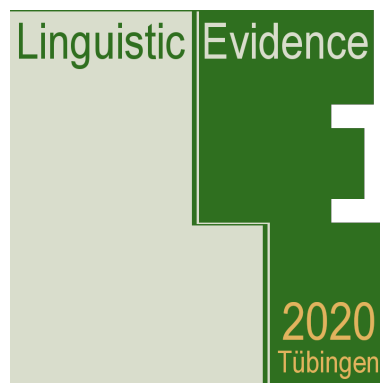


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# Anaphoric Potential of Pseudo-Incorporated Nominals in Comparison with Compounds and Implicit Objects<sup>1</sup>

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## 1 Types of Object Nominals and their Anaphoric Uptake

Constituents of linguistic acts do not only contribute to the meaning their truth-conditional or social meaning, they often also introduce entities and concepts, so-called discourse referents, that can be picked up by anaphoric expressions in subsequent discourse (cf. Karttunen 1969). Expressions with the same referential or truth-conditional meaning can differ in their anaphoric potential, as in Barbara Partee's example *I dropped ten marbles and found {all of them except for one / only nine of them}*, where the first but not the second variant allows for easy anaphoric reference (*It is probably under the sofa*) (cf. Heim 1982). Subsequent research has identified the types of quantifiers (e.g. *all* vs. *every*, Kamp & Reyle 1993), the animacy status (Fukumura & van Gompel 2011), the syntactic role (e.g. subject vs. object, cf. work in Centering Theory, cf. Poesio et al. 2004), the semantic role (e.g. Schumacher et al. 2015), the configurational position (heads vs. non-heads, cf. Gordon et al. 1999) and the rhetorical relation (cf. Kehler et al. 2008), among others, as influences on anaphoric accessibility. We can observe accessibility differences by the different ways of anaphoric uptake, from null pronouns, simple pronouns and demonstratives to full definite DPs, or the impossibility of anaphoric uptake (cf. Gundel et al. 1993, Ariel 2001).

The current paper contributes to this body of literature by studying one of the factors of accessibility. It has been observed that the more a constituent is structurally integrated in another constituent, the less accessible it is for uptake by anaphora. For example, Ward et al. (1991) show that morphologically integrated words are difficult to access (e.g. *\*Animal<sub>i</sub> hunters tend to like them<sub>i</sub>*, under the co-referring reading), and van Geenhoven (1998), Farkas & de Swart (2003), Massam (2009), Mithun (2010) and others discuss the anaphoric potential of incorporated objects and pseudo-incorporated objects in contrast to other objects.

Here, we will investigate different types of object arguments in German with respect to their anaphoric potential – the ease to refer to these object arguments anaphorically. This arguably depends on the way how nominal arguments and verbal predicates are syntactically combined and semantically integrated, and hence can provide cues for the nature of this combination and integration. In particular, we are interested in the possible realizations of object arguments that can be described as “indefinite.” See (1) for examples that vary minimally, followed by the continuation (2) with an anaphoric pronoun.

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- (1) a. *Maria hat im Frühjahr wieder viele Blumen gesät.* Indefinite w. determiner  
 Maria has in spring again many flowers sowed  
 ‘Maria sowed many flowers in spring again.’
- b. *Maria hat im Frühjahr wieder Blumen gesät.* Bare noun  
 Maria has in spring again flowers sowed  
 ‘Maria sowed flowers in spring again.’
- c. *Maria war im Frühjahr wieder am Blumensäen.* Infinitival compound  
 Maria was in spring again at flower.sowing  
 ‘Maria was sowing flowers in spring again.’
- d. *Maria war im Frühjahr wieder mit der Blumensaat beschäftigt.* Nominal compound  
 Maria was in spring again with the flower.sowing occupied  
 ‘Mary was busy with the sowing of flowers in spring again.’
- e. *Maria hat im Frühjahr wieder gesät.* Implicit object  
 Maria has in spring again sowed  
 ‘Mary sowed again in spring.’
- (2) *Sie werden wunderschön blühen.*  
 they will beautifully bloom  
 ‘They will flower beautifully.’

Examples (1)(a,b) show syntactic objects and (1)(c,d) show morphologically incorporated objects. In particular, (1)(c) illustrates the so-called “Rheinische Verlaufsform”, which is close to the English progressive but less strongly grammaticalized, at least in Standard German. Notice that (1)(c) is of a more verbal character than (1)(d), where the head is a deverbal noun. As for (1)(e), the object is not specified explicitly but the example implies that there is an object. This is clearer in the following paradigm, where in (3)(e) the object appears to be realized in the verb, *fischen* ‘to fish’.

- (3) a. *Martha hat gestern viele Fische gefangen.*  
 Martha has yesterday many fish.PL caught  
 ‘Martha caught many fish yesterday.’
- b. *Martha hat gestern Fische gefangen.*  
 Martha has yesterday fish.PL caught  
 ‘Martha caught fish yesterday.’
- c. *Martha war gestern beim Fisch(e)-fangen.*  
 Martha was yesterday at fish.(PL)-catching  
 ‘Martha was catching fish yesterday’
- d. *Martha war gestern beim Fisch(\*e)-fang.*  
 Martha was yesterday at.the fish-catching  
 ‘Martha was at the fish catching yesterday’
- e. *Martha hat gestern gefischt.*  
 Martha has yesterday fished  
 ‘Martha fished yesterday’
- (4) *Sie haben sehr gut geschmeckt.*  
 they have very good tasted  
 ‘They tasted very good.’

Bare nouns in Standard German generally need to be plurals or mass nouns. But there is also an idiomatic construction involving bare singular count nouns such as *Zeitung lesen* ‘read the

newspaper’, *Fernsehen schauen* ‘watch TV’, *Fahrrad fahren* ‘ride a bicycle’, *Gitarre spielen* ‘play guitar’. (5) provides an example, where (a) contains a regular indefinite DP, and (b) a bare singular. It is rendered by a weak definite in the English gloss. The issue, again, is whether the antecedents (5)(a,b) differ in their anaphoric potential, as in continuations such as (6).

- (5) a. *Peter hat heute morgen eine Zeitung gelesen.*  
 Peter has today morning a newspaper read  
 ‘Peter read a newspaper this morning.’
- b. *Peter hat heute morgen Zeitung gelesen.*  
 Peter has today morning newspaper read  
 ‘Peter read the newspaper this morning.’

- (6) *Sie war sehr interessant.*  
 she was very interesting  
 ‘It (the newspaper) was very interesting.’

Bare singular count nouns are quite restricted; for example, *\*Zeitschrift lesen* ‘read the journal’ is not possible. They are quite productive for riding or driving vehicles, and for playing instruments.

In addition, German has, like English, weak definites as in (7). In the weak definite reading of *die Zeitung*, Peter and Martha could have read different newspapers, and they could have read more than one newspaper.

- (7) *Peter und Martha haben heute morgen die Zeitung gelesen.*  
 Peter and Martha have today morning the newspaper read  
 ‘Peter and Maria have read the newspaper this morning.’

Just like bare singulars, weak definites are restricted to idiomatic readings (Carlson & Sussman 2005, Schwarz 2013). For example, there is no weak definite reading for *die Zeitschrift lesen*.

Anaphoric uptake with weak definites is a debated issue. For English, Scholten & Aguilar-Guevara (2010) claimed that in English, uptake of weak definites is better than with bare nominals with examples like (8):

- (8) a. *I checked the calendar when I was planning my appointments and put it back in my desk.*  
 b. ?? *Lola is still in school because her class had to help to clean it.*

However, such tests are problematic because anaphoric uptake in (8)(a) may be enabled due to the strong reading of the definite antecedent.

In Section 2 we present a number of experiments that investigate the anaphoric potential of the different object realizations. In Section 3 we present proposals about modelling these differences in a framework of semantic interpretation, using the format of Discourse Representation Theory (DRT).

## 2 Experimental Evidence for Differences in Anaphoric Potential

In this section we report on some of the experiments that we conducted to investigate the anaphoric potential of different types of antecedents.

### 2.1 Antecedent Choice, Bare Plurals, Compositions, Implicit Objects

In the first experiment we investigated in a pairwise comparison the anaphoric potential of the object in sentences like (1)(a)/(b), (b)/(c), (c)/(d) and (d)/(e), altogether four conditions. We selected these pairwise comparisons (and did not compare, for example (a) with (c)) because

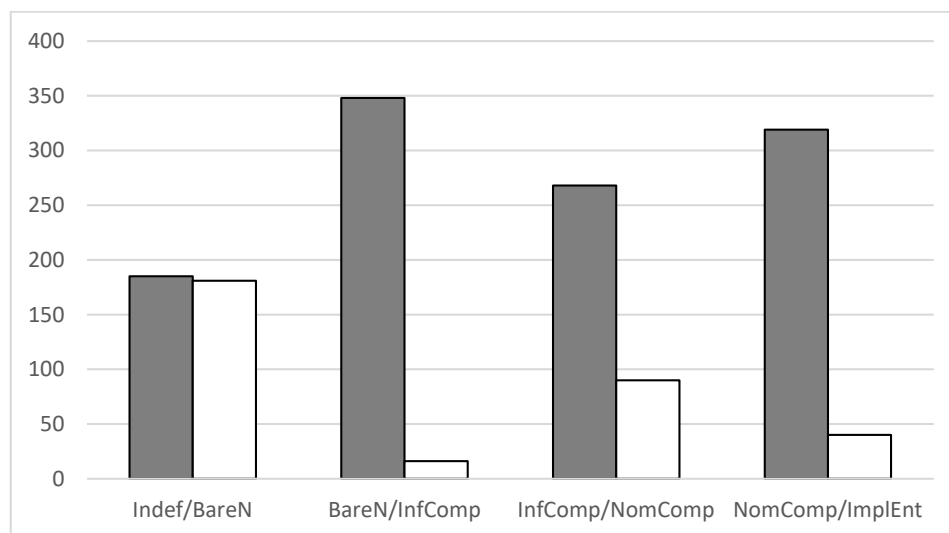
our intuition told us that these pairs were the most “similar” ones in terms of anaphoric potential. Furthermore, it is plausible to expect transitivity: if, for example, (a) has a greater or equal potential than (b), and (b) a greater potential than (c), then we can safely assume that (a) has a greater potential than (c).

Forty-seven native German speakers took part in an online survey. The experiment consisted of 31 items of a pair of antecedent sentences and one continuation in the four conditions mentioned, plus twelve fillers, distributed in four lists using a Latin Square design. Each participant read exactly one of the items of a pair. (9) specifies four example items as antecedent sentences, and the second sentence that contains the anaphoric constituent, *sie* ‘them’.

- (9) a. *Samuel hat heute wieder* { *viele Schuhe gekauft.* / *Schuhe gekauft.* }  
 Samuel has today again {many shoes bought / shoes bought}
- b. *Samuel* { *hat* / *war* } *heute wieder* { *Schuhe gekauft.* / *am Schuhekaufen.* }  
 Samuel {has / was} today again {shoes bought / at shoes.buying}
- c. *Samuel war heute wieder* { *am Schuhekaufen.* / *beim Schuhkauf.* }  
 Samuel was today again {at shoe.buying / at shoe.purchase}
- d. *Samuel* { *war* / *hat* } *heute wieder* { *beim Schuhkauf.* / *groß eingekauft.* }  
 Samuel {was / has} today again {at shoe.buying / bought a lot}

*Er hat sie sich nach Hause liefern lassen.*  
 he has them to.self to home deliver let  
 ‘He had them delivered to his home.’

The task was to choose the antecedent sentence that matched the continuation sentence best by a mouse click. This is a tightly restrained production experiment that can provide categorical data about preferences. Participants were asked to read practice sentences in which the practice items as well as some of the fillers encouraged checking anaphoric accessibility. The results are shown in Figure 1.



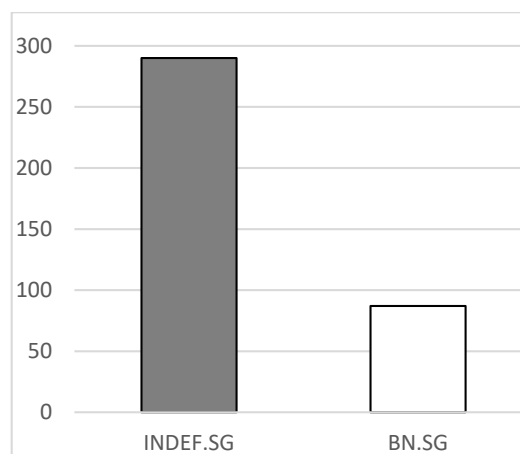
**Figure 1.** Antecedent choice, (a) indefinite plural nouns with specified number, (b) bare plural nouns, (c) compound with infinitival nouns, (d) compound with deverbal noun, (e) implicit argument. Vertical axis: absolute numbers (participants and items)

The results show clearly that indefinite plural nominals (a) and bare plurals (b) do not differ in their anaphoric potential. Both antecedent clauses were selected equally as antecedents. Furthermore, bare plurals (b) make much better antecedents than compounds of infinitival nouns (c). These make considerable better antecedents than compounds of deverbal nouns (d), and compounds of deverbal nouns make better antecedents than objects that are just implied by the meaning of the verbal predicate (e).

## 2.2 Antecedent Choice, Bare Singulars vs. Singular Indefinites

In Experiment 2 we tested the anaphoric potential of bare singular nouns as in (5)(b) in comparison to singular indefinites as in (5)(a). Twenty-nine participants took part in an online experiment with a similar set-up and task as in Experiment 1. Items included 13 bare singular count nouns (e.g. *Zeitung lesen* ‘read newspaper’, *Zigarre rauchen* ‘smoke cigar’ and *Mercedes fahren* ‘drive Mercedes’) versus their indefinite singular counterparts, marked with the indefinite article (e.g. *eine Zeitung lesen*, *eine Zigarre rauchen*, *einen Mercedes fahren*). We included five fillers in the materials. (10) is an example item; the results are presented in Figure 2.

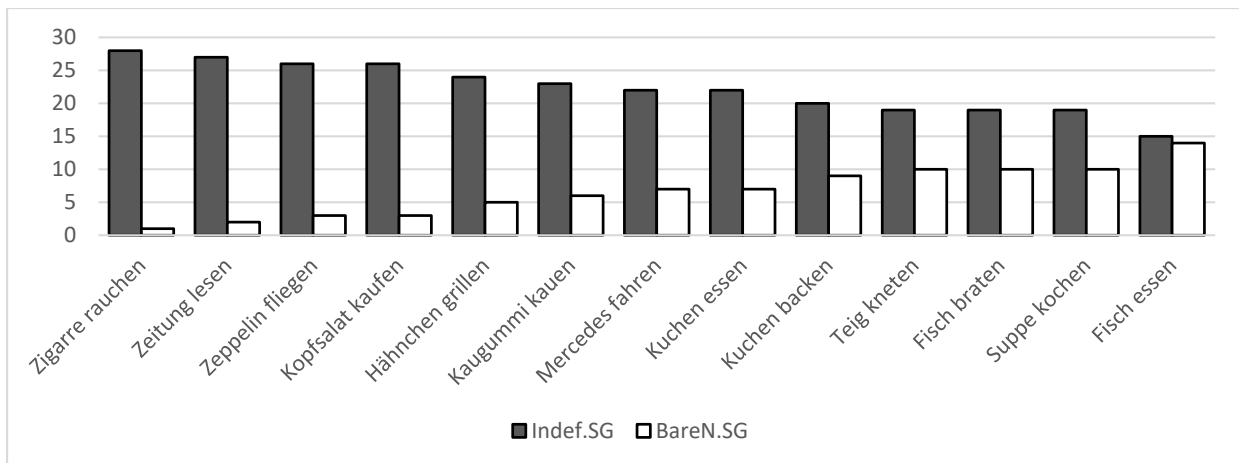
- (10) *Meine Großmutter hat viel Geld und ist { einen Mercedes / Mercedes } gefahren.*  
 my grandmother has much money and is {a Mercedes / Mercedes} driven  
*Sie hat ihn täglich mit dem Gartenschlauch abgespritzt.*  
 she has it daily with the.DEF garden.hose down.spray  
 ‘My grandmother has a lot of many and drove {a Mercedes / Mercedes}. She hosed it down every day with the garden hose.’



**Figure 2.** Antecedent choice, comparison of singular indefinite antecedent with singular bare nouns; y-axis: absolute numbers (29 participants, 13 items)

Singular indefinite nouns were chosen more often than bare singular nouns as antecedents. This is in contrast with the comparison between indefinite plurals and bare plurals in (a) and (b) in the previous experiment, cf. Figure 1. Obviously, singular indefinites make much better antecedents than bare singulars, different from plural indefinites and bare plurals.

Closer inspection of the items revealed that there are differences between individual items; we list the results for all experimental items in Figure 3.



**Figure 3.** Antecedent choice; singular indefinites vs. singular bare nouns, all items<sup>2</sup>

All examples allow for the indefinite singular form (e.g. *einen Fisch essen*, *eine Suppe kochen*, *einen Teig kneten*), that is, they can be used as count nouns, in contrast to rigid mass nouns like *Gold* (cf. *Gold kaufen* ‘buy gold’ vs. *\*ein Gold kaufen*). However, some items allow more readily for a mass noun use. This holds in particular for *Kuchen* ‘cake’, *Teig* ‘dough’, *Fisch* ‘fish’ and *Suppe* ‘soup’ that appear towards the right-hand side of Figure 3 (e.g., a Google search revealed 1500 occurrences of *hat einen Fisch gegessen* ‘has eaten a fish’ vs. 1000 occurrences of *hat Fisch gegessen* ‘has eaten fish’). In contrast, *Zigarre* ‘cigar’, *Zeitung* ‘newspaper’ and *Zeppelin* ‘airship’ do not easily occur as mass nouns. We think that it is the mass noun use of the singular bare nouns that enables anaphoric reference. Bare mass nouns have a similar interpretation to bare plurals, and hence a similar anaphoric potential, equivalent to indefinites.

### 2.3 Anaphora Choice, Non-Biased and Plural-Biased Cases

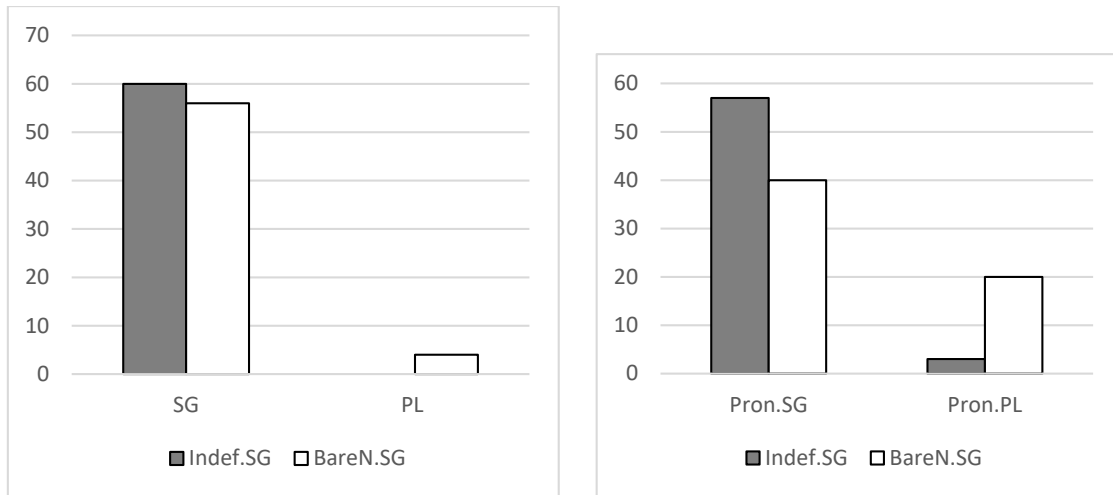
Anaphoric uptake may depend not only on the specific grammatical form of the antecedent, but also on plausible assumptions about the described situation. In Experiment 3, we investigated the anaphoric potential of singular indefinites vs. bare singular nouns in an unbiased context vs. in a context biased towards a plural interpretation (e.g. *Anna hat für ihre Geburtstagsparty Kopfsalat gekauft* ‘Anna bought lettuce for her birthday party’).

Participants were presented with a sentence containing a singular bare noun or a singular indefinite in each of the two contexts. Their task was to choose the most suitable anaphora (singular or plural) in a subsequent sentence (forced choice task). Thirty native speakers of German participated online. The experiment consisted of eight items and five fillers in four conditions (four lists, Latin Square design). An example item in the four conditions is illustrated in (11), with *den ganzen Tag* triggering a plural bias. We also specify the follow-up clause in a neutral context and with a plural bias.

- (11) *Peter hat {den ganzen Tag} {eine Zeitung / Zeitung} gelesen. {Sie war / Sie waren alle} sehr langweilig.*  
 Peter has the whole day {a newspaper / newspaper} read {it was / they were all} very boring

<sup>2</sup> The examples translate, from left to right, as ‘smoke cigar’, ‘read newspaper’, ‘fly airship’, ‘buy lettuce’, ‘drive Mercedes’, ‘eat cake’, ‘knead dough’, ‘fry fish’, ‘cook soup’ and ‘eat fish’, respectively (notice that *Fisch(e)* has a regular plural in German).





**Figure 4.** Anaphora choice in distinct contexts; y-axis: absolute numbers (30 participants, eight items)

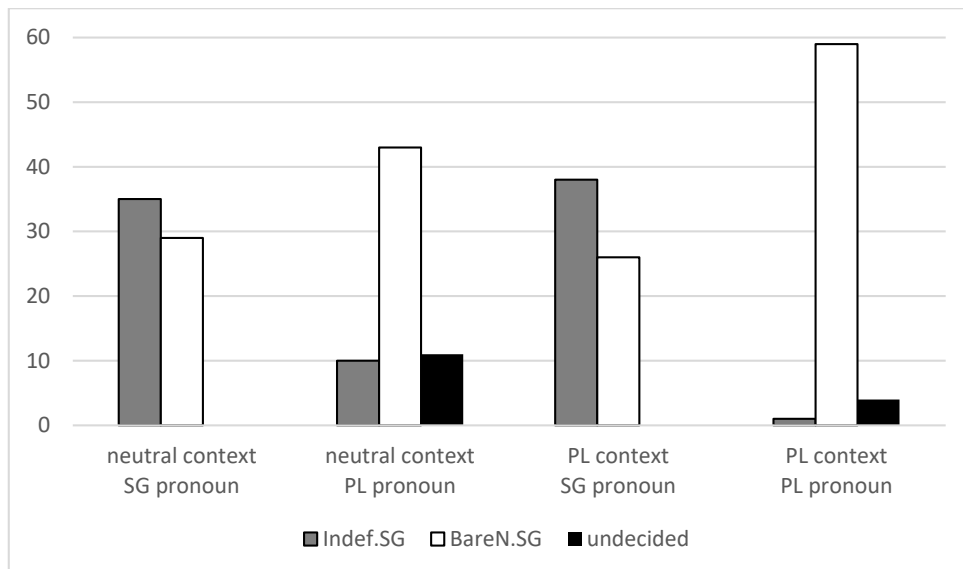
(a) Unbiased context

(b) Context with plural bias

In the unbiased context, anaphoric reference with a singular pronoun is preferred for both singular bare nouns as well as singular indefinites. In the context biased towards a plural interpretation, anaphoric reference with a singular pronoun is still the preferred option for both singular indefinite and singular bare nouns, but the latter are quite frequently (in about one third of the cases) taken up by plural anaphora.

#### 2.4 Antecedent Choice, Singular Indefinites vs. Bare Singular Nouns

In Experiment 4, which used the same materials as Experiment 3, participants were presented with a continuation sentence containing singular or plural reference, with the task of selecting the most suitable antecedent, choosing between a singular bare noun and a singular indefinite nominal. There were 32 participants, different from Experiment 3 and eight items with five fillers. The results are given in Figure 5.



**Figure 5.** Antecedent choice, singular indefinites vs. bare nouns in neutral and plural contexts with given singular vs. plural anaphor; y-axis: absolute number (32 participants, 8 items)

Singular pronouns prefer singular indefinite antecedents over singular bare nouns, but this preference is surprisingly small. Predictably, plural pronouns disfavor singular indefinites and rather opt for singular bare nouns, especially in plural contexts.

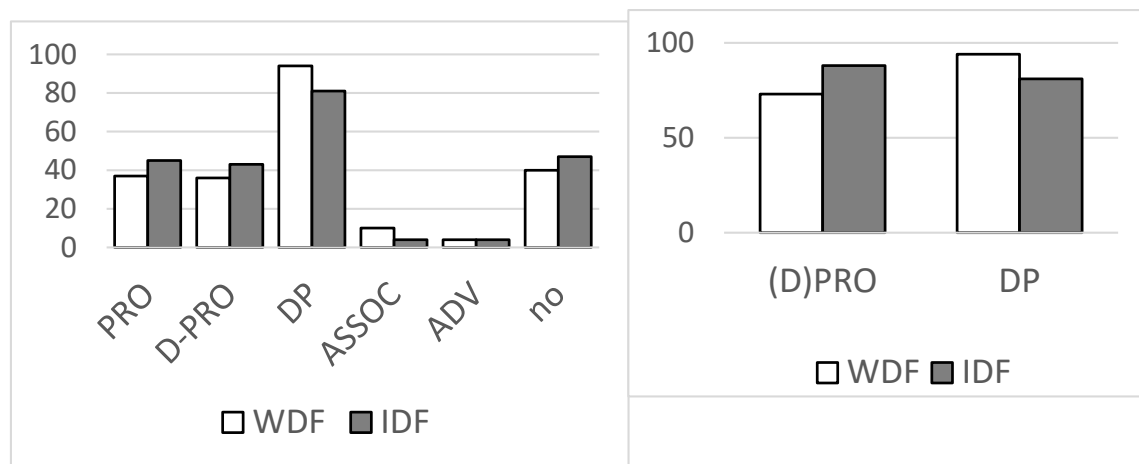
## 2.5 Free Discourse Completion, Weak Definites and Compound Antecedents

Investigating the weak definite interpretation of objects as in *Peter hat heute morgen die Zeitung gelesen* (cf. (7)) is difficult because of the competing strong interpretation of the definite. We therefore report here on one experiment using weak definites in directional PPs. With some prepositions, definiteness is marked on the preposition, not the nominal component. Even in this case the marking is ambiguous because it also could identify an entity supposed to be known in the context (cf. Schwarz 2009).

The test items of Experiment 5 were constructed in a way as to make it likely that anaphoric reference to the prepositional object would occur, as in (12).

- (12) *Sophie ist wegen starker Bauchschmerzen {zu einem Arzt} gegangen. Als erstes fragte \_\_\_\_*  
*Sophie is because strong.GEN belly.ache {to a doctor / to.DEF doctor} went at first asked \_\_\_\_*  
 ‘Sophie went {to a doctor / to the doctor} because of strong belly ache. At first \_\_ asked \_\_’

We constructed 15 items with two conditions and investigated the continuations by 30 participants, who saw each item under one condition, and obtained the following results:



**Figure 6.** Free continuation of antecedent clauses with singular weak definite (WDF) vs. singular indefinite (IDF) nominal antecedent; PRO: personal pronoun, e.g. *er*, D-PRO: d-pronoun, e.g. *der*, DP: full DP, e.g. *der Doktor*, ASSOC: associative anaphor other than the mentioned antecedent, e.g. *die Praxis*, ADV: adverbial, e.g. *dort*, no: no uptake. Right chart: Cumulative D-PRO and PRO. Y-axis: absolute numbers (15 items, two conditions, 30 participants)

We observe a tendency that weak definites are less often taken up by pronouns, and more often by full DPs, when compared to indefinites. However, in the current setup this was not significant ( $p = 0.15$ ). Altogether, we found that weak definites make surprisingly good antecedents; in particular, anaphoric uptake does not rely on associative anaphora.

Among the fillers of the experiment, there were four items with bare singular antecedents like (13) (the others were *Schlitten fahren* ‘ride sled’, *Gitarre spielen* ‘play guitar’ and *Suppe kochen* ‘cook soup’). The results are presented in Figure 7.

- (13) *Vera war am Wochenende Schlittschuh laufen. Leider passte \_\_\_\_\_*  
 Vera was on.DEF weekend skating.shoe run unfortunately fitted \_\_\_\_\_<sup>3</sup>  
 ‘Vera went ice-skating on the weekend. Unfortunately, \_\_\_\_\_ fitted \_\_\_\_\_’

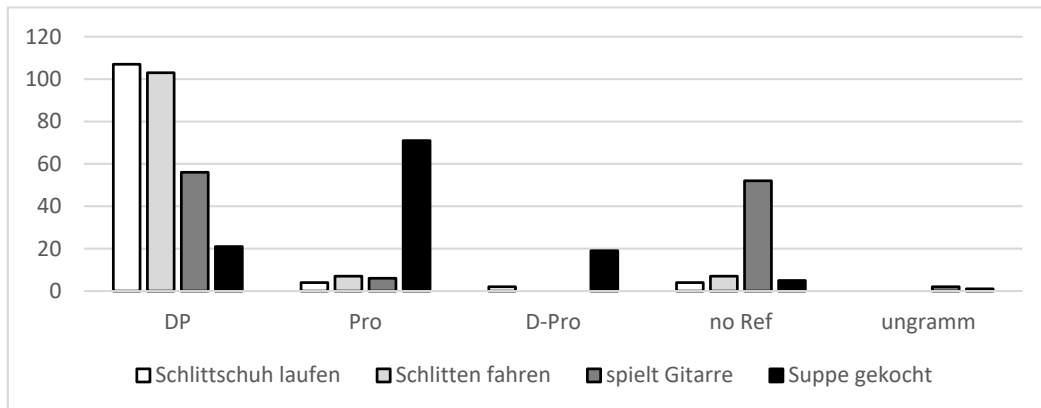


Figure 7. Free continuation, bare singular antecedents; y-axis: absolute number of uptakes

As stated, we tested only four items, and the results must be taken as very preliminary. The high uptake of the object in *Suppe kochen* speaks for an analysis in which *Suppe* is treated as a bare mass noun, and otherwise as a regular object. *Gitarre spielen* lacks anaphoric reference quite often, which may point to a special interpretation for expressions denoting an activity that is executed habitually and requires training. With the exception of *Suppe kochen*, bare singulars appear to lead much less often to pronominal uptake than weak indefinites. The typical uptake for the other antecedents is with full DPs.

### 3 Modelling Anaphoric Uptake

What are the theoretical predictions for the semantic representation of the object realizations in (1)/(3)(a-e), for bare singulars as in (5)(b), and for the objects in light verb constructions as in (1)(d)? In particular, what do they tell us about the anaphoric potential of the objects, and are they compatible with the experimental observations presented in Section 2? In the following, we attempt to represent various theoretical assumptions within the general framework of Discourse Representation Theory (DRT) in a form close to Kamp & Reyle (1993), which can still be taken as the standard theory for the representation of discourse referents.

#### 3.1 Anaphoric Uptake in Standard DRT

Classical DRT (cf. Kamp 1981) offers several distinct representations for nominals: as indefinites, they trigger the introduction of a discourse referent (DR) that is subject to existential quantification. As quantifiers, their determiners introduce a quantified condition over the nominal predicate and the clause in which it occurs, introducing and/or binding DRs in their scope. And as pronouns they pick up accessible DRs. Definite descriptions may introduce a DR, identifying it with the unique entity that falls under the description (cf. the treatment of names in Kamp 1981), or they may pick up a discourse referent already introduced. The cases of indefinites, quantifiers, and pronouns are illustrated in the following examples, where  $x_i$  are entity DRs,  $e_i$  are event DRs and  $n$  is the time of utterance.

<sup>3</sup> The other items were: *Sarah war heute Schlitten fahren, es lag aber kaum Schnee. Mühsam zog... / Joachim spielt seit zwei Jahren Gitarre, das Musikgeschäft, in welchem... / Jan hat heute morgen Suppe gekocht. Leider schmeckte ...*

- (14) *Martha watered a flower.*  
 $\langle x_1 x_2 e_1 \mid x_1 = \text{Martha}, \text{flower}(x_2), e_1 < n, e_1: \text{water}(x_1, x_2) \rangle$
- (15) *Martha watered every flower.*  
 $\langle x_1 \mid \text{Martha} = x_1, \langle x_2 \mid \text{flower}(x_2) \rangle \Rightarrow \langle e_1 \mid e_1 < n, e_1: \text{water}(x_1, x_2) \rangle \rangle$
- (16) *Martha watered a flower. It grew.*  
 $\langle x_1 x_2 e_1 e_2 \mid \text{Martha} = x_1, \text{flower}(x_2), e_1 < n, e_1: \text{water}(x_1, x_2), e_2 < n, e_2: \text{grow}(x_2) \rangle$

A discourse representation structure (DRS) consists of a pair of discourse referents (DRs) and conditions on these discourse referents, written in boxes or, as here, in parentheses of the form  $\langle \text{DRs} \mid \text{Conditions} \rangle$ . Such DRSs are constructed from the input – the DRS of the antecedent text and the current sentence with its syntactic structure and lexical material – leading to a more complex DRS. DRSs are interpreted with respect to models; for example, (14) is true in a model if and only if there is a mapping from the entity DRs  $x_1$  and  $x_2$  and the event DR  $e_1$  into entities and events in the model such that all the conditions are satisfied – in particular, that  $x_1$  is anchored to Martha, that  $x_2$  is anchored to a flower, that  $e_1$  is before  $n$  (due to past tense) and that  $e_1$  is anchored to an event in which  $x_1$  waters  $x_2$ . That is, DRSs are interpreted as if there were an unselective existential quantifier, with all the DRs as variables (here,  $\exists x_1, x_2, e_1 [x_1 = \text{Martha}, \text{flower}(x_2), e_1 < n, e_1: \text{water}(x_1, x_2)]$ ). Example (15) contains a duplex condition due to its quantified DP; this is satisfied in a model for a mapping  $g$  if and only if every extension of  $g$  that includes  $x_2$  and makes the first sub-DRS true in the model (here, for which  $x_2$  is a flower) can be extended so that it makes the second box true (here, that  $e_1$  is anchored to an event in which  $x_1$  watered  $x_2$ ).

Classical DRT predicts that anaphoric uptake of *every flower* by *it* is not possible after quantified antecedents as in (15), as the possible antecedent,  $x_2$ , is introduced within a quantified condition. That is, a text like (17) is rightly classified as infelicitous, if *it* is supposed to refer to *every flower*.

- (17) *Martha watered every flower. # It grew.*

While classical DRT makes a clear-cut distinction between nominal expressions that can be an antecedent or not, the standard version of Kamp & Reyle (1993) provides for more nuanced ways in which nominal expressions can serve as antecedents. One such option is illustrated in (18).

- (18) *Martha watered every flower. They grew.*

Kamp & Reyle (1993, Section 4.2.6) propose that duplex conditions allow for the formation of a larger DRS from the duplex condition and a summation over one of the DRs (expressed by  $\Sigma$ ); this is then identified with a new DR. To indicate that this new DR is anchored to a sum of individual entities, Kamp & Reyle represent it by a capital letter. This DR can then be picked up by a plural pronoun. The resulting DRS for (18) is illustrated in (19):

$$(19) \left\langle \begin{array}{l} x_1 e_1 \\ X_3 \\ e_2 \end{array} \mid \begin{array}{l} x_1 = \text{Martha}, \langle x_2 \mid \text{flower}(x_2) \rangle \Rightarrow \langle e_1 \mid e_1 < n, e_1: \text{water}(x_1, x_2) \rangle, \\ X_3 = \Sigma x_2 \langle x_2 e_1 \mid \text{flower}(x_2), e_1 < n, e_1: \text{water}(x_1, x_2) \rangle, \\ e_2 < n, e_2: \text{grow}(X_3) \end{array} \right\rangle$$

Here,  $X_3$  is anchored to the sum of all entities to which  $x_2$  can be anchored, where  $e_1$  can be anchored to an event that is a watering of  $x_2$  by  $x_1$  – the sum of all the flowers that Martha watered.

Kamp & Reyle (1993) do not make any claims about differential accessibility of DRs. For them, a DR is either accessible, or not. However, notice that the anaphoric uptake in (18) requires the construction of a DRS out of the sub-DRSs of a duplex condition, the abstraction of one DR, the summation over this DR, the introduction of a new DR and the identification with this new DR. This makes it plausible to assume that the anaphoric reference in (18) is more complex for processing than a case that provides a DR from the outset, like (20).

(20) *Martha watered many flowers. They grew.*

$$\left\langle \begin{array}{l} x_1 X_2 e_1 \\ e_2 \end{array} \middle| \begin{array}{l} x_1 = \text{Martha, many}(X_2), \text{flowers}(X^2), e_1 < n, e_1: \text{water}(x_1, X_2) \\ e_2 < n, e_2: \text{grow}(X_2) \end{array} \right\rangle$$

The assumption that complexity in *theoretical* representation is related to complexity in *cognitive* representation, and hence in linguistic processing, appears well motivated, given the fact that Kamp (1981) explicitly set out to develop not only a theory of Truth, but also of Semantic Representation. However, the prediction that there is a difference in the ease of anaphoric update differs between (18) and (20) has not been empirically tested. In the current paper, we will not test this either, but take it as a still unproven assumption.

### 3.2 Anaphoric Uptake of Indefinite and Bare Plural Objects

We start with the modelling of plural indefinites with an overt indication of number, such as *viele Fische* ‘many fish’, and bare plurals, such as *Fische*. As Section 2.1 showed, there is no difference in their anaphoric potential in episodic sentences such as *Martha hat (viele) Fische gefangen* ‘Martha caught (many) fish’; both are suited equally well for anaphoric uptake and are better than all the competitors. This speaks for a similar representation of these two cases, as introducing sum DRs. We take (3)(a), containing a syntactic object with a determiner, to have the DRS representation (21), where a plural DR  $X_2$  is introduced and easily available for anaphoric uptake.

(21) *Martha hat viele Fische gefangen. Sie haben gut geschmeckt.*

$$\left\langle \begin{array}{l} x_1 X_2 e_1 \\ e_2 \end{array} \middle| \begin{array}{l} x_1 = \text{Martha, many}(X_2), \text{PL}(X_2), \text{fish}(X_2), e_1 < n, e_1: \text{catch}(x_1, X_1), \\ e_2 < n, e_2: \text{taste\_good}(X_2) \end{array} \right\rangle$$

As for the bare plural case, (3)(b), we suggest the interpretation (22), which differs from (21) only insofar as it lacks the quantity information provided by *viele* ‘many’. This representation predicts that bare plurals make as good antecedents as plural DPs with an explicit specification of quantity.

(22) *Martha hat Fische gefangen.*

$$\langle x_1 X_2 e_1 \mid x_1 = \text{Martha, PL}(X_2), \text{fish}(X_2), e_1 < n, e_1: \text{catch}(x_1, X_2) \rangle$$

This means that *viele* ‘many’ is different from quantifiers like *every* or *most* insofar as it does not introduce a duplex condition.<sup>4</sup> This is reflected in syntax, as *viele* occupies the syntactic position of number words, not of a quantificational determiner; for example, it can be preceded by a definite article, as in *die vielen Fische* ‘the many fish’.

There are competitors to the uniform treatment of plural indefinites like *viele Fische* ‘many fish’ and bare plural nouns like *Fische* ‘fish-PL’. The best-known is Carlson (1977), who assumes that bare plurals refer to kinds (cf. Krifka et al. 1995 for discussion). Carlson distinguishes between different types of verbal predicates: kind-level predicates express properties

<sup>4</sup> This applies to the cardinal reading of *viele*. There is also a proportional reading in which it describes a high proportion (cf. Partee 1989), which should allow for anaphoric uptakes characteristic for proportional quantifiers (cf. Nouwen 2020).

of kinds, object-level predicates trigger existential quantification of specimens of the kinds, and the predicate is applied to a specimen.<sup>5</sup> This is illustrated, without going into details, in (23), where  $k$  is a variable over kinds,  $R$  is the realization relation that relates a kind to its specimens, and  $F$  is the kind fish.

- (23) *Martha hat Fische gefangen.*  
 $\lambda k \exists x [R(k, x) \wedge \text{catch}(M, x)](F)$   
 $= \exists x [R(F, x) \wedge \text{catch}(M, x)]$

A variant of this general approach by McNally (1995) assumes that bare nouns express a property that involves existential quantification over the elements that the property applies to.

The kind/property analysis of bare plurals states that existential quantification arises by a local process associated with the verbal predicate. This predicts that bare plurals have narrow scope with respect to other operators, such as negation or other quantifiers. However, this was contested for German (cf. Kratzer 1980) with examples like (24); the prominent reading is that Hans thought that some belladonna berries were cherries, which requires a wide-scope interpretation of the existential quantifier of *Tollkirschen*.

- (24) *Hans wollte Tollkirschen an den Fruchtsalat tun, weil er sie mit richtigen Kirschen verwechselte.*  
 ‘Hans wanted to put Belladonna berries in the fruit salad because he confused them with cherries.’

Here we would like to point out that in German (at least when considering the syntactic region called “middle field”) scope is expressed by linear order due to the head-final syntax, and that bare nominals, in their non-generic reading, resist positions left of other scope-taking operators.

- (25) a. *Martha hat jeden Tag {viele Gedichte / Gedichte} gelesen.*  
 Martha has every day many poems poems read  
 ‘Every day, Martha read (many) poems.’,  $\forall > \exists$
- b. *Martha hat {viele Gedichte / ?Gedichte} jeden Tag gelesen.*  
 Martha has many poems poems every day read  
 ‘Martha has read (many) poems every day.’,  $\exists > \forall$

The case *Gedichte jeden Tag lesen* in (25)(b) is indeed degraded, and even in this position tends to evoke a  $\forall > \exists$  reading.

As for the anaphoric potential of bare nominals, theories that involve existential quantification over specimens or over the entities subjected to a property can assume a quantification that involves accessible DRs. For example, McNally & van Geenhoven (1998) represent them as introducing a DR that is subject to the general existential closure. This results in the modeling like (22), and predicts that bare plurals like *Fische* are equally accessible as indefinite plurals like *viele Fische*.

We would like to point out that the DRT framework offers other possible interpretations as well. Krifka & Modarresi (2016), in work on pseudo-incorporation in Persian, have proposed a narrow-scope existential quantifier. Application of this quantifier shows no truth-conditional difference to indefinites that undergo the general existential quantification over the DRs but entails differences in their anaphoric accessibility. This proposal assigns the following representation to (22).

<sup>5</sup> This is a simplification of Carlson’s theory, who assumes spatio-temporal stages instead of events.

$$(26) \langle x_1 e_1 | x_1 = \text{Martha}, \exists \langle X_2 | \text{RL}(\text{Fish}, X_2), e_1 < n, e_1: \text{catch}(x_1, X_2) \rangle \rangle$$

Conditions of the form  $\exists \langle \dots | \dots \rangle$  are not part of the repertoire of Kamp & Reyle (1993), but can be interpreted in a straightforward way: they are true in a model under a mapping  $g$  if and only if  $g$  can be extended in such a way that it makes the DRS  $\langle \dots | \dots \rangle$  true. After checking the truth conditions, we revert to the previous mapping  $g$ , which prevents  $X_2$  from being picked up directly. But abstraction and summation can apply as in (27). This should show up in a degraded anaphoric uptake, compared to (21).

(27) *Martha hat Fische gefangen. Sie haben gut geschmeckt.*

$$\left\langle \begin{array}{l} x_1 e_1 \\ X_3 \\ e_2 \end{array} \middle| \begin{array}{l} x_1 = \text{Martha}, \exists \langle X_2 | \text{RL}(\text{Fish}, X_2), e_1 < n, e_1: \text{catch}(x_1, X_2) \rangle, \\ X_3 = \Sigma X_2 \langle X_2 | \text{RF}(\text{Fish}, X_2), e_1 < n, e_1: \text{catch}(x_1, X_2) \rangle, \\ e_2 < n, e_2: \text{taste\_good}(X_3) \end{array} \right\rangle$$

Another way of distinguishing between the representation of indefinites and bare plurals was proposed by Modarresi (2015), also in work on Persian pseudo-incorporated objects. Kamp & Reyle (1993) have assumed, in addition to singular and plural DRs, a class of number-neutral discourse referents for which they use Greek letters  $\delta_1, \delta_2$  etc. These DRs can be anchored to both atomic and sum individuals. As overt pronouns carry a singular or plural feature, they are compatible with such number neutral DRs. However, overt pronouns carry the additional information that the DR is anchored to an atomic or a sum individual (inclusive plural interpretation), and this additional information is disfavored for anaphoric expressions, as their semantic content ideally is presupposed, old information. We now can assume that bare plurals are actually number-neutral, as suggested by Sauerland et al. (2005).<sup>6</sup> Evidence for this is, for example, that a question like *Hast du Fische gefangen?* ‘Did you catch fish?’ can be answered by *Ja, einen* ‘Yes, one’, but not by *Nein, nur einen* ‘No, only one’. This leads to the following representations with a plural and a singular anaphoric uptake:

$$(28) \text{Martha hat Fische gefangen. } \left\{ \begin{array}{l} \text{Sie haben gut geschmeckt.} \\ \text{? Er hat gut geschmeckt.} \end{array} \right\}$$

$$\left\langle \begin{array}{l} x_1 e_1 \delta_2 \\ e_2 \end{array} \middle| \begin{array}{l} x_1 = \text{Martha}, \text{fish}(\delta_2), e_1 < n, e_1: \text{catch}(x_1, \delta_2) \\ \{ \text{PL}(\delta_2), e_2 < n, e_2: \text{taste\_good}(\delta_2) \} \\ \{ \text{SG}(\delta_2), e_2 < n, e_2: \text{taste\_good}(\delta_2) \} \end{array} \right\rangle$$

This representation predicts a slight degradation of anaphoric uptake, as the pronoun adds the information that the number-neutral discourse referent  $\delta_2$  is anchored to one or more than one entity, represented by the conditions  $\text{SG}(\delta_2)$  and  $\text{PL}(\delta_2)$ , respectively. There is a quite clear degradation in the case of the singular pronoun *er* which could be explained in a variety of ways. In particular, a number-neutral DR would have an a priori much greater chance to be anchored to a sum individual than to an atomic individual. Alternatively, the effect may be due to a competition with expressions like *Maria hat einen Fisch gefangen* ‘Mary caught a fish’, as *einen Fisch* ‘a fish’ and the bare plural *Fische-e* ‘fish-PL’, both being expressions consisting of a lexeme and a grammatical morpheme, are arguably equally complex.

In the Antecedent Choice Experiment 1, we did not observe a difference between the anaphoric potential of indefinite plurals and bare plurals. This suggests that representation (22),

<sup>6</sup> The plural nouns are associated with two readings: an exclusive reading in upward-entailing contexts and an inclusive reading in downward-entailing contexts. Many accounts consider bare plurals as number neutral with multiplicity arising as a result of scalar implicature in positive sentences (such as the test example in experiment 2.1 (b) repeated as (29)). For more details on various implicature accounts of plurals, see Sauerland et al. (2005), Spector (2007), Zweig (2009), Mayr (2015) among others.

where indefinite plurals and bare plurals make similar contributions, should be preferred over (27) and (28), which predict a slightly degraded anaphoric uptake in the case of bare plurals.

### 3.3 Anaphoric Uptake of Incorporated Objects in Compounds

We now turn to the case of anaphoric reference to constituents that are part of a compound. German is well-known for nominal composition, whereas verbal composition is limited to a few cases such as *schlafwandeln* ‘to sleepwalk’. Consequently, composition of an object with a verbal predicate is only possible if the latter is first changed into a noun. For German, there are two types of composition that are relevant here. First, compounds like *Blumensäen* ‘sowing of flowers’ and *Fisch(e)fängen* ‘catching of fish’ have *Säen* ‘sowing’ and *Fängen* ‘catching’ as heads, neuter nouns that are identical to the infinitive forms of the verb, *säen* and *fängen*. Second, compounds like *Blumensaat* ‘flower sowing’, *Fischfang* ‘fish catch’ and *Schuhkauf* ‘shoe purchase’ have heads like *Saat*, roughly, ‘sowing’, *Fang* ‘catch’ and *Kauf* ‘purchase’ with varying formation and gender; their formation is not productive, and in addition to events (as so-called “nomina actionis”) they can also refer to participants of the event. Infinitival nouns like *Fängen* are used productively in spoken German to express progressive aspect, a construction known as “Rheinische Verlaufsform”, as it is particularly characteristic for the Western part of the German-speaking regions. This form has been argued to allow for noun incorporation (cf. Barrie & Spreng 2009). The predicative use of deverbal nouns, either with a light verb as in (1)(d) or as the main predicate with a locative construction as in (3)/(5)(d), is considerably rarer and less productive, just as the morphological derivation itself.

We start with infinitival nouns. The status of the specifying noun in forms like *Blumensäen* is unclear because the infinitival noun also occurs in constructions in which the object is syntactically realized by an accusative nominal, cf. (29), e.g. as a definite description, an indefinite or a bare plural. But notice that in this case the object precedes the locative marker *am* (cf. Ramelli 2013).

- (29) *Martha war*  $\left\{ \begin{array}{l} \text{die Blumen} \\ \text{einige Blumen} \\ \text{Blumen} \end{array} \right\}$  *am Säen.*  
 Martha was {the flowers / some flowers / flowers} at sowing  
 ‘Martha was sowing the flowers / some flowers / flowers.’

This shows that the nominal infinitive can assign case to the direct object, showing their verbal character. However, the preposition *am* has to occur adjacent to it (cf. \**am die Blumen Säen*). This suggests that in *am Blumensäen* ‘at the sowing of flowers’ the composition constituent *Blumen* ‘flowers’ fills the direct object slot by incorporation, thereby making this slot unavailable for other objects. (30) shows the paradigm; while *Säen* ‘sowing’ (just like the underlying verb) has a transitive and an intransitive alternant (cf. a, with a potential object *Primeln* ‘primroses’), *Blumensäen* ‘sowing of flowers’ only allows for an intransitive use (cf. b).

- (30) a. *weil Martha* [VP (*Primeln*) [V [PP *am* [N *Säen*]]] [V° *war*]]  
 because Martha primroses at sowing was  
 b. *weil Martha* [VP (\**Primeln*) [V [PP *am* [N *Blumensäen*]]]] [V° *war*]]  
 because Martha primroses at flower.sowing was

What is the discourse effect of parts of compound words? Morphologically complex words were considered anaphoric islands (cf. Postal 1969), but Ward et al. (1991) pointed out with examples like *John took up deer hunting. He thinks that they are exciting to track.* that pragmatic principles allow for anaphoric reference into complex words. To our knowledge, the discourse effects of constituents within a composition have rarely been modelled within DRT. One exception is van Geenhoven (1998) for object incorporation in West Greenlandic, which appears to be fully discourse transparent. However, we have seen in Experiment 1, that objects



that enter the meaning by compounding are less accessible than regular syntactic objects. Furthermore, the clear difference we found between infinitival nouns (*Blumensäen*) and deverbal nouns (*Blumensaat*) indicates that different types of composition have distinct effects on anaphoric accessibility.

For infinitival nouns, we can assume that the noun applies to the event, but no DR is introduced by it. We assume that the morphological process of compounding does not directly interface with dynamic meaning, that is, the introduction of DRs. This corresponds to the DRT analysis proposed by Farkas & de Swart (2003) for pseudo-incorporated objects in Hungarian. The precise formulation of the rule there is problematic (cf. Yanovich 2008, Krifka & Modarresi 2016). We will assume here that morphological composition is computed outside of the DRT component, with the result that no DRs are involved at this stage. See (31) for an example derivation for the static meaning of *Fischefangen* ‘catching fish’.

$$(31) \quad \llbracket \text{Fischefangen} \rrbracket = \lambda R \lambda e \lambda y_1 \exists y_2 [\text{fish}(y_2) \wedge R(e)(y_1)(y_2)] (\lambda e \lambda y_2 \lambda y_1 [e: [\text{catch}(y_1, y_2)]]) \\ = \lambda e \lambda y_1 \exists y_2 [\text{fish}(y_2) \wedge e: [\text{catch}(y_1, y_2)]]$$

This expresses a relation between events  $e$  and individuals  $y_1$  such that there is an individual  $y_2$  that falls under the predicate ‘fish’ (an atomic or sum individual where every atomic part is a fish), and  $e$  is an event in which  $y_1$  catches  $y_2$ . This relation enters the DRS construction like an intransitive episodic predicate, resulting in the following representation (the progressive meaning is not captured in this representation).<sup>7</sup>

$$(32) \quad \text{Martha war am Fischefangen.} \\ \langle x_1 \ e_1 \mid x_1 = \text{Martha}, e_1 < n, \lambda e \lambda y_1 \exists y_2 [\text{fish}(y_2) \wedge e: [\text{catch}(y_1, y_2)]] (e_1)(x_1) \rangle \\ = \langle x_1 \ e_1 \mid x_1 = \text{Martha}, e_1 < n, \exists y_2 [\text{fish}(y_2) \wedge e_1: [\text{catch}(x_1, y_2)]] \rangle$$

For the DRS construction, *Fischefangen* as in (31) functions like an intransitive episodic predicate; only the subject argument and the event can be filled by DRs. Notice that  $y_2$  is not a DR but a variable that helps to specify the truth conditions of the predicate. In particular, the condition  $\exists y_2 [\text{fish}(y_2) \wedge e_1: [\text{caught}(x_1, y_2)]]$  is true under an assignment  $g$  for a model if and only if  $g$  anchors  $x_1$  to an entity and  $e_1$  to an event and there is a  $y_2$  in the model such that  $y_2$  is one or more fish, and  $e_1$  is an event of catching of  $y_2$  by  $x_1$ . No DR for the fish is introduced, but the existence of a fish is guaranteed by the condition. Consequently, direct anaphoric uptake of the fish is impossible.

The question now is, what allows the indirect anaphoric uptake reported for similar constructions by Ward et al. (1991)? We propose that this is an instance of associative anaphora or bridging, as assumed by Asudeh & Michelsen (2000) for related cases involving singular bare nouns in Danish. Associative anaphora (cf. Clark 1977) are enabled if there is a cognitively salient relation between an accessible DR and a description, as in the following case:

$$(33) \quad \text{There was a car standing at a corner. The windshield was broken.} \\ \left\langle \begin{array}{l} x_1 \ x_2 \ e_1 \mid \text{car}(x_1), \text{corner}(x_2), e_1 < n, e_1: \text{stand\_at}(x_1, x_2) \\ x_3 \ e_2 \mid \text{windshield\_of}(x_1, x_3), e_2 < n, e_2: \text{broken}(x_3) \end{array} \right\rangle$$

<sup>7</sup> One option is a partitive semantics for the progressive, resulting in the following meaning, where the event discourse referent is anchored to a part of an event  $e$  of catching fish:

$$\langle x_1 \ e_1 \mid x_1 = \text{Martha}, e_1 < n, \exists e \exists y_2 [\text{fish}(y_2) \wedge e: [\text{catch}(x_1, y_2)] \wedge e_1 \sqsubseteq e] \rangle$$

Dayal (2011) shows that aspect plays a role for the accessibility of pseudo-incorporated nominals, with imperfective aspect reducing the anaphoric potential. It would be interesting to investigate whether the progressive has this function even in English in cases like *Martha sowed flowers* vs. *Martha was sowing flowers* which do not imply composition as in German.

Examples like *There was a car standing at the corner. The refrigerator was broken.* are odd because there is no cognitively salient relation between cars and refrigerators (even though occasional cars might have built-in refrigerators). Typically, associative anaphora need to be supported by a description such as *windshield*, but it has often been observed that there are cases in which pronouns are possible if they carry sufficient information.

- (34) (*Did you know?*) *Martha has married last week. He is a car seller.*  

$$\left\langle \begin{array}{l} x_1 \ e_1 \mid x_1 = \text{Martha}, e_1 < n, \text{week\_before}(n, e_1), \exists y_1 [e_1 : \text{marry}(x_1, y_1)] \\ x_2 \mid \text{bride/groom\_of}(e_1, x_1)(x_2), \text{male}(x_2), \text{car\_seller}(x_2) \end{array} \right\rangle$$

The concept ‘marry’, predicated of Martha, makes salient the unique individual to which Martha is married (here, the bride/groom  $y_1$  which is defined for marriage events  $e_1$  and a marriage partner  $x_2$ ; notice that  $y_1$  is not a DR). For this person, a new DR  $x_2$  is introduced, the pronoun *he* specifies  $x_2$  as male, and  $x_2$  is predicated to be a car seller.

Anaphoric reference to the caught fish in (32) is achieved in the same way, as events of catching fish are cognitively related to the fish that are caught in these events, e.g. by the patient relation:

- (35) *Martha war am Fischefangen. Sie haben gut geschmeckt.*  

$$\left\langle \begin{array}{l} x_1 \ e_1 \mid x_1 = \text{Martha}, e_1 < n, \exists y_1 [\text{fish}(y_1) \wedge e_1 : [\text{catch}(x_1, y_1)]] \\ x_2 \ e_2 \mid \text{patient\_of}(e_1)(x_2), \text{PL}(x_2), e_2 < n, e_2 : \text{taste\_good}(x_2) \end{array} \right\rangle$$

A catching event arguably provides a salient relation, as catching events have patients. Continuation with a full definite noun phrase like *die Fische* is also possible and perhaps even preferred. The definite description can be interpreted as functional on the accessible event  $e_1$  (cf. Löbner 1998 for functional definite descriptions), resulting in the following interpretation:

- (36) *Martha war am Fischefangen. Die Fische haben gut geschmeckt.*  

$$\left\langle \begin{array}{l} x_1 \ e_1 \mid x_1 = \text{Martha}, e_1 < n, \exists y_1 [\text{fish}(y_1) \wedge e_1 : [\text{catch}(x_1, y_1)]] \\ x_2 \ e_2 \mid x_2 = \Sigma y_1 [\text{fish\_of}(e_1)(y_1)], \text{PL}(x_2), e_2 < n, e_2 : \text{taste\_good}(x_2) \end{array} \right\rangle$$

Here,  $\text{fish\_of}(e)(y)$  holds if  $y$  is a fish (or are fish) in the event  $e$ . The summation operator  $\Sigma$  forms the sum of all these entities, and a new discourse referent  $x_2$  is introduced to be anchored to that sum. Again, this is a more complex way of referring to an entity in discourse than the simple uptake of a DR that was already introduced.

We now turn to the second, more lexicalized compound. One semantic property that distinguishes expressions like *Fischefangen von Fischfang* is that they cannot assign case (cf. *die Fische am Fangen* vs. *\*die Fische beim Fang*). In the terminology of Grimshaw (1990), *Fangen* is a complex event noun that comes with an argument structure, whereas *Fang* is a simple event noun. This distinction can explain their different anaphoric potential if we assume that the meaning of *Fangen* applies to a structured event  $\langle e, y \rangle$  of a catching event  $e$  and the object  $y$  that is caught in  $e$ , whereas *Fang* just refers to catching events  $e$  (in its event-related reading; in the result reading it refers to the object  $y$  that is caught). Using capital E for structured events like  $\langle e, y \rangle$ , we can assume an intransitive meaning for *catch* that takes such complex events, with E:  $\text{catch}(y)$  if and only if  $\text{event}(E) : \text{catch}(y, \text{object}(E))$ , where  $\text{event}(\langle e, y \rangle) = e$  and  $\text{object}(\langle e, y \rangle) = y$ . The more complex semantic representation of *Fangen* allows for an easier identification of the object due to the structure of the event E.

- (37) *Martha war am Fischefangen. Sie haben gut geschmeckt.*  

$$\left\langle \begin{array}{l} x_1 \ E_1 \mid x_1 = \text{Martha}, E_1 < n, \exists y_2 [\text{fish}(y_2) \wedge E_1 : [\text{caught}(x_1)]] \\ x_2 \ e_2 \mid x_2 = \text{object\_of}(E_1), \text{PL}(x_2), e_2 < n, e_2 : \text{taste\_good}(x_2) \end{array} \right\rangle$$

Deverbal nouns like *Fang*, in their eventive reading, are interpreted as applying to simple events, resulting in the interpretation proposed above in (35) and relying on a bridging relation *patient\_of* that is less salient than the relation *object\_of*.

There are other possible explanations for the difference between *Fischefangen* und *Fischfang*. Meinschaefer (2005) observes that frequentative operators can be applied to infinitival nouns but not to deverbal nouns (cf. *das häufige Fischefangen* ‘the frequent catching of fish. vs. \**der häufige Fischfang*). This suggests that the latter contains the formation of a sum or kind formation over events, which blocks easy access to the object. A proposal along these lines was made by Schwarz (2013) for incorporation and also for weak definites in English. We can adapt this idea within a dynamic framework, as follows.

We assume the kind “up” operator  $\cap$  of Chierchia (1998) that applies to a property P, where  $\cap P$  is a kind individual concept that delivers for all world-time indices *i* the sum of all entities that fall under P at *i*. A compound deverbal noun like *Fischfang* would start out with the property  $\lambda i \lambda e \exists y_1 \exists y_2 [\text{fish}_i(y_2) \wedge e: \text{catch}_i(y_1, y_2)]$ , = FF, a property that identifies for each world-time-index *i* the predicate that applies to events *e* in which someone caught fish in *i*. Chierchia’s “up” operator yields the kind  $\cap FF$ . This individual concept can be changed back to a predicate by the “down” operator at a world-time index, yielding the sum of all fish catching events in *i*, rendered as  $\cup \cap FF(i)$ . The construction with *beim*, as in *beim Fischfang*, or light verbs like *teilnehmen*, identifies an event *e* that is part of that sum,  $e \sqsubseteq \cup \cap FF(i)$ , and the subject of the predication is specified as the agent of *e*. Thus, the fish involved in the description of *e* (as an event of the fish-catching kind) are not directly accessible anymore. They have to be recovered by a *patient\_of* relation or, better, by the *fish\_of* relation that was employed in (36).

(38) *Martha war beim Fischfang. { ? Sie / Die Fische } haben gut geschmeckt.*

$$\left\langle \begin{array}{l} x_1 \ e_1 \\ x_2 \ e_2 \end{array} \middle| \begin{array}{l} x_1 = \text{Martha}, e_1 < n, \text{agent}(e_1, x_1), e_1 \sqsubseteq \cup \cap \lambda i \lambda e \exists y_1 \exists y_2 [\text{fish}_i(y_2) \wedge e: \text{catch}_i(y_1, y_2)] \\ \left\{ \begin{array}{l} \text{patient\_of}(e_1, x_2) \\ x_2 = \Sigma y_2 [\text{fish\_of}(e_1)(y_2)] \end{array} \right\}, \text{PL}(x_2), e_2 < n, e_2: \text{taste\_good}(x_2) \end{array} \right\rangle$$

In this way, associative anaphora is the only way to refer back to the participants of a verbal predicate turned into a kind individual.

### 3.4 Anaphoric Uptake with Bare Singulars and Weak Definites

We now turn to bare singulars, like *Zeitung lesen* ‘read the newspaper’. In Section 2.2 we have seen that they make much worse antecedents than singular indefinites such as *eine Zeitung lesen*. Some items, such as *Fisch essen*, made better antecedents; we have argued that in these cases a mass noun interpretation of the object was possible, allowing for a similar analysis as with bare plurals (cf. Section 3.2).

Asudeh & Mikkelsen (2000), on Danish, and Borthen (2003), on Norwegian, included the anaphoric behavior of bare singulars in their investigation. Judging from their examples, bare singulars have a wider use in these languages, but both authors argue that they have a reduced anaphoric potential. Asudeh & Mikkelsen (2000) suggest that anaphoric uptake involves bridging. Borthen (2003) disagrees because bare singulars allow more easily for anaphoric uptake than verbs with implicit objects (e.g. *jeg kjørte bil til jobben* ‘I drove car to work’ vs. *jeg bilte til jobben* ‘I drove (lit. “car-ed”) to work’) and assumes that bare singulars do introduce DRs; however, this does not explain their reduced anaphoric potential compared to indefinite nominals.

As bare singulars like *Zeitung lesen* ‘read the newspaper’, *Auto fahren* ‘drive a car’, *Klavier spielen* ‘play (the) piano’ help to describe the type of an event, they presumably do not introduce an immediately accessible DR. Any of the interpretations (32), (37) and (38) could be proposed

for them, given our current knowledge. A decision between these or other options should be based on an investigation of differences in anaphoric accessibility between bare singulars like (39)(a), infinitival noun compounds like (b), and nominal compounds like (c).

- (39) a. *Martha hat Zeitung gelesen.*  
 b. *Martha war beim Zeitunglesen. Sie war sehr interessant.*  
 c. *Martha war bei der Zeitungslektüre.*

It is our impression that the continuations (39)(a) and (b) are comparable, and better than (c) (where there is an interfering factor as *Lektüre* ‘reading’ is a feminine noun that *sie* could refer to). This suggests representations along the lines of (32) or (37) for bare singulars.

As for weak definites, we have seen that (at least as propositional objects) they make quite good antecedents, though probably less so than indefinites. This speaks for the proposal of Krifka & Modarresi (2016), a paper that focuses on bare singular nouns in Persian, which can have a definite interpretation, and argues that they should be analyzed like weak definites. The proposed analysis is that they are dependent definites that refer to the unique entity of the specified sort with respect to an event, which is introduced via existential closure. This is illustrated in (40) for the weak definite reading of *die Zeitung*.

- (40) *Peter hat die Zeitung gelesen. Sie war interessant. Er ist dann eingenickt.*

$$\left. \begin{array}{l} x_1 \\ e_2 \\ x_3 \\ e_3 \end{array} \right| \begin{array}{l} x_1 = \text{Peter}, \exists (e_1 x_2 | x_2 = \text{newspaper}_{\text{of}(e_1)}, e_1 < n, e_1 : \text{read}(x_1, e_1)) \\ e_2 = \Sigma e_1 (e_1 x_2 | x_2 = \text{newspaper}_{\text{of}(e_1)}, e_1 : \text{read}(x_1, e_1)) \\ x_3 = \Sigma x_2 (e_1 x_2 | x_2 = \text{newspaper}_{\text{of}(e_1)}, e_1 : \text{read}(x_1, e_1)) \\ \text{SG}(x_3), e_3 < n, e_3 \approx e_2, e_3 : \text{interessant}(x_3) \\ \exists (e_4 | e_4 < n, e_3 < e_4, e_4 : \text{doze\_off}(x_1)) \end{array} \right\}$$

The proposal assumes existential closure over the verbal predicate, following Diesing (1992). The existential closure applies to the event  $e_1$  introduced by the verbal predicate. The weak definite *die Zeitung* is interpreted as dependent on the event, yielding the unique single newspaper involved in the event. It introduces a DR  $x_2$  for that newspaper, necessarily also within the existential closure. The newspaper, just as the event, cannot be picked up directly in subsequent discourse, but only via summation (cf. (19)). The analysis shows summation over the events  $e_1$ , leading to the event DR  $e_2$ , and summation over the newspaper  $x_2$ , leading to the DR  $x_3$ . As we have seen in Experiment 3 for bare singulars, situations that make it plausible that summation leads to more than just one newspaper allow for uptake by plural pronouns.

The next sentence can refer to these DRs, indicating that  $x_3$  is a single newspaper (due to the singular feature); it also expresses that the state  $e_3$  is cotemporaneous to  $e_2$  (expressed here by  $\approx$ ). This way of reviving an otherwise inaccessible DR via abstraction and summation implies some additional cognitive effort, which predicts a somewhat lower anaphoric potential of weak definites, as compared to indefinites. It also predicts that reference to a sum individual is possible (*Sie / Die Zeitungen waren interessant*), as summation over  $x_2$  may create a sum individual if Peter read more than just one newspaper (this corresponds to the number-neutral interpretation of weak definites). Evidence for summation over the events  $e_1$  comes from the last sentence, in which the temporal relation *dann* relates the newly introduced event of dozing-off to  $e_2$ , the maximal newspaper-reading event.

### 3.5 Anaphoric Uptake with Implicit Objects

Cases with implicit objects such as *säen* in (1)(e) and *fischen* in (3)(e) are at the bottom end when it comes to the anaphoric potential for the object. The only conceivable mechanism for anaphoric uptake in such cases is associative anaphora. As the nature of the object is not specified, definite descriptions work much better than pronouns. This also holds for denominal verbs such as *fischen* ‘to fish’ because they are not restricted to their etymological source; *fischen*

allows for objects such as octopuses, corals and even coins and human souls (Matthew 4:19). We might distinguish between a prototypical meaning ‘extract fish from water with an instrument’ and an extended meaning, like ‘extract an object from a three-dimensional space’, where associative anaphors can address participants of the prototypical meaning, like the fish, the water, or the instrument. The prototypical meaning and the extended meaning are indicated as alternants in (41), with the prototypical meaning on top and the generalized meaning on the bottom.

(41) *Martha hat gefischt. Die Fische haben gut geschmeckt.*

$$\left( \begin{array}{l} x_1 \ e_1 \\ x_2 \ e_2 \end{array} \middle| \begin{array}{l} x_1 = \text{Martha}, e_1 < n, \exists y_1 [e_1 : \left. \begin{array}{l} \text{fish}(y_1) \wedge \text{extract from water with instrument} \\ \text{extract from\_3D\_space} \end{array} \right\} (x_1, y_1)] \\ x_2 = \Sigma y_1 [\text{fish\_of}(e_1)(x_1)], \text{PL}(x_2), e_2 < n, e_2 : \text{taste\_good}(x_2) \end{array} \right)$$

## 4 Conclusion

In this paper we set out to investigate the anaphoric potential of various realizations of syntactic objects in German. We saw experimental evidence that their anaphoric potential – the ease by which they can be picked up by anaphora – varies; some make better antecedents than others; some allow for easy uptake by pronouns, others require complex strategies like associative anaphora. We employed different experimental techniques, as some of the constructions – in particular, weak definites, bare singulars and deverbal nominalizations – are quite restricted, and prevent a systematic comparison across categories. It should be stressed that some of the experimental results are preliminary and have to be checked more systematically.

We then proposed ways of modelling the anaphoric potential of different antecedents, with Discourse Representation Theory as the general framework. We extended classical DRT by existential closure that limits the direct accessibility of DRs but allows for access by abstraction and summation, and by the binding of arguments without introducing DRs, which allows for associative anaphora. With associative anaphors we discussed subcategories, in particular structured events that allow for accessing the object position, formation of event kinds that make it more difficult to access participants of the event.

The experimental findings and the proposed DRT modelling are summarized in Table 1.

**Table 1.**

Antecedent type	Example	Anaphoric potential	Proposed DRT modelling
Singular indefinite	<i>eine Zeitung lesen</i>	high	Accessible singular DR
Bare plural indef.	<i>Zeitungen lesen</i>	high	Accessible plural DR
Weak definite	<i>die Zeitung lesen</i>	slightly reduced	DR in existential closure, accessible after abstraction and summation
Bare singular	<i>Zeitung lesen</i>	more reduced	No DR introduced, associative anaphora
Infinitival nominal	<i>am Zeitunglesen sein</i>	more reduced	No DR introduced, assoc. anaphora via structured events
Deverbal nominal	<i>bei der Zeitungslektüre sein</i>	very reduced	No DR introduced, formation of event kind assoc. anaphora possible
implicit object	<i>lesen</i>	absent	No DR introduced, assoc. anaphora difficult

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