John Benjamins Publishing Company

This is a contribution from Linguistics in the Netherlands2020

© 2020. Algemene Vereniging voor Taalwetenschap

All rights reserved

This electronic file may not be altered in any way. The author(s) of this article is/are permitted to use this PDF file to generate printed copies to be used by way of offprints, for their personal use only.

Permission is granted by the publishers to post this file on a closed server which is accessible only to members (students and faculty) of the author's/s' institute. It is not permitted to post this PDF on the internet, or to share it on sites such as Mendeley, ResearchGate, Academia.edu.

Please see our rights policy on <https://benjamins.com/content/customers/rights>

For any other use of this material prior written permission should be obtained from the publishers or through the Copyright Clearance Center (for USA: www.copyright.com).

Please contact rights@benjamins.nl or consult our website: www.benjamins.com

Event-distributivity and exhaustivity

Insights into distributive share markers from experiments with German *jeweils*

Ana Bosnić^{1,2} Maximilian Velich¹ & Jennifer Spenader¹

¹ University of Groningen | ² University of Nantes

Distributive-share markers such as *jeweils* in German or *po* in Serbian allow for event-distributive readings, where events are distributed over spatio-temporal units, unlike distributive quantifiers such as *each* in English that only allow individual-distributive readings. Some researchers propose that German *jeweils* should be analyzed as a universal event-distributive quantifier. In contrast, other researchers claim distributive share markers (e.g. Serbian *po*) are simply event plurality markers. We investigated these claims with *jeweils* in two experiments. Experiment 1 tested if both individual and spatial (event) distributive readings are readily available for transitive sentences in German, and if there is an exhaustivity requirement on the restrictor argument. Experiment 2 was designed to force event-distributive readings and further disambiguate the results from Experiment 1. Our findings suggest that *jeweils* seems to be a true universal event quantifier, and highlight that distributive share markers can differ in fundamental features cross-linguistically.

Keywords: quantification, distributivity, distributive share markers, exhaustivity, event-distributive readings

1. Introduction

In semantically distributive events which express a pairing relation between two sets, the set of individuals (a plural argument) that is distributed over is termed the “(distributive) key” (which must be semantically plural (Gil 1995)), and the set of objects that are distributed is termed the “(distributive) share”, using terminol-

ogy introduced by Choe (1987).¹ In (1) the set of monkeys is the key, while the set of umbrellas is the share.

- (1) *Each monkey is holding one umbrella.*

Languages differ in the linguistic devices they have available to express distributivity. All languages have distributive key markers. For example, English *each* is a quantificational determiner that combines syntactically with the key (in (1), the set of monkeys). But some languages also have markers that syntactically and semantically associate with the share argument, e.g. one umbrella. For example, Example (1) can be expressed with the distributive share marker (DistShare) *po* in Serbian (2) or *jeweils* in German (3):

- (2) *Majmuni drže po jedan kišobran.*
 monkeys hold.PL DISTR one umbrella.ACC
 ‘Monkeys hold DISTR one umbrella.’
- (3) *Die Affen halten jeweils einen Regenschirm.*
 the monkeys hold.PL DISTR one.ACC umbrella
 ‘The monkeys hold DISTR one umbrella.’

While it is universally acknowledged that distributive key markers like *each* are universal quantifiers, it is not clear what semantic analysis should be given to DistShare markers. Additionally, little experimental research has been done with DistShare markers. Cross-linguistically DistShare markers seem to share some key features but, similarly, very little experimental research has directly compared specific features across languages. Furthermore, they yield additional readings, called event-distributive readings, in which distribution is not done over individual members of the distributive key, but over relevant subevents, separated spatially or temporally.

In this paper we report on two picture verification experiments with German *jeweils*. The goal of the experiments is twofold: we tested two properties of *jeweils* – namely, to what extent *jeweils* allows event-distributive readings and whether it shows an exhaustivity requirement on its distributive key argument. Given that universal quantifiers share a core feature of exhaustivity (i.e. their restrictor (key) set need to be exhaustively used, while the share set does not have this requirement), it is a good diagnostic for checking whether *jeweils* can be analyzed as a universal distributive quantifier or not.

1. This terminology is preferred, because more general quantificational terms such as “restrictor” and “nuclear scope” do not have an explicit term for the set corresponding to the share.

These results also add to the debate between two main approaches to DistShare markers: one approach analyzes them as universal (event) quantifiers (following Balusu 2006; Choe 1987; Gil 1995; Zimmermann 2002, among others), and the other analyzes them as markers of event plurality, i.e. distributive markers that only require at least two events satisfying the given predicate without involving universal quantification (Cable 2014; Knežević 2015; Matthewson 2000; Müller & Negrão 2012; Pasquereau 2018 a.o.).

The experiments carried out are based on one of the previous experiments done with transitive sentences and Serbian DistShare marker *po* (Bosnić et al., 2020b, to appear), adapted for German. Based on the earlier experimental results, Bosnić et al. (2020b) found a clear split in the population in which one population shows a pattern of responses equivalent to a universal quantifier, while the other shows a pattern of responses that corresponds to a marker of event plurality. Given that Serbian results show that native speakers can have clear differences in their interpretations of DistShare markers, we also look closely at the responses to see if there is also evidence of different populations in German. Our experiments show that German *jeweils* show a pattern of responses equivalent to a universal quantifier but that the split in the population is based on whether the speakers (readily) allow event-distributive readings.

2. Background

At first glance, DistShare markers seem to be the complement of distributive key markers – meaning that they syntactically and semantically associate with what is being distributed rather than what is distributed over, but this is actually an oversimplification.²

First, DistShare markers need to associate with a numerically quantified set, e.g. *po* + *num DP* or *jeweils* + *num DP*. This is in contrast to distributive key markers which can directly quantify sets. Second, they can communicate *event-distributive* readings. For instance, when DistShare markers are used in intransitive sentences, the share marker associates with the only overt argument, the subject, so the distributive key is not linguistically expressed. Consider (4)–(6):

- (4) *Jeweils ein Affe tanzt.* (German)
DISTR a monkey dances

2. Binominal *each* seems to be the exception – it is claimed that binominal *each* is a distributive key marker, but that it syntactically attaches to the distributive share set.

- (5) *Pleš-e po jedan majmun* (Serbian)
dances DISTR one monkey
- (6) *Wenswungi-ka han-mali-ssik chwum-ul chwu-ko iss-ta.* (Korean)
monkey one-DISTR dance dance
'DISTR one monkey is dancing (at different places/on different occasions).'

Since the only linguistic argument of the verb (the subject) in (4)–(6) is marked as the distributive share, the distributive key argument must be covert, meaning that only an event-distributive interpretation is possible (i.e. the event of one dancing monkey is distributed over a key set of implicit spatial or temporal arguments of the verb). In other words, the set of monkeys has to be distributed over another plurality that can serve as the distributive key. More importantly, this implicit key has to be contextually determined (see the discussion in Zimmermann (2002) for *jeweils*, and Balusu (2006) for reduplicated numerals in Telugu). The examples in (4), (5) and (6) thus could mean – ‘One monkey is dancing in each place/each time interval’, but it does not necessarily mean ‘Each monkey is dancing’ – the latter must exhaust the set monkeys, while the former need not exhaust the set of monkeys. See Figure 1 for a felicitous scenario for Examples (4)–(6).

Figure 1. A felicitous scenario for sentences (4)–(6). Crucially, this scenario does not hold for the sentence with distributive key markers – therefore, ‘Each monkey is dancing’ is false

If these DistShare markers are universal quantifiers, one consequence is that the key set is required to be exhausted, regardless of it being explicit, or implicit (spatial or temporal, contextually determined). In Figure 1, a potential plural,

covert argument could be the set of cages, interpreted as relevant spatial units over which distribution (exhaustively) takes place. Exhaustivity requirements of DistShare markers have been tested experimentally in Serbian and Korean.

2.1 Experimental studies of exhaustivity requirement

Bosnić et al. (2020a) visually manipulated whether or not the spatial distributive key was exhausted in a series of picture verification experiments with adult Serbian and Korean speakers. Test sentences were intransitives like (5) and (6) above, with the DistShare marker associated with the overt subject argument. The distributive key argument was linguistically implicit, and had to be inferred from the visual presentation (e.g. cages). Bosnić et al. (2020a) found that when a DistShare marker was used with the subject of an intransitive sentence, non-atomic individuals (i.e. groups) were interpreted as the key that needed to participate exhaustively in the predicated action (see Figure 2). In fact, these results initially suggested that relevant sets of individuals (groups of monkeys) defined the relevant spaces that were then interpreted as the distributive key, because experimental participants rejected items where the distributive key was not exhausted. This result seemed to support an analysis of DistShare markers as universal quantifiers.

Figure 2. Non-exhausted condition for the sentences (5)/(6), from Bosnić et al. (2020a). This condition was strongly rejected because of the presence of non-dancing monkeys in two groups, suggesting that the key should be the spaces defined by the groups of individuals (monkeys)

In a follow-up series of experiments, Bosnić et al. (2020b) looked at transitive sentences in Serbian with the DistShare marker associated with the object. They tested two visual situations, with a large group of individuals and with four smaller distinct groups of individuals, each with three variations (one exhausted

and two types of non-exhausted scenarios). The *One Group* situation (Figure 3) focused on checking individual-distributive scenarios with the overt distributive key in the sentences (the subject). The *Four Groups* situation (Figure 4) investigated the conclusions from Bosnić et al. (2020a) that groups of individuals can be interpreted as an implicit spatial key. A universal quantification analysis would predict that all individuals in the first condition and all the groups in the second condition must exhaustively participate, but an analysis of DistShare markers as pluractional (event plurality) markers would have no such requirement and non-exhausted conditions should be fully accepted.

Figure 3. One Group-Exhausted Condition, from Bosnić et al. (2020b). The predicate is true for all individuals

Figure 4. Four Groups-Exhausted Condition, from Bosnić et al. (2020b). The predicate is true for all four visually separated groups

Bosnić et al. (2020b) found that participants showed three identifiable patterns of responses: (i) some participants showed a clear individual-distributive pattern, accepting only *One Group-Exhausted* items like Figure 3, similarly to *each*, (ii) another group consistently required that both the overt (zebras) and covert (groups/spaces) key are also exhausted, as predicted by an analysis of DistShare markers as universal event quantifier and the conclusions from the intransitive sentences, but (iii) the third group of participants did not require exhaustivity and seemed to simply accept all the cases, resembling a pattern of responses predicted for pluractional markers.

The three distinct patterns of responses prompted two follow up experiments that tested whether the observed (non)exhaustive effects originated from another linguistic construction in the sentence, namely the subject argument. It is often claimed that definite plural DPs receive a maximal interpretation, meaning that the expression such as *the boys* would mean *all the (contextually relevant) boys* (Križ 2017; Schwarz 2013). Even though Serbian is a determiner-less language, the bare plural DPs in general carry a maximality implicature, i.e. the hearer expects the referent to be maximal (definite) in any given context, unless the context rules maximality out. Namely, the bare plural DP *monkeys* may be interpreted as definite (maximally) or as indefinite (non-maximally). The second follow-up experiment was designed to unambiguously force the definite reading with an additional linguistic context (e.g. *There are 8/12 monkeys in the picture*). This set-up predicted that the third pattern of responses (in which all the conditions were accepted) would disappear. By forcing the definite interpretation of the bare subject, the majority of participants required all the monkeys to be exhausted (accepting Figure 3, but not Figure 4), which resulted in the individual-distributive pattern (such as pattern (i) in the first experiment), but unexpectedly, the third pattern did not disappear entirely. However, it is well-known that the maximal interpretation of definite plurals can be weakened by so-called “pragmatic slack” (i.e. using the expression imprecisely, non-maximally, as long as the exceptions are not relevant in the context), so variation in acceptance rates is to be expected (Lasnik 1999). What’s more, this experiment also contained sentences without *po* and interestingly, the same individual-distributive (exhaustive) pattern was found in sentences with and without *po* with 27/61 participants. These results suggest that exhaustivity requirements may also originate from the definiteness of the subject and the maximality requirements associated with definiteness, and are not necessarily derived from the exhaustivity requirements of the DistShare marker *po*. The third follow-up experiment tested precisely whether the observed exhaustivity requirements originate from the maximality effects of the subject DP or the exhaustivity requirements of *po* using so-called homogeneity

effects in negative sentences with *po*.³ The experiment revealed a clear split in the population, in which one group of participants treats *po* as a universal quantifier and another as a marker of event plurality (a pluractional). Bosnić et al. (2020b) thus speculate there is an ongoing diachronic process of semantic weakening from a distributor with universal force to a mere marker of event plurality.

Could the conclusions from Bosnić et al. (2020a and 2020b) be generalizable to other DistShare markers? Given the lack of similar experimental evidence with other markers, our present study focused on German *jeweils*. Bosnić et al. (2020b) showed that a universal quantifier analysis for Serbian *po* only partly holds and that some participants consider it to be a marker of event plurality with much weaker requirements. However, it would be premature to then conclude that the same is true of all DistShare markers. *Jeweils* may behave differently. In the next section we briefly summarize what has been claimed about the interpretation of *jeweils* in previous theoretical research.

2.2 German *jeweils*

One of the most detailed analyses of *jeweils* is given in Zimmermann (2002). Like Zimmermann (2002), Champollion (2016) and Gil (1995) have also claimed that German *jeweils* is a universal quantifier, further suggesting that all DistShare markers should be analyzed as a type of universal (event) distributive quantifier. Zimmermann (2002) proposes an analysis where *jeweils* combines syntactically with a key argument (its restrictor), but unlike standard universal quantifiers, the key is not derived from a lexical NP argument, but instead a covert pronominal NP that has as its antecedent a contextually provided distributive key set. This contextual key set is in a distributive relation with the members of the share. This analysis can be applied both to intransitives and transitives, and can derive both individual and event-distributive readings. However, how the distributive key set is determined by the context is not further specified, but because *jeweils* is a universal quantifier in this analysis, all members of the key set must exhaustively relate to a member of the share set. One way to guide interpretations is by visually manipulating scenes, like Bosnić et al. (2020a) did.

3. In contexts where the property ascribed to the plurality denoted by a subject DP does not hold uniformly, or “homogeneously”, sentences with definite plurals are trivalent: they are judged neither completely true, nor completely false and result in gap scenarios. In contrast, sentences with a universally quantified subject come out as false. Universal quantifiers are thus said to remove homogeneity effects (see Križ & Chemla 2015 and references therein for details and experiments on homogeneity).

Zimmermann's analysis of *jeweils* could also account for the experimental results Serbian *po* found in Bosnić et al. (2020a) with intransitive sentences and partly in Bosnić et al. (2020b) with transitive sentences. But how similar is *jeweils* to Serbian *po*? By using the same materials from the Serbian transitive experiment (Bosnić et al. 2020b) we can start to examine this question more directly.

First, if *jeweils* is a true universal quantifier, then it must have the fundamental property of universal quantifiers of requiring its key set (restrictor) to exhaustively participate in the predicate. Recall that in Serbian, Bosnić et al. (2020b) found two populations. Will German speakers treat *jeweils* as universal quantifiers, as has been claimed, and will this interpretation be consistent across participants?

Second, is *jeweils* fully acceptable with event-distributive readings? We know that certain examples with *jeweils* (e.g. in intransitive sentences or transitives without an overt plurality) can only be interpreted as having an event-distributive reading, but are these readings easily accessible to all German speakers, even when there is an overt key competitor?

To investigate these two questions, we adapted the experiment used in Bosnić et al. (2020b) to German. Experiment 1 focuses on determining what the exhaustivity requirements are with *jeweils*. Experiment 2 investigated whether or not event-distributive readings are indeed possible in German with limited context, and checked that exhaustivity requirements indeed originate from *jeweils* and not from a maximal interpretation of a plural DP.

3. Experiment 1

3.1 Method

3.1.1 Participants

60 monolingual native German speakers (Mean age: 29.53, Range:19–58, 37 female) participated in the experiment. The entire experiment was done online and took approximately 10 minutes.

Experiment 1 investigated two questions. First, will German speakers reject non-exhausted situations (Figure 5, (b) and (e)) with a definite subject and the DistShare marker associated with the object (and to what degree)? Second, will German speakers readily accept situations where the distributive key has to be interpreted as relevant spaces, visually defined with groups of individuals (Figure 5(d)), or will this event-distributive interpretation of DistShare markers be rejected? This question is separate from the exhaustivity issue.

a. One-Exhausted

b. One-Non-exhausted

c. One-Other object

d. Four-Exhausted

e. Four-Non-exhausted

f. Four-Other object

Figure 5. The six conditions used in Experiment 1, taken from Bosnić et al. (2020b)

3.1.2 Materials

We followed the design of Experiment 1 from Bosnić et al. (2020b), but since German has determiners, it was not necessary to manipulate the context – we could simply use a definite article with the subject DP and test the role of definiteness more directly.⁴ We used a 2×3 factorial design and a picture verification task. The independent variables were *Group Size* (of individuals) with two levels: *One* and *Four*, and *Picture* with three levels: *Exhausted*, *Non-exhausted* and exhausted with a different object – *Other object*. There were six observations per condition, five controls and 20 filler items. Control items were unambiguous situations with numerically quantified expressions to check whether participants pay attention (e.g. ‘Three monkeys are holding an umbrella’ paired with Figure 5(d)). Filler items were sentences with weak quantifiers *few* and *many* and intransitive verbs (e.g. ‘Many tigers are sleeping’ or ‘Few parrots are flying’). In Experiment 1, the target sentences always had a definite subject with *jeweils* just before the numerically quantified object DP, always with one object (7) (see Appendix C for a complete list of target items).

- (7) *Die Affen halten jeweils einen Regenschirm.*
‘The monkeys are holding DISTR one umbrella.’

The pictures were the same as those used in the Serbian study (Figure 5). Note that in the *One* condition, there is one large group of non-overlapping individuals, while in the *Four* condition there are four groups of three individuals close to each other, visually separated into the four corners. In the exhausted cases, all individuals in the *One* condition fulfilled the predicate (e.g. they held an umbrella), and in the *Four* condition, one member of each group fulfilled the predicate. In the non-exhausted case, two members in the *One* condition did not fulfill the predicate. In the non-exhausted *Four* condition, two of the groups (which groups were varied across items) had no member that fulfilled the predicate. In the *Other object* condition, characters that were not participating in the predicated action instead participated in a different action (e.g. they held a present). The *Other object* condition simply shows another way of making a non-exhausted condition by using the same verb (*to hold*) with a different object. This condition was potentially interesting to compare with the typical non-exhausted condition – by having a sharp contrast between different objects it may be easier to compare the two sets and evaluate the situation more confidently.

4. Although there is a logical question of testing and comparing German definite plurals vs. German bare plural DPs, note that bare plural DPs in German yield generic interpretations (e.g. the monkeys as species), and the German informants found this construction to be inappropriate for the given situations.

3.2 Predictions

- I. If *jeweils* is similar to Serbian *po* (for some or all speakers), in the sense that for some speakers it is interpreted as a pluractional marker without any exhaustivity requirements, because the subject is definite (signaled by the definite subject argument, e.g. *Die Affen*), we expect the subject to be interpreted maximally, with participants strongly accepting only *One-Exhausted* condition, and rejecting all non-exhausted conditions, including the *Four-Exhausted* condition, since it also violates the maximal interpretation. Since the maximality property of definite plural expressions can be pragmatically weakened, that rejection rate may not be as strict for non-exhausted scenarios as it would be with a universal quantifier in which the distributive key **must** be exhausted.
- II. If *jeweils* is instead a universal quantifier (for some or all speakers), it will contribute an exhaustivity requirement for the restrictor set, in addition to the maximality requirements contributed by the definite subject argument. These two factors should together cause participants to strongly reject all non-exhausted cases.
- III. If *jeweils* is similar to Serbian *po* in allowing event-distributive readings, we also predict that we will see the similar pattern of acceptance with the *One* condition, which investigates individual quantification, as with the *Four* condition, which tests the ability of *jeweils* to license event quantification.

3.3 Results of Experiment 1

Figure 6. Results of Experiment 1. Pictures with *One* or *Four* groups in the *Exhausted*, *Non-exhausted* and *Other Object* conditions. Bars show mean acceptance, lines show the distribution, and each dot represents an individual (jittered to make them more visible)

Looking at the results in Figure 6, for the *One* condition, participants overwhelmingly accepted the exhausted condition, and overwhelmingly rejected the *Non-exhausted* and *Other Object* conditions. This is not entirely comparable to the Serbian results from Bosnić et al. (2020b) because Serbian speakers accepted non-exhausted pictures about 30% of the time – in fact, there was a group of participants that systematically accepted non-exhausted scenarios. For the *Four* condition, as predicted, participants did consistently reject the non-exhausted pictures, similar to their Serbian counterparts. The rejection of the *Other Object* condition was also expected. These results all suggest that there is an exhaustivity condition, which seems to originate from *jeweils* rather than from the definite key argument.

However, participants gave a range of responses in the *Four-Exhausted* condition. This condition tested whether or not *jeweils* could license an event-distributive reading where the share is distributed over relevant spaces, and should have been accepted. We can also see by the individual responses (note the clustering of dots at the top and bottom of the column), and the distribution lines, that in the *Four-Exhausted* conditions there are two populations. 23 participants accepted every item, similar to Serbian participants, while a group of 31 participants consistently rejected every item. This contrasts with the *One-Exhausted* condition where all participants are clustered at the top of the graph. These results suggest that event-distributive readings are less accessible than individual-distributive readings for German speakers.

3.3.1 Analysis

We used mixed effect logistic models to analyze the results using a stepwise variable addition procedure. Model comparisons (comparing AIC scores)⁵ found that the maximal best model retained the fixed factors PICTURE (Exhausted, Non-Exhausted and Other Object) and GROUP (One vs. Four) with a significant interaction between them. The best model also had a random slope of the fixed factor PICTURE for both *Subjects* and *Items*. Most relevant, participants were significantly more likely to accept items in the *One-Exhausted* condition than in the *Four-Exhausted* condition ($\beta=5.6872$; $z=9.765$; $p<0.0001$) (see Appendix A for a full model output).

5. An AIC decrease of more than two indicates that the goodness of fit of the model improves significantly (Akaike, 1974).

3.4 Discussion of Experiment 1

We found that German speakers strongly rejected the *Non-Exhausted* conditions with the DistShare marker *jeweils* on the object when the subject was marked for definiteness. This was predicted under the assumption that *jeweils* should be analyzed as a universal quantifier (see prediction (II) above). If the effects were coming solely from the maximal interpretation, however, we would not expect the rejection rate to be so high, and more importantly, the *Four-Exhausted* condition would also not be accepted as such a high rate because it violates the maximal interpretation of the subject argument (see (I) above).

This brings us to the crucial *Four-Exhausted* condition (see (III) above). Semantic analyses of DistShare markers suggest that groups of individuals that contain the participating individual should be sufficient to define the relevant spatial key over which the relevant events (e.g. of one monkey holding one umbrella) are distributed. Instead, we identified two populations: One group systematically rejected *Four-Exhausted* and accepted only *One-Exhausted*, and the other group accepted both *Four-Exhausted* and *One-Exhausted*, essentially allowing the group (spatial) reading.⁶

In debriefing, some participants reported that they rejected the *Four-Exhausted* condition because the activity was not a group activity, i.e. some individuals were not participating and they were thus not exhausted. These participants explicitly noted that if the activity had been a collective one, such as e.g. washing a van, then they would have accepted the item, because even if only one individual in each group would be depicted in the picture as doing the action, it could be inferred that the group as a whole was doing the action. This type of collective interpretation, where it is assumed that all members of each group participated in the action, is then essentially equivalent to the individual-distributive situations of the *One-Exhausted* conditions. Speakers that do not accept event-distributive readings with *jeweils* may simply be treating the *Four* condition like *One* condition. These participants then accept the *Four-Exhausted* condition in cases where they interpret each group as collectively participating in the action (equivalent to *One-Exhausted*, but indistinguishable from acceptance because of an event-distributive interpretation), and reject it when this collective participation as unlikely (e.g. holding an umbrella).

In order to fully interpret the results from Experiment 1, we need to do additional experiments. First, we would like to confirm that the exhaustivity requirement found in Experiment 1 originates from *jeweils*. Further, we need more straightforward evidence that some German speakers do accept event-distributive

6. Note that the second pattern was not found in the Serbian experiment in Bosnić et al. (2020b) when the subject was made definite.

readings from *jeweils*. Because Experiment 1 used plural definite subjects (e.g. *Die Affen*), all the individuals in the picture could be taken as the key, despite the visual manipulations into groups. This interpretation might be much more accessible in German than an event-distributive interpretation, but this does not rule out the possibility that an event-distributive reading is also possible. To investigate both these questions, we can use sentences with singular indefinite subjects and test the *Four* condition only. This should make only event-distributive readings possible, since the only plurality available for the key is the implicit spatial argument, i.e. multiple groups. We therefore expect that if event-distributive readings are available, participants will now accept the exhausted condition.

4. Experiment 2

4.1 Method

4.1.1 Participants

24 monolingual native German speakers participated (Mean Age: 30.04, Range 20–60, 16 females) in the second experiment, which was also done online.

4.1.2 Materials

Experiment 2 was designed to specifically test the availability of the event-distributive (spatial) readings of the *Four* condition only. Experiment 2 had a 2×2 design, with the factors PICTURE (with Exhausted and Non-exhausted pictures (Figure 5(d) and 5(e)) and SENTENCE (Indefinite vs. Definite). We manipulated the definiteness of the subject by using either an indefinite singular subject, e.g. (8), or a definite plural subject using the same sentences as those used in Experiment 1, e.g. (9):⁷

- (8) *Ein Affe hält jeweils einen Regenschirm.*
'One monkey holds DISTR one banana.'
- (9) *Die Affen halten jeweils einen Regenschirm.*
'The monkeys are holding DISTR one banana.'

7. Although it is more natural and frequent to use *jeweils* in sentences with overt plurals, a few informants accepted this sentence with Figure 5(d) because they inferred that it is 'one monkey per group' based on the visual context provided. The sentence with a definite plural subject, on the other hand, although more natural on its own, was not as felicitous for the scenario in Figure 5(d). A frequent comment was that every monkey should hold an umbrella for it to be accepted.

4.2 Results of Experiment 2

The descriptive results are presented in Figure 7. First, in the *Definite* condition, participants rejected non-exhausted items, similar to Experiment 1. In the new *Indefinite* condition, they also overwhelmingly rejected non-exhausted pictures. This is unexpected if the exhaustivity requirement originates from maximality requirements associated with a definite key argument, and suggests that *jeweils* is indeed the source of the exhaustivity requirement.

Figure 7. Results of Experiment 2. Mean acceptance rates are shown by the bars, individual responses are shown by each dot (jittered), and the lines show the distribution. Results for the indefinite singular subjects are on the left, and definite plural subjects on the right

For the *Exhausted* conditions, we see a range of responses both for the definite and the indefinite cases. However, the distribution of answers for the *Definite-Exhausted* cases is not similar to the distribution of answers in Experiment 1 for the same condition. Here, we cannot identify two populations anymore, and the majority of people answered at chance (see footnote 7 for a possible explanation). On the other hand, we see that participants more consistently accept *Indefinite-Exhausted* items, and they accept them at a higher rate, but still not completely.

4.2.1 Analysis

We used mixed effect logistic models to analyze the results. Model comparisons (comparing AIC scores) found that the maximal best model retained the interaction between the fixed factors PICTURE and SENTENCE TYPE. *Items* were not a significant random factor in the best model and there was a random slope of both fixed factors for *Subjects*. Participants were significantly more likely to accept

Exhausted items with the definite subject than *Non-Exhausted* items with the definite subject ($\beta = -6.2412$; $z = -3.364$; $p = 0.0008$), but the difference between exhausted definite subject DP and indefinite subject DPs was not significant: ($\beta = 0.8081$; $z = 1.260$; $p = 0.2078$) for exhausted scenarios and ($\beta = 0.0504$; $z = 0.057$; $p = 0.9547$) for non-exhausted scenarios (see Appendix B for a full model output).

4.3 Discussion of Experiment 2

Judging from the results of the *Indefinite-Exhausted* condition, event-distributive readings are undoubtedly possible, but not readily available in out-of-the-blue situations for some German speakers.⁸ When they are available, the spatial key has to be exhausted. Speakers who reject event-distributive readings might accept them in the right context. Recall that Zimmermann (2002), as well as Champollion (2016), argued that event-distributive readings require a predetermined relevant context. Crucially, German speakers rejected non-exhausted items regardless of the definiteness of the subject, suggesting that that an exhaustivity requirement originates from *jeweils* itself.

5. General discussion and conclusions

We performed two experiments to test the exhaustivity requirement and availability of event-distributive readings with the DistShare marker *jeweils* in German. Our findings are summarized below:

- i. Experiment 1 uncovered two populations with different patterns of responses – one population only allows individual-distributive readings with German *jeweils*, while the other seems to allow event-distributive (spatial) readings as well. Non-exhausted conditions, however, were systematically rejected. The results suggest that *jeweils* has exhaustivity requirements and allows for event-distributive readings.
- ii. Experiment 2 confirmed that exhaustivity originates from *jeweils*, contributing further evidence that *jeweils* is a universal distributive quantifier that can distribute over events (spatiotemporal locations) even without an explicit linguistic context. Further, when the linguistic form constrained possible interpretations to event-distributive interpretations, this interpretation was available to the majority of participants.

8. This could arguably also be the case for the Serbian speakers, given the three patterns of responses that were found in the transitive experiment in Bosnić et al. (2020b).

Finally, it seems that there is strong evidence that *jeweils* is a universal quantifier, but unlike Serbian, we did not find evidence that there is a subset of speakers for whom the universal import is “weakening” to simply communicate plural (distributive) events (i.e. speakers who accept every condition).

Evidence from German and Serbian results together show that DistShare markers in different languages can have different interpretations, despite being given a uniform analysis cross-linguistically in many previous theoretical accounts. While German *jeweils* certainly behaves like a universal quantifier, the same analysis only applies to a subset of the population of Serbian speakers for Serbian *po*. In addition, *jeweils* does not seem to be undergoing semantic weakening towards a marker of event plurality. However, a good follow up study would be to test for homogeneity effects in German to strengthen these speculations.

We hope that our experiments spark further interest in testing additional claims about DistShare marker interpretations, which can contribute new insights to the abundant theoretical research. We believe our experiments have already shown that there is more variation and complexity cross-linguistically than previously thought, suggesting more experimentation can lead to a more nuanced picture of these markers.

Acknowledgements

We thank Anna de Koster for invaluable comments and feedback on this paper. This research would not be possible without the participants in our experiments and we appreciate their input and judgments. Finally, we thank the Grote Taaldag audience for the useful discussion and feedback.

References

- Akaike, Hirotugu. 1974. “A new look at the statistical model identification.” *IEEE Transactions on Automatic Control* 19: 716–723. <https://doi.org/10.1109/TAC.1974.1100705>
- Balusu, Rahul. 2006. “Distributive reduplication in Telugu.” In *Proceedings-NELS*, Vol. 36(1): 39–52. Amherst, MA: GLSA (Graduate Linguistic Student Association), UMass
- Bosnić, Ana, Jennifer Spenader and Hamida Demirdache. 2020a. Dancing monkeys in Serbian and Korean – exhaustivity requirements on distributive share markers. *Glossa: a journal of general linguistics* 5(1): 78. 1–28. <https://doi.org/10.5334/gjgl.858>.
- Bosnić, Ana, Hamida Demirdache & Jennifer Spenader. 2020b. “Exhaustivity and homogeneity effects with distributive share markers – experimental evidence from Serbian po” (accepted to Syntax, August 2020).
- Cable, Seth. 2014. “Distributive numerals and distance distributivity in Tlingit (and beyond).” *Language* 90(3): 562–606. <https://doi.org/10.1353/lan.2014.0055>

Champollion, Lucas. 2016. "Overt distributivity in algebraic event semantics." *Semantics and Pragmatics* 9(6): 1–65.

Choe, Jae-Woong. 1987. "Anti-quantifiers and a theory of distributivity." PhD dissertation, University of Massachusetts, Amherst.

Gil, David. 1995. "Universal quantifiers and distributivity." In *Quantification in natural languages* 2 ed. by Elke Bach, Eloise Jelinek, Angelika Kratzer & Barbara B. Partee. 321–362. Springer, Dordrecht.

Knežević, Nataša. 2015. "Numerals and Distributivity in Serbian: at the syntax-semantics acquisition interface." PhD dissertation, University of Nantes, Nantes.

Križ, Manuel. 2017. "In Soviet Russia, alcohol is dependent on you." *Festschrift for Martin Prinzhorn. Wiener Linguistische Gazette (WLG)* 82: 173–180.

Križ, Manuel & Emmanuel Chemla. 2015. "Two methods to find truth-value gaps and their application to the projection problem of homogeneity." *Natural Language Semantics* 23(3): 205–248. <https://doi.org/10.1007/s11050-015-9114-z>

Lasersohn, Peter. 1999. "Pragmatic halos." *Language* 75(3): 522–551. <https://doi.org/10.2307/417059>

Matthewson, Lisa. 2000. "On distributivity and pluractionality." In *Semantics and Linguistic Theory* 10: 98–114. <https://doi.org/10.3765/salt.v10i0.3105>

Müller, Ana & Esmeralda Vailati Negrão. 2012. "On distributivity in Karitiana." *Verbal plurality and distributivity* 546 ed. by Patricia Cabredo Hofherr and Brenda Laca. 159–184. Berlin: Walter de Gruyter. <https://doi.org/10.1515/9783110293500.159>

Pasquereau, Jérémy. 2018. "Event plurality in Seri (with Patricia Cabredo-Hofherr and Carolyn O'Meara)." In *Proceedings of SULA* 10. 1–15.

Schwarz, Florian. 2013. "Maximality and definite plurals – experimental evidence." *Proceedings of Sinn und Bedeutung* 17, 509–526.

Zimmermann, Malte. 2002. *Boys buying two sausages each: On the syntax and semantics of distance-distributivity*. Utrecht: LOT.

Appendix A.

Experiment 1

Formula: Answer ~ Picture * Group + (1 + Picture | Subjects) + (1 + Picture | Items)

	Estimate	Std. Error	z value	Pr(> z)
Four – Exhausted (Intercept)	−0.4225	0.4934	−0.856	0.39174
Four – Other Object	−8.5944	2.1028	−4.087	< 0.000001 ***
Four – Non-exhausted	−7.1546	1.4442	−4.954	< 0.000001 ***
One – Exhausted	5.6872	0.5824	9.765	< 0.000001 ***
One – Other Object	−3.2311	1.0448	−3.093	0.00198 **
One – Non-exhausted	−3.7288	0.7675	−4.858	< 0.000001 ***

Appendix B.

Experiment 2

Formula: Answer ~ Picture * Sentence Type + (1 + Sentence Type + Picture | Subjects)

	Estimate	Std. Error	z value	Pr(> z)
Exhausted – Definite (Intercept)	0.24018	0.54247	0.443	0.657951
Non-exhausted – Definite	-6.24120	1.85521	-3.364	0.000768 ***
Exhausted – Indefinite	0.80810	0.64154	1.260	0.207802
Non-exhausted – Indefinite	0.05039	0.88750	0.057	0.954722

Appendix C.

Items

Die Schimpansen putzen jeweils ein Fenster.	Die Papageien tragen jeweils ein Geschenk.
Die Nashörner schieben jeweils ein Auto.	Die Panther ziehen jeweils einen Schlitten.
Die Eulen halten jeweils einen Blumenstrau.	Die Bären schieben jeweils ein Fass.
Die Affen essen jeweils eine Banane.	Die Löwen bauen jeweils ein Lego Haus.
Die Koalas bemalen jeweils eine Vase.	Die Tiger trinken jeweils eine Packung Milch.
Die Panther waschen jeweils einen Van.	Die Eulen tragen jeweils einen Hut.
Die Bären schieben jeweils ein Fass.	Die Papageien ziehen jeweils ein Spielzeugauto.
Die Zebras halten jeweils einen Ballon.	Die Nashörner heben jeweils eine Hantel.
Die Nilpferde essen jeweils eine Portion Eis.	Die Pandas bauen jeweils einen Schneemann.
Die Tiger bemalen jeweils ein Ei.	Die Gorillas trinken jeweils eine Flasche Coca Cola.
Die Elefanten waschen jeweils ein Boot.	Die Schimpansen halten jeweils einen Regenschirm.
Die Affen schieben jeweils einen Kinderwagen.	Die Nilpferde ziehen jeweils einen Baum.
Die Pandas halten jeweils einen Ball.	Die Elefanten heben jeweils ein Klavier.
Die Löwen essen jeweils eine Keule.	Die Zebras bauen jeweils eine Sandburg.
Die Gorillas streichen jeweils ein Brett.	Die Koalas trinken jeweils einen Saft.

Address for correspondence

Ana Bosnić
University College Groningen
Hoendiepskade 23/24
9718 BG Groningen
The Netherlands
a.bosnic@rug.nl

Co-author information

Maximilian Velich
Bernoulli Institute for Mathematics,
Computer Science and Artificial Intelligence
University of Groningen
maximilian@velich.me

Jennifer Spenader
Bernoulli Institute for Mathematics,
Computer Science and Artificial Intelligence
University of Groningen
j.spenader@ai.rug.nl