic error, in which the picture depicting an action different from the one in the test sentence is chosen. Figure (3) (reproduced from Sauerland et al. 2016) shows the frequencies of the four types of responses for all 19 sites of the study. The sites are abbreviated by their ISO two-letter country code on the X-axis.
(see appendix A), and grouped by language (sub-)family. The responses at each site are split by subject and object questions. The lower dark gray indicates correct responses, the lower light gray number errors, the upper dark gray indicates theta-role reversal, and the upper light gray semantic errors.

Our prediction was that, if the singular meaning is included in the plural meaning, as hypothesized in this paper, children across languages should make the number error, as long as the plural in the language they speak is semantically unmarked.

The frequency of the number error is shown in the following graph in (4). The plural morphemes are listed in appendix A. As can be seen, the number error amounts to between ca. 10% to ca. 50% of all the responses. The number error was observed in every participating language, and it was independent of the phonological shape of the plural morphology.

If the plural meaning is marked and necessarily excludes the singleton referent context, we do not expect participants to make this type of error.

3. Experiment 2 & 3

42 monolingual German speaking children (3;6-8;6, M=5;10) and 10 monolingual German speaking adults participated in these experiments. Child participants were recruited from a day care center and two public schools in Berlin, Germany, and received a sticker for participating the study. Adult participants were recruited among non-linguistics students at the Humboldt University, and received 5 euro for participating in the study.

Experimental sessions with child participants took place in a quiet room of the day care center or the schools that they normally attended. The participants
were tested individually. The two experiments were conducted on the same day, except for one child, who participated in the second task one month after the first task, due to his absence from the day care.

Experiment 2 (Question task) was adapted from Sauerland et al. (2005), and Experiment 3 (covered card task) was adapted from Pearson et al. (2011). The items used in these experiments are shown in the Appendices.

3.1. Experiment 2: Question task

In this study, participants were shown a series of pictures on an iPad, using Keynote presentation software (Apple). After seeing each slide, participants were asked a yes/no question about the picture, containing a plural expression. There were three types of items: (i) test items, where plural was used when there was a singleton referent in the picture, (ii) control-yes items, where plural was used when there were more than one referent in the picture (and hence, the use of singular expression would be judged false), and (iii) control-no items, which is false, independent of whether the plural or singular expression was used. The number of items and an example each are listed below.

(5)  

<table>
<thead>
<tr>
<th></th>
<th>#</th>
<th>example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>3</td>
<td>Does this girl have noses?</td>
</tr>
<tr>
<td>Control-Yes</td>
<td>3</td>
<td>Does this cat have paws?</td>
</tr>
<tr>
<td>Control-No</td>
<td>7</td>
<td>Does this fish have legs?</td>
</tr>
</tbody>
</table>

The test items were either three or four items apart from each other in order not to have the test items too close together. We constructed a list with all other items randomized. All the audio stimuli were recorded in a soundproof room, and were embedded in a slide to play from the iPad.

3.1.1. Method

Participants were told at the beginning of the experiment that they see a picture on the iPad, and that they would hear a sentence about the picture. Their task was to tell the experimenter if the sentence they heard matches or does not match the picture.

What we expect is shown in (6).

(6)  

a. If the plural is semantically marked, the use of plural with a singleton referent is never acceptable.  

b. If the plural is semantically unmarked, the use of plural with a singleton referent may be accepted by children (though not by adults because of a pragmatic considerations, such as the Maximize Presupposition).
3.1.2. Results

The adults rejected the use of plural in a singleton referent context around 83% of the time (25/30), whereas children rejected the same context around 26% of the time (33/126). Fisher’s exact test shows that the response pattern of adults and that of children are independent of each other (p < 0.01). In a control false condition, children correctly rejected the sentence 96.8% of the time (122/126), and in a control yes condition, they accepted the sentence 97.6% of the time (123/126). Adults were at ceiling for both conditions.

To examine whether there is an effect of age among children, we ran Person’s product-moment correlation between age and the number of times the participant rejected the use of plural in a singleton context. Person’s product-moment indicates that there is a strong correlation between the age in months and the number of items rejected for the test items (t = 5.3682, p < 0.01).

Let us next divide the child participants into two groups by age. Younger group consisted of 24 children (3;7 to 5;11, M=4;8) and older group consisted of 18 children (6;0 to 8;6, M=7;5). Child participants in the younger group accepted the use of plural in the test condition 95.7% of the time (66/69), whereas the older group accepted the use of plural in the same condition 47.4% of the time (27/57). The fisher’s exact test shows that the two ratio between the rejection and acceptance in the two age groups of children are independent of each other (p < 0.01), and also between the older group of children and adults (p < 0.01).

3.2. Experiment 3: Covered card task

In Experiment 3, we adapted a task originally used by Pearson et al. (2011) for plural comprehension of adult English speakers. We have adjusted the items and expression in order to only have nouns whose plural morphology (in Dative) is -en³.

3.2.1. Material

In this task, the participants were shown a series of slides on an iPad, using the Keynote presentation software (Apple). On every slide, there were three cards shown. One of the three cards was covered, and two were open, allowing pictures on these two cards to be visible. The participants were told that there is always exactly one card that matches the description, and the matching card might or might not be the covered one. The task of the participant is to choose the card

³This was done to use the most common morphology for plural in German. The two most frequent morphological forms for plural in German are -e and -en in Nominative. Half of the nouns that we used in this task have -e as its plural form, and the other half, -en. Under the preposition mit ‘with’, however, the nouns take Dative case, and hence, all of the forms that were used in this experiment were -en.
that matches the description, played from the iPad. All the audio stimuli were pre-
recorded in a sound-proof room.

Let us illustrate this with an example. In the test condition, the visible pictures included a singleton referent of the plural expression used in the audio stimuli. In (7), you see a table and a carrot on the two open cards, and one card that is covered. The audio stimuli for this slide was *Zeig mir die Karte mit Tischen* ‘Show me the card with tables.’ If the participant accepts the use of plural with a singleton referent, they should choose the card with a single table on. If the participant does not accept the use of plural with a singleton referent, on the other hand, they should choose the covered card. There were seven trials of the test condition per participant.

(7) \textit{Show me the card with tables.}

In a control trial, on the other hand, the open cards included a picture with multiple referents, as shown in (8). The audio stimuli for this slide was *Zeig mir die Karte mit Hunden* ‘Show me the card with dogs.’ The card that contains multiple dogs is, of course, compatible with the plural expression, and because there is only one card that matches the description, we predicted that participants would choose only the open card for this type of trial. There were three control items per participant.

(8) \textit{Show me the card with dogs.}

In addition, there were different types of fillers: (i) none of the visible cards match the description, forcing the participant to choose the covered card (13 items); (ii) singular expression, with one of the open card containing a singleton referent, forcing the participant to choose one of the open cards (four items); and (iii) items from another experiment (12 items). To examine whether the use
of singular affects the comprehension of the plural expression, we divided the experiment into two blocks, and used the singular expression only in the second block. In total, each experimental trial consisted of eight warm up items and 39 experimental items.

To summarize, we predict that if the plural is semantically unmarked, and hence, is compatible with a singleton referent context, participants should choose the visible card with a singleton referent of the plural expression used in the stimuli. While adult speakers may reject the use of plural expression in a singleton referent context because of a pragmatic considerations, children may more readily accept its use.

3.2.2. Result

Children overall chose the covered card 26.9% of the time (79/294) for the test items, while they correctly chose the open card 96.8% of the time (122/126) for the control items, and the covered card 98% of the time (535/546) for the filler items without matching referent on any of the open cards. Adults, on the other hand, chose the covered card 82.9% of the time (58/70), and chose the visible card with multiple referents 96.7% of the time (29/30) and the covered card for the filler item 100% of the time (130/130). We used Fisher’s exact test to determine whether the ratios of choosing the (target) covered card and the open card with a singleton referent for children and adults are dependent on each other, and found that they are not ($p < 0.01$).

To examine whether there is an effect of age, we ran Person’s product-moment correlation between age and the number of times the participant chose the covered card for the test context. Person’s product-moment indicates that there is a strong correlation between the age in months and the number of items choosing the covered card for the test items ($t = 4.7656, p < 0.01$).

As in experiment 2, we divided children into two groups by age: children above and below 72 months old. Younger children chose the open singleton referent picture 98.2% of the time (165/168) whereas the older children chose them 39.7% of the time (126/50). Fisher’s exact test shows that the ratio between the two groups is independent of each other ($p < 0.01$), indicating that there is an effect of age.

4. Discussion

So far, we have seen that children overall are more likely to accept the use of plural expression with a singleton referent, compared to adults. Let us now compare the results of experiment 2 and 3. If the results that we have found in the experiment 2 and 3 are not dependent on the experimental design, we predict that the results between the two experiments should correlate.
To evaluate this prediction, we plotted the number of times a participant rejected the use of a plural expression in a singleton referent context in experiment 2 as the X-axis and the number of times the same participant chose the covered (target) card when a singleton referent of the plural expression is open/visible in experiment 3 as the Y-axis. The resulting scatter plot is shown in (9). In this scatter plot, the children above 72 months are plotted with a circle, and the children younger than 72 months are plotted with a triangle. As can be seen, the younger children (plotted as a triangle) clustered around the bottom left corner of the plot, indicating that they accepted the use of plural in a singleton context in both Experiment 2 and Experiment 3. Older children, on the other hand, clustered around the top right corner, indicating that they rejected the use of plural in a singleton context in Experiment 2, and chose the covered card, not the open card with a singleton referent, in Experiment 3.

(9)

The resulting graph suggests that children’s non-adultlike responses are not due to the design of the experiment.

4We have added some jitter when plotting each individual in order to make each data point visible.
5. Conclusion

In this paper, we have presented experimental evidence supporting the hypothesis that the plural is semantically unmarked, and hence, includes the meaning of singular, although the plural is the morphologically marked form in the relevant languages that we have considered: Young children accept the use of plural expression in a singleton referent context, more readily than adults do. The evidence came from three different experiments: Experiment 1 analyzed the number error from a wh-question comprehension task, while Experiment 2 and 3 examined whether monolingual German speakers accept the use of plural in a singleton context.

The hypothesis defended in this paper predicts that if the plural is semantically marked in a language, it does not contain the meaning of singular, and hence, it would not be compatible with a singleton referent context, even for children. For example, Bale & Khanjian (2014) argue that singular form is semantically unmarked, unlike other languages, in Turkish, and plural is semantically marked. In this type of language, the singular form is compatible with the plural referent context, unlike in English and German, for example. If this is the case, we predict that young children may reject the use of plural form in a singleton referent context, unlike their German/English speaking peers, but accept the use of singular form in a context of plural referent context. We leave this for the future research, however.

Appendix A: Plural forms

<table>
<thead>
<tr>
<th>Language</th>
<th>Sg vs PL</th>
<th>Language</th>
<th>Sg vs PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE Estonian:</td>
<td>-0 vs -d</td>
<td>LT Lithuanian:</td>
<td>-a vs -os</td>
</tr>
<tr>
<td>FI Finnish:</td>
<td>-0 vs -t</td>
<td>HR Croatian:</td>
<td>-a vs -e</td>
</tr>
<tr>
<td>MT Maltese:</td>
<td>-a vs -i</td>
<td>RS Serbian:</td>
<td>-u vs -e</td>
</tr>
<tr>
<td>IL Hebrew:</td>
<td>-a vs -ot</td>
<td>PL Polish:</td>
<td>-e vs -i</td>
</tr>
<tr>
<td>EL Greek:</td>
<td>-a vs -es</td>
<td>UK English:</td>
<td>-0 vs -es</td>
</tr>
<tr>
<td>CY Cypriot Greek:</td>
<td>-a vs -es</td>
<td>DE&amp;AT German:</td>
<td>-0 vs -en</td>
</tr>
<tr>
<td>NL Dutch:</td>
<td>-0 vs -en</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DK Danish:</td>
<td>-0 vs -ene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE French:</td>
<td>-0 vs -es</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT Italian:</td>
<td>-e vs -a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT European Portuguese:</td>
<td>-0 vs -s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RO Romanian:</td>
<td>-a vs -e</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Items used for the Question task

Test sentences:
(10) a. Hat dieses Mädchen Nasen?
    hat this.Neut.Nom girl nose.pl
‘Does this girl have noses?’
b. Hat dieser Junge Zungen?
    hat this.Masc.Nom boy tongue.pl
‘Does this boy have tongues?’
c. Hat dieser Junge Köpfe?
    hat this.Masc.Nom head.pl
‘Does this boy have heads?’

Contro Yes items:
(11) a. Hat diese Katze Pfoten?
    hat this.Fem.Nom cat paw.pl
‘Does this cat have paws?’
b. Hat dieser Mann Ohren?
    hat this.Masc.Nom man ears?
‘Does this man have ears?’
c. Hat diese Erzieherin Beine?
    hat this.Fem.Nom daycare.teacher.Fem leg.pl
‘Does this daycare teacher have legs?’

Control No items:
(12) a. Hat dieser Fisch Beine?
    hat this.Masc.Nom fish leg.pl
‘Does this fish have legs?’
b. Hat dieses Schaf Schuhe?
    hat this.Neut.Nom sheep shoe.pl
‘Does this sheep have shoes?’
c. Hat dieser Junge Regenschirme?
    hat this.Masc.Nom boy umbrella.pl
‘Does this boy have umbrellas?’
d. Hat dieser Affe Hosen?
    hat this.Masc.Nom monkey pant.pl
‘Does this monkey have pants?’
e. Hat dieses Mädchen Orangen?
    hat this.Neut.Nom girl orange.pl
‘Does this girl have oranges?’
f. Hat dieses Baby Zähne?
    hat this.Neut.Nom baby tooth.pl
‘Does this baby have teeth?’
Appendix C: Items used in the covered card task

Test items:

(13) a. Zeig mir die Karte mit Tischen.
Show me the card with table.pl
‘Show me the card with tables.’
b. Zeig mir die Karte mit Tassen.
show me the card with cup.pl
‘Show me the card with cups.’
c. Zeig mir die Karte mit Orangen.
show me the card with orange.pl
‘Show me the card with oranges.’
d. Zeig mir die Karte mit Jacken.
show me the card with jacket.pl
‘Show me the card with jackets.’
e. Zeig mir die Karte mit Mühren.
show me the card with carrot.pl
‘Show me the card with carrots.’
f. Zeig mir die Karte mit Keksen.
show me the card with cookie.pl
‘Show me the card with cookies.’
g. Zeig mir die Karte mit Pilzen.
show me the card with mushroom.pl
‘Show me the card with mushrooms.’

References


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