A Multiple Cue Explanation of
Collective Interpretations with *each*

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1. Introduction

There are many different ways to interpret sentences with plural expressions. We focus on the two most common ways: collectivity and distributivity. Consider sentence (1). In distributive interpretations, individual subjects act separately on individual objects (see Figure 1). In collective interpretations, individuals act on the object(s) referred to by the predicate as a group (see Figure 2).

(1) The girls are carrying a box.
(2) Each girl is carrying a box.

These two interpretations are also associated with different linguistic descriptions. For the distributive interpretation, distributive markers such as the quantifier *each* are preferred, e.g. (2). But (2) is strongly dispreferred with collective situations, where a distributively unmarked sentences like (1) is more appropriate.
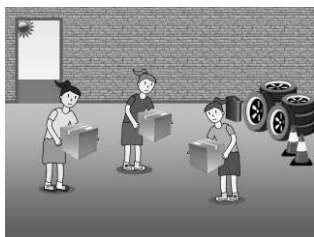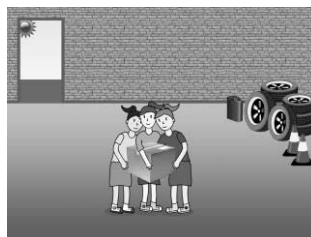

Figure 1. Distributive

Figure 2. Collective

However, while *each* is clearly a marker for distributivity, a definite plural subject as in (1) is not a marker for collectivity and is semantically compatible with both

interpretations. Although both interpretations are semantically compatible, it has been found that adults fully accept the collective interpretation, but that they find the distributive interpretation marginal (Frazier et al, 1993; Kaup et al, 2002). This raises the question why the distributive interpretation in combination with definite plurals is found to be marginal. Another question lies in the interpretation differences between adults and children.

Unlike adults, children fully accept sentences like (1) in both collective and distributive interpretations. They don't find the distributive interpretation to be marginal. In addition, they also allow distributive markers like *each* to describe collective situations, which is highly dispreferred by adults (Brooks and Braine, 1996; Pagliarini et al., 2012, de Koster et al., 2017). This suggests that they do not yet associate distributive marking with a distributive interpretation.

Dotlačil (2010) argues that the adult association of definite plurals with a collective interpretation is derived from a conversational implicature. Semantically, adults recognize that *each* is a marker for distributivity. An adult hearer confronted with a sentence without *each* can reason that if the speaker had intended a distributive interpretation, they would have used distributive marking (2). Since they did not, they must intend a collective interpretation.

Dotlačil's implicature account (2010) thus explains the adult interpretation of unmarked sentences like (1), but it also offers a potential explanation of children's non-adultlike interpretations and their development.

Under the implicature account, children will first have to learn that distributive markers such as *each* are distributive. Once they understand the distributive character of *each* they can use this information to compare what a speaker has said to what a speaker could have said, realizing that a distributively unmarked sentence like (1) suggests the speaker did not intend a distributive interpretation. The implicature account thus predicts that children's rejection of collective interpretations for sentences with *each* will precede their rejection of distributive interpretations for sentences without distributive marking. Support for this prediction has been found in both Italian (Pagliarini et al., 2012) and in Dutch (de Koster et al., 2017). Both studies have shown that (i) children understand the distributive character of *each* around age 8-9 and (ii) they are nearing the adult rejection rate for distributive interpretations of unmarked sentences around age 11-12.

Besides these findings, one consistently unexpected result has turned up in studies testing distributive and collective interpretations, particularly in Dutch. Several studies show that Dutch adults show unexpectedly high acceptance rates of the distributive quantifier *each* describing collective situations. In Dutch, Rouweler and Hollebrandse (2015) found a very high rate of acceptance (45%). De Koster et al. (2017) and de Koster et al. (2018) also found high acceptance rates of around 35%. These results are theoretically problematic if the meaning of *each* is claimed to be unequivocally distributive. If *each* is truly a pure distributive marker, how can we explain these high acceptances?

Furthermore, these results also present a challenge for the implicature account, which depends on hearers comparing unmarked sentences like (1) to

potentially distributively marked sentences like (2) to arrive at a collective interpretation: if distributively marked sentences with *each* can also get collective readings, a comparison of a speaker's unmarked utterance with a hypothetical *each*-marked alternative is not informative.

In the current work we investigate whether the high acceptance rates of *each* in collective situations could be due to differences in the interpretation of events. In particular, we study the role of verb semantics on the acceptability of *each* in collective situations. We find that *each* can be used to describe collective situations only when the verb implies a group action that consists of multiple independent actions (such as 'brushing a horse'). In contrast, collective situations become marginal in combination with *each* when the verb implies a group action that requires teamwork in which individuals rely on each other (such as 'lifting a box'). We find this for both Dutch adults and children (10-11 years old) and English adults.

2. Background

Verbs differ in whether or not they are compatible with distributive or collective actions. For example, predicates consisting of verbs like *gather* or *surround* are exclusively collective, and cannot occur with *each*, e.g. '*each student gathered in the aula' vs. 'the students gathered in the aula'. Predicates like *smile* or *blink* on the other hand are exclusively distributive (Scha, 1981, Link, 1991).

When testing preferences for collective or distributive interpretations of predicates, researchers use verbs that allow both readings, like *carry, pull, brush* or *wash.* To disambiguate these readings, distributive markers like *each* can force a distributive interpretation. But how do we explain the previously mentioned high acceptance rates of *each* in collective situations, when *each* is supposed to be a marker for distributivity?

We propose that the acceptance of *each* in collective situations is affected by the type of verb. We differentiate two verb types: *dependent* verbs and *independent* verbs. We distinguish these two types on the basis of two different ways to interpret the distributive reading, labeled by Pagliarini et al. (2012) as dependent and independent distributivity. They give the following example:

(3) The boys lifted two boxes.

This sentence can be true if the boys lifted two boxes in one joint action (collective). However, the sentence could also be true if each boy lifted two boxes individually. The latter interpretation is a distributive reading of sentence (3). Within this distributive reading it is possible to distinguish two different interpretations. With a dependent distributive reading, each boy lifted different boxes, so in total twice as many boxes were lifted as there were boys. With an independent reading, all the boys lifted the same two boxes but in different events (first one boy lifts both boxes, then the next one, etc.). The terminology is inspired

by dependence/independence distinction used in the analysis of indefinites (Brasoveanu and Farkas, 2016, and references therein).

Pagliarini et al. (2012) mention in the discussion section of their paper that some of their items in the collective condition might have been interpreted as independent distributive actions rather than a collective action. This might explain the adult acceptance of collective situations in combination with the distributive marker *each*. Accepting a sentence with *each* in a collective situation makes sense if the collective action is actually interpreted as three independent distributive actions. In this interpretation, the distributive marker *each* distributes over events rather than objects.

(4) Each girl brushed a horse.

Take for example a situation where three girls brush one horse together. This situation would be classified as a collective action. However in combination with sentence (4) it could be classified as separate distributive events when *each* distributes over brushing events rather than over the object. So the previously mentioned high acceptance rates of *each* in collective situations might arise as a result of these even interpretations.

We propose that this difference in interpretation can be affected by different verb types, among others. Certain verbs describe situations that are compatible with both collective and distributive events: What we will call *independent verbs* are verbs that describe situations that permit interpreting each agent as acting in a separate subevent, regardless of the number of objects. In contrast, *dependent verbs* are compatible with situations where the agents are dependent on each other to complete the action, and their actions can't be interpreted as separate subevents.

Consider a situation where three agents perform an action together affecting one object. With dependent verbs, the agents may rely on each other to complete the action that affects the object. Independent verbs on the other hand can always be interpreted as giving rise to a joint action that consists of multiple independent actions affecting the object.

Let's illustrate this with an example. Figure 4 shows a situation in which three boys carry one barrel together. The boys rely on each other to make sure that the barrel does not fall. What will happen if one of the boys leaves? Maybe the barrel will become too heavy and it might fall. We can use the predicate *carry a barrel* to describe this situation. But because the agents rely on each other in a joint action, this situation and predicate are not compatible with *each*. This is because *each* requires every boy to be associated with its own subevent of carrying a barrel and we cannot say of each boy that the predicate applies to him (e.g. boy 1 carried a barrel, boy 2 carried a barrel and boy 3 carried a barrel). So *each* will not be acceptable with this predicate. Note however, that if the event structure is different, and there is a 1-to-1 pairing of boys with barrels, then this sentence is perfectly fine.

In contrast to *carry*, a verb like *brush* in a collective context (Figure 6), shows a situation in which three girls are all acting on a single object. However, if one girl leaves, it does not affect the brushing actions of the other girls. Further, we

can say of each girl that the predicate applies to her, e.g. girl 1 brushed a goat, girl 2 brushed a goat and girl 3 brushed a goat. The predicate *brushing a goat* seems to permit a division into independent subevents without necessitating a 1-to-1 pairing with goats as was the case for dependent verbs. This suggests that independent verbs will permit the distributive marker *each* even in what at first glance seems to be a collective situation.

In summary, the distinction between dependent and independent verb types seems to determine whether or not a predicate is compatible with distributive markers such as *each*. Verbs differ as to what types of event-structural interpretations they are compatible with. By comparing dependent verbs, that in collective situations only permit an event structure that is incompatible with multiple subevents, to independent verbs, that allow a multiple subevent interpretation, we can investigate whether or not there is a systematic pattern in the previous findings that would then explain the unexpectedly high rates of acceptance of distributive marking in combination with collective situations.

We examine this hypothesis in Experiment 1 by testing Dutch adults and children. We tested 10 and 11 year old children because previous findings showed that 10 and 11 year old children have a complete understanding of the quantifier *each* and that they accept *each* in collective situations to a similar degree as adults. This makes it possible to directly compare their results to the results of the adults.

The hypothesis is tested in both a between and a within subjects design. In the between subject design, each participant receives only one verb type, whereas in the within subject design, participants receive both verb types. We test both designs, because (i) we want to see the results of participants that are not influenced by seeing both verb types (between) and (ii) we want to see if the predicted difference is strong enough to appear when participants see both verb types (within).

It has always been claimed that Dutch distributive markers are less distributive than their English counterparts, because several experimental results showed that Dutch participants were more lenient in their acceptance of distributive markers in collective situations than English participants (Rouweler and Hollebrandse, 2015, de Koster et al., 2017). However, if there is a predictable and systematic difference based on semantic features of the verbs in Experiment 1 for Dutch, then we should also re-examine these earlier assumptions about the difference between English and Dutch. We do this in Experiment 2 by testing English adults with the same materials and procedure as in Experiment 1.

3. Experiment 1
3.1. Participants

82 Dutch adults and 102 Dutch children participated in the experiment. The children were recruited from two primary schools in Groningen, the Netherlands, and carried out the experiment in a quiet room in their school. Table 1 reports the distribution of the participants and their characteristics. Please note that each child received only one verb type (a between subjects design). The adults were divided

into two groups: in one group each adult received only one verb type (between subjects design) and in the other group they received both verb types (within subjects design).

Table 1. Number of Dutch children and adults per participant group.

Verb Type	Dutch Children (Between)	Dutch Adults (Between)	Dutch Adults (Within)
Independent	**46** Mean age 11;2, range 10;0 - 11;11	**26** Mean age 23	**31** Mean age 20
Dependent	**56** Mean age 10;11, range 10;2 - 11;10	**25** Mean age 33	

3.2. Design and Procedure

The experiment consisted of a 2 x 2 x 2 design with the factors PICTURE, SENTENCE and VERB TYPE. The pictures depicted either a distributive (Figures 3 and 5) or a collective situation (Figures 4 and 6) and the sentences were all of the form Subject-Verb-Indefinite object, beginning either with the definite plural *De* '*the*' (5 and 7) or the quantifier *Elke* '*each*' (6 and 8). We also distinguished two different verb types: dependent and independent verbs.
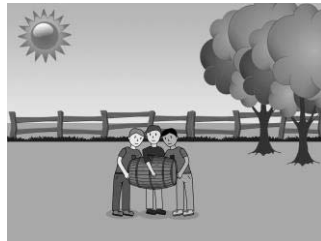

Figure 3. Distributive: Dependent Verbs

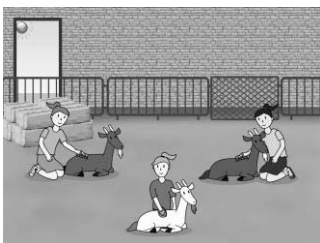**Figure 4.** Collective: Dependent Verbs
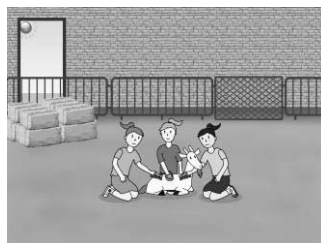

Figure 5. Distributive: Independent Verbs

Figure 6. Collective: Independent Verbs

For the dependent verbs, the following four verbs were used: *tillen, dragen, vasthouden* and *trekken* (in English: 'lift', 'carry', 'hold' and 'pull'). For the independent verbs four different verbs were used: *aaien, borstelen, kammen* and *wassen* (in English: 'pet', 'brush', 'comb' and 'wash').

Dependent Verbs	Independent Verbs
(5) **De** jongens **droegen** een vat.	(7) **De** meisjes **borstelden** een geit.
The boys were carrying a barrel.	*The girls were brushing a goat.*
(6) **Elke** jongen **droeg** een vat.	(8) **Elk** meisje **borstelde** een geit.
Each boy was carrying a barrel.	*Each girl was brushing a goat.*

The experiment was a truth value judgment task in a narrative context. Participants were instructed to help farmer Frank with his paperwork. Three boys and three girls did chores on his farm and to pay them it was necessary to know who performed which task. Luckily farmer Frank took photos of all the chores and he needed to know exactly what was depicted on the pictures. The participants were therefore asked to judge whether a sentence describing the picture matched the picture or not. The sentences were in past tense, because they were descriptions of events that happened in the past.

Participants that saw only one verb type (between subjects design) received 24 target items, 20 filler items and 6 control items, resulting in a total of 50 items. Participants that saw both verb types (within subjects design) received 48 target items. They received the same filler and control items, resulting in a total of 74 items. The filler items tested the some-all implicature and the control items were easy yes-no questions to check for attention. Items were distributed over 4 lists and were presented randomly.

3.3. Predictions

The design of the experiment results in four conditions for each verb type: The-Collective, The-Distributive, Each-Collective and Each-Distributive. Although we tested Dutch *elke 'each'* and Dutch *de 'the'* in Experiment 1, in the remainder of Section 3 we will refer to them as *each* and *the* for reasons of clarity.

Both conditions The-Collective and Each-Distributive are expected to be unaffected by the difference in verb type, since it has been found in several studies that they are fully accepted by both adults and children.

If the previously found high acceptance of *each* in collective contexts is indeed due to a difference in verb type, we expect a **higher** acceptance rate for items of condition Each-Collective for independent verbs than for dependent verbs. We also expect to see this difference regardless of a between-subject or within-subject design. In other words, regardless of whether participants receive only one or both verb types, we expect the difference to be the same. We also expect to see the aforementioned difference in the children, since Dutch children learn the distributive character of *each* around age 8 (de Koster et al., 2017) and we tested children aged 10 and 11. So we expect the results of condition Each-Collective to be similar for all three participant groups.

Condition The-Distributive is expected to show a similar pattern as condition Each-Collective, since the implicature is based on the distributive force of *each*. If condition Each-Collective is affected by a difference in verb type, so should condition The-Distributive. We expect the children to show a higher acceptance

rate for condition The-Distributive than both adult groups, since it has been found in previous studies that children of around 11 years old have not reached the adult interpretation yet.

3.4. Results

Descriptive statistics are presented in Table 2. Note that conditions Each-Distributive and The-Collective are omitted from the table, since they are fully accepted by all participant groups and for both verb types. As a reminder, the Children and the Adults Between group received only one verb type, whereas the Adults Within group received both verb types.

Table 2. Proportion of 'yes' responses (with standard errors) by verb type for Experiment 1.

Condition	Verb Type	Children (Between)	Adults (Between)	Adults (Within)
Each-Collective	Dependent	0.09 (0.02)	0.21 (0.03)	0.23 (0.03)
	Independent	0.48 (0.03)	0.51 (0.04)	0.45 (0.04)
The-Distributive	Dependent	0.64 (0.03)	0.57 (0.04)	0.59 (0.04)
	Independent	0.70 (0.03)	0.54 (0.04)	0.56 (0.04)

The gray area in Table 2 presents the results of condition Each-Collective. We can see a similar difference in acceptability for all three participant groups; condition Each-Collective is accepted more with verb type 'independent' than with verb type 'dependent'. In contrast, condition The-Distributive seems to be unaffected by a difference in verb type and the acceptance rates are similar between groups. Only the children show a slightly higher acceptance rate for condition The-Distributive (for both verb types), compared to both adult groups.

The data were analyzed using generalized mixed effect logistic modelling. We first analyzed the data of the three participant groups separately to check for a significant difference in verb type. The three final models were similar and contained the factors SENTENCE, PICTURE and VERB TYPE (treatment coded; reference levels were 'each' for SENTENCE, 'collective' for PICTURE and 'independent' for VERB TYPE). For the three models, the maximal random-effects structure licensed by the data also included a random intercept for participants and by-participant random slopes for either SENTENCE or PICTURE (depending on the data of the participant group).

For all three participant groups a main effect of SENTENCE and PICTURE was found as well as an interaction between the two. Crucially, we also found a main effect of VERB TYPE for all three groups (Children: β= -4.653 ; z= -5.566; p<.001, Adults Between: β= -2.966; z= -2.824; p<.01, Adults Within: β= -2.514; z= -5.812; p<.001), which shows that dependent verbs had lower acceptance rates compared to the independent verbs in condition Each-Collective.

Furthermore, the data of both adult groups revealed an effect of interaction between factors SENTENCE('the') and VERB TYPE('dependent'), significant for the Adults Between group and going in the same direction for the Adults Within group (Adults Between: β= 4.085; z= 2.025; p<.05, Adults Within: β= 2.514, z= 0.936; p>.1). The estimated effects are in the opposite direction and roughly of equal size compared to the main effect of VERB TYPE. This shows that the effect of VERB TYPE, present in condition Each-Collective, was removed in sentences without 'each'. For the children, we observed a trending interaction between the factors PICTURE('distributive') and VERB TYPE('dependent') (β=3.693; z= 1.879; p=.060), showing that the effect of VERB TYPE decreased for distributive situations.

Post-hoc Tukey multiple comparisons revealed no significant difference in verb type for condition The-Distributive (Children: β= -0.593; z= -1.125; p=.922, Adults Between: β= 0.205; z= 0.641; p=.999, Adults Within: β= 0.287; z= 0.844; p=.985).

We also performed an analysis on the full dataset containing the data of all three participant groups to check for a difference between the groups. A similar final model revealed that the factor PARTICIPANT GROUP (with three levels: Children, Adults Between and Adults Within) had no significant effect, showing that the results of the groups were similar.

3.5. Discussion

The results of conditions The-Collective and Each-Distributive followed our predictions. They are fully accepted by all participant groups, as predicted, so we will not discuss them further.

The results of condition Each-Collective also followed our predictions. Items of condition Each-Collective were accepted more with independent verbs than with dependent verbs. We found no difference between the groups, which means that it indeed did not matter whether participants received one or both verb types. Both the Adults Between and Adults Within group showed a significant difference in verb type for condition Each-Collective. It makes sense to expect that seeing both verb types in the same experiment would reduce the interpretation difference, leading to a similar interpretation of *each* regardless of the difference in verbs. However, our results show that this was not the case. Participants exposed to both verb types reacted similarly as participants exposed to only one.

Condition The-Distributive, on the other hand, did not follow our predictions. We predicted that the results of condition The-Distributive would show a similar pattern as condition Each-Collective. When condition Each-Collective is affected by a difference in verb type, so would condition The-Distributive, since the implicature calculation involved in this condition is based on the distributive character of *each*. However, this is not what we found. We found no significant difference in verb type for condition The-Distributive.

In hindsight this makes sense, the difference in verb type does not reduce the aforementioned distributive character of *each*, but instead influences it. In particular, independent verbs cause *each* to distribute over events rather than

objects. For the implicature to be calculated, a hearer simply needs to compare the uttered unmarked sentence to the more informative option with *each*, and this remains possible, even in the case of independent verbs, since a purely distributive interpretation of independent verbs (with a one-to-one pairing of subjects and objects) is still available as an alternative option.

As predicted, the children showed a slightly higher acceptance rate for condition The-Distributive compared to both adult groups. The acceptance rates of the adults for condition The-Distributive (around 55%) follow previous findings (Pagliarini et al., 2012; de Koster et al., 2017) and fit well with the observation that rates of implicature calculation are not just 0% or 100% but vary (cf., van Tiel et al., 2016).

In summary, the unexpectedly high acceptance of *each* in collective situations indeed seems to be caused by different verb types and the event structures they permit, which in turn affects the appropriateness of distributive marking. We found a consistent and predictable semantic difference between the two verb types. Because this difference originates in the meaning of the verbs, it is likely to be found with other languages as well. We test this by replicating Experiment 1 with English in Experiment 2.

4. Experiment 2

Experiment 2 is a replication of Experiment 1 with adult native speakers of English. Earlier research on Dutch often attributed a high acceptance of Dutch *elke* in collective situations to a difference in the distributive character of Dutch *elke* versus English *each*. Dutch *elke* was claimed to be a weaker distributive marker compared to the strongly distributive *each* in English. However, the results of Experiment 1 showed that the acceptance of Dutch *elke* in collective situations strongly correlated with the verb types used in the predicates. This thus points to a different explanation than the proposed difference in the distributive character of Dutch *elke* and English *each*. We therefore expect to see this correlation with verb type for English *each* as well.

If we indeed find a similar difference in verb type, this would be a valuable contribution to the field of distributivity research, since it could offer a principled explanation for differences in experimental results within and between languages.

4.1. Participants

88 English speaking adults participated in the experiment. They were recruited via Amazon Mechanical Turk. Participants were paid $2.50 or $3.00 for their participation depending on whether they participated in the within or between subjects experiment. All participants were self-reported native speakers of English and had U.S. IP addresses. Table 3 reports the distribution of the participants and their characteristics. Note that we did not test English children. In this experiment we first want to establish if the influence of the two verb types

found in Experiment 1 also holds for English. We again tested participants in both a between subjects design and a within subjects design.

Table 3. Number of English adult participants per participant group.

Verb Type	English Adults Between	English Adults Within
Independent	24 Mean age 36	34 Mean age 40
Dependent	30 Mean age 38	

4.2. Design and Procedure

The design and procedure of Experiment 2 were the same as for Experiment 1. All sentences of Experiment 1 were translated into English (*elke* was translated as *each*), and participants were presented with the same pictures as Experiment 1.

4.3. Results

Descriptive statistics are presented in Table 4. Please note that conditions Each-Distributive and The-Collective are omitted from the table, since they were fully accepted by both participant groups and for both verb types.

The gray area in Table 4 presents the results of condition Each-Collective. We can see a difference in acceptability for both participant groups. Condition Each-Collective is accepted more with verb type 'independent' than with verb type 'dependent'. Condition The-Distributive seems to be unaffected by the difference in verb type. We do see a difference in the acceptance rate of condition The-Distributive between groups: the Adults Within group shows a lower acceptance rate than the Adults Between group.

Table 4. Proportion of 'yes' responses (with standard errors) by verb type for Experiment 2.

Condition	Verb Type	English Adults Between	English Adults Within
Each-Collective	Dependent	0.31 (0.03)	0.33 (0.03)
	Independent	0.71 (0.04)	0.53 (0.04)
The-Distributive	Dependent	0.61 (0.04)	0.41 (0.03)
	Independent	0.61 (0.04)	0.36 (0.03)

The data were analyzed using generalized mixed effect logistic modelling. We first analyzed the data of both participant groups separately to check for a significant difference in verb type. The two models were similar and contained the factors SENTENCE, PICTURE and VERB TYPE (treatment coded; reference levels were 'each' for SENTENCE, 'collective' for PICTURE and 'independent' for VERB TYPE). For the two models, the maximal random-effects structure licensed by the

data also included a random intercept for participants. By-participant random slopes were included for SENTENCE (for the Adults Between model) and PICTURE (for the Adults Within model).

For both participant groups a main effect of SENTENCE and PICTURE was found as well as an interaction between the two. Crucially, we also found a main effect of VERB TYPE('dependent') for both groups (Adults Between: β= -3.844; z= -3.560; $p<.001$, Adults Within: β= -1.509; z= -4.952; $p<.001$).

Furthermore, the data of both groups revealed an effect of interaction between factors SENTENCE('the') and VERB TYPE('dependent'), significant for the Adults Between group and going in the same direction for the Adults Within group (Adults Between: β= 3.912; z= 2.110; $p<.05$, Adults Within: β= 1.509, z= 1.035; $p>.1$). The estimated effects are in the opposite direction and of equal size compared to the main effect of VERB TYPE. This shows that the effect of VERB TYPE, present in condition Each-Collective, was removed in sentences without 'each'. For the Adult Between group, we also observed a trending interaction between the factors PICTURE('distributive') and VERB TYPE('dependent') (β=2.814; z= 1.681; $p=.092$), showing that the effect of VERB TYPE decreased for distributive situations.

Post-hoc Tukey multiple comparisons revealed no significant difference in verb type for condition The-Distributive (Adults Between: β= -0.022; z= -0.013; $p=1.00$, Adults Within: β=0.476; z= 1.528; $p=.734$).

We also performed an analysis on the full dataset containing the data of both participant groups to check for a difference between the groups. A similar final model revealed that the factor PARTICIPANT GROUP (with two levels: Adults Between and Adults Within) was significant (β=-1.405; z= -2.616; $p<.01$). With the Adult Between group as the reference level, it means that the Adult Within group had lower acceptance rates than the Adult Between group. Post-hoc Tukey multiple comparisons revealed that this significant difference between the groups originates from condition The-Distributive (The-Distributive: β= -2.097; z= -3.041; $p<0.05$, Each-Collective: β=-0.714; z= -1.008; $p=.964$).

4.4. Discussion

The results of conditions The-Collective and Each-Distributive followed our predictions. They are fully accepted by all participant groups, as predicted, so we will not discuss them further.

The results of condition Each-Collective also followed our predictions. Items of condition Each-Collective were accepted more with independent verbs than with dependent verbs. These results are similar to the results of Experiment 1 testing Dutch.

One finding not addressed so far is the fact that even with independent verbs, the Adults Within group accepted items of condition Each-Collective only in 53% of the cases on average (71% of the cases for the Adults Between group). If we are right that in case of independent verbs, what appears to be a collective situation

is in fact a distributive situation with different subevents, why is *each* not fully accepted? The same question could be asked for *elke 'each'* in Experiment 1.

There are two possible explanations. First, it could be that aside from requiring distributivity, *each* carries another requirement. This has been suggested by Tunstall (1998), who argues that the predicate in the scope of *each* consists of sub-events that must be differentiable from each other. This differentiation can be driven by different times/locations of each sub-event or different entities introduced by indefinites in the scope of *each*. It is not clear how this condition is satisfied in our experiments. For example, the sub-events of brushing a goat in Figure 6 (i.e. girl 1 was brushing a goat, girl 2 was brushing a goat, girl 3 was brushing a goat), all share the same entity (the same goat) and are located at the same place and same time. Since Dutch children and adults showed a similar pattern as English adults, this explanation would suggest that the same condition that Tunstall (1998) observes for English *each* should be valid for Dutch *elke 'each'*. Alternatively, it is possible that condition Each-Collective with independent verbs is not fully accepted because some speakers differ in what they consider sub-events, with some speakers assuming that the predicate has to hold for the whole group, which would go against the distributivity requirement of *each*.

Condition The-Distributive shows a similar pattern as in Experiment 1. We again did not find an effect of verb type on this condition, similar to the Dutch results. The only difference in results can be found between the groups. The Adult Within group showed lower overall acceptance rates than the Adult Between group. Post-hoc tests revealed that this difference could be found in condition The-Distributive. This can be explained by the fact that implicature rates can show varying acceptance rates (cf., van Tiel et al., 2016).

In summary, similar to Experiment 1 for Dutch, participants interpretations of condition Each-Collective show that also for English, the interpretation of *each* was influenced by the different verb types and the event structures they permit.

5. Conclusions

It is well established in semantic research that event structures interact with distributivity and collectivity (Schein, 1993, Landman, 2000, Champollion, 2017). In this paper, we have investigated how verb types affect the acceptability of distributive markers (*elke 'each'* in Dutch, *each* in English).

We have observed that even situations that appear to be collective at first glance can be combined with distributive markers if events are described using independent verb types. This is because independent verb types allow us to consider sub-events, satisfying the condition of distributivity. In contrast, the acceptance of collective situations decreases if one uses dependent verb types. The effect of verb types on acceptability of distributive markers supports the view that distributive markers require distributivity.

The results shed light on previously problematic findings by arguing that high acceptance rates of distributive markers with collective situations, reported

in previous studies, do not show that distributive markers can be interpreted as collective. Rather, those high rates seem to be the result of event structures that license the distributivity requirement of such markers. The results also have methodological consequences. They show that care has to be taken when constructing materials that should probe collective and distributive interpretations. Apart from other considerations, we should also take into account what predicate, and in particular, what verb will be used to describe distributive and collective situations.

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