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ORIGINAL RESEARCH

# Generic conjunctivitis

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## Abstract

Generic sentences involving phrasal conjunctions present a prima facie problem for the standard theory of generics according to which they express quasi-universal generalisations about what is characteristic for members of a particular kind. For example, the sentence 'Elephants live in Africa and Asia' is true, even though it is uncharacteristic for an elephant to live in both Africa and Asia. In response to this problem, theorists have recently proposed radical departures from the standard view. This paper argues that such departures are unwarranted: not only do they fail to fully accommodate the data involving generic conjunctions, their scope is overly narrow, since the phenomena in question also arise in non-generic contexts. I propose a new theory of generics that aims to account for generic conjunctions in a principled manner and which sheds new light on the mereological commitments of natural language.

**Keywords** Generics · Characterising sentences · Conjunction · Bernhard Nickel

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## 1 Introduction

There is an orthodox way of thinking about the semantics of characterising sentences, such as those in (1), according to which they express universal or near-universal generalisations about what is characteristic for a contextually determined subset of members of a particular kind.[1,2]

(1) a. Ravens are black.
b. Whales are mammals.
c. Elephants have trunks.
d. Bishops move diagonally.

According to the orthodoxy, characterising sentences (or *generics*, for short) have a tripartite quantificational structure involving a phonologically null generic operator called ‘Gen’. The quantificational strength of *Gen* is quasi-universal and it encodes some kind of intensional component, which accounts for the exception-permitting behaviour of characterising sentences. Devotees of the orthodoxy differ in how they treat the intensional component of *Gen*. Some claim that characterising sentences express relative frequency probability judgments smoothed out over suitable stretches of times and histories (Cohen, 1999a). Others hold that they express claims about what properties are had by all (or most) normal individuals of a certain kind (Asher and Morreau, 1991, 1995; Krifka et al., 1995; Pelletier and Asher, 1997; Eckardt, 2000; Asher and Pelletier, 2013). But, despite diverging on these details, most extant theories of characterising sentences subscribe to some variant of the orthodoxy.

However, recent theorists have argued that characterising sentences involving phrasal conjunctions, such as those in (2), pose serious problems for the orthodoxy (Carlson, 1977a; Schubert and Pelletier, 1987; Nickel, 2008, 2016; Liebesman, 2011).[3] Call these sentences *generic conjunctions*.

(2) a. Elephants live in Africa and Asia. (Nickel, 2008)
b. Cardinals are red and lay eggs. (Asher and Pelletier, 2013)
c. Humans are male and female.[4] (Nickel, 2016)

[1] See, for example, the theories expressed in Krifka et al. (1995), Pelletier and Asher (1997), Mari et al. (2013a), as well as Cohen (1999a), Greenberg (2004).

[2] This paper focuses primarily on characterising sentences involving bare plural noun phrases in subject position, rather than indefinite and definite singular noun phrases, since the semantics of these latter sentences differ in subtle ways that puts them outside the scope of this thesis. Nevertheless, I shall discuss (in)definite singular characterising sentences involving conjunctions in Sect. 5.4.

[3] Coordination poses problems for the standard approach across the board. For a related argument that disjunctive coordination also poses a problem, see Nickel (2010). Briefly, Nickel argues that the standard approach cannot accommodate so-called *free choice* effects in generics, in which characterising sentences involving disjunction coordination like ‘Elephants live in Africa or Asia’ seem to entail conjunctions of simpler characterising sentences like ‘Elephants live in Africa and elephants live in Asia’.

Generics involving copredications, such as ‘Ducks lay eggs and are widespread throughout Europe’ and ‘Snow is white and is falling right now through Alberta’, also pose problems for the orthodoxy (Carlson, 1977a; Schubert and Pelletier, 1987; Liebesman, 2011). For some discussion of this phenomenon, see Sect. 6.2.

[4] An anonymous reviewer questions the acceptability of (2c) and so I would like to justify its inclusion. First, Nickel (2016: 123) explicitly deals with this sentence when motivating his revisionist account of

Generic conjunctions involve equally good, but mutually incompatible characteristic properties, none of which are satisfied by the majority of the kind. For example, (2a) is true even though not all/most elephants (in a suitable domain) live in both Africa and Asia; indeed, to my knowledge, none do. Sentence (2b) is more difficult to deal with, since it seems to predicate two properties to cardinals, even though no cardinal can have both: only male cardinals are red and only female cardinals lay eggs. And, again, (2c) is true, even though no human is both male and female. These observations pose a problem for orthodox approaches to generics, since they predict that (2a) is true iff all or most (contextually determined) elephants live in both Africa and Asia; that (2b) is true iff all or most (contextually determined) cardinals are both red and lay eggs; and that (2c) is true iff all or most (contextually determined) humans are both male and female. Since no elephant lives in both Africa and Asia, no cardinal is both red and lays eggs, and no human is both male and female, the orthodoxy is empirically inadequate.[5]

The phenomenon under consideration is not isolated to characterising sentences with bare plural subject terms.[6] Consider, for example, the following sentences:

(3) Mary smokes [cigars and cigarettes]$_f$ after dinner. [7]

(4) a. The/*an elephant lives in Africa and Asia.
b. The/*a cardinal is red and lays eggs.
c. The/*a human is male and female.

Sentence (3) illustrates that a similar phenomenon also arises with habitual sentences with coordinated noun phrases. For (3) seems true even though Mary may never smoke both a cigar and a cigarette after dinner. This suggests that an explanation of the relevant data should be general enough to accommodate habitual sentences without plural subject terms. Furthermore, the sentences in (4) demonstrate that the phenomenon arises for characterising sentences with generically-interpreted definite singular subject terms too, but not their indefinite singular counterparts. This presents a problem for any conservative extension of the orthodoxy according to which these sentences are true only if all/most of the relevant members of the kind in question have

Footnote 4 continued
generics, and so I take it on good faith that there is *some* reading of the sentence on which it is a true characterising sentence. Consequently, I aim to reconcile this reading with the orthodoxy. Admittedly, however, this reading can be difficult to hear, and so an explanation of this fact should also be forthcoming. For those readers who are struggling to hear the reading on which the sentence is true, consider the alternative 'Humans are penised and breasted', the truth of which does not require any humans to satisfy both properties (although, in this case, overlap isn't an issue).

[5] The problem of generic conjunctions is further bolstered by the intuitive acceptability of inferences involving conjunction introduction under the scope of a generic operator (cf. Leslie, 2007):

(i) Peacocks lay eggs
Peacocks have fabulous blue-green tails
———
Peacocks lay eggs and have fabulous blue-green tails

[6] Indeed, to foreshadow my arguments in Sect. 3, the phenomena are not even isolated to characterising sentences; see, for example, the sentences in (23)–(25).

[7] This example is due to Timothy Williamson (p.c.). Focal stress is orthographically marked with '[.]$_f$' which is phonologically realised by focusing the bracketed constituent or with the appropriate prosody.

the predicated property. Moreover, there is a marked difference between the bare plural and definite singular generic conjunctions, which all seem true, and their indefinite singular counterparts, which seem false, at least when interpreted generically. This fact is surprising and an explanation of these additional data points should be forthcoming.

The study of generic conjunctions is important for at least two reasons. First, judgments about generic conjunctions are robust and systematic. Other sentences that apparently pose problems for theories of characterising sentences, such as ‘Ducks lay eggs’ or ‘Mosquitos carry the West Nile Virus (WNV)’, are limited and the truth-value judgments of well-informed native speakers vary.[8] Contrastingly, generic conjunctions seem to present a unified class and judgments about their truth are firm. Consequently, such sentences make for more stable data for linguistic inquiry.

Second, when confronted with the problem of generic conjunctions, some theorists have been tempted to jettison the standard approach in favour of more revisionary accounts which deny that characterising sentences express claims about the properties had by a majority (Nickel, 2008, 2016). Such accounts represent a significant departure from the orthodoxy, and so we should be cautious about accepting them without a thorough investigation into the nature of generic conjunctions. In particular, it is worth considering whether they can be accommodated within the familiar majority-based framework, explaining the facts concerning generic conjunctions as epiphenomena of more general, independently known phenomena. If so, then the data concerning generic conjunctions would not support these revisionary views.

This paper argues that a satisfactory explanation can be given for generic conjunctions without departing from the orthodox approach to characterising sentences. In particular, accommodating generic conjunctions does not require us to revise our assumptions about the logical form of characterising sentences nor to take radically different approaches to their semantics. I develop a general account of the behaviour of generic conjunctions that both vindicates the standard approach to characterising sentences and undermines a central motivation for revisionist semantics. In what follows, I make use of a particular combination of syntactic and semantic assumptions which I feel is best suited to supplement my hypothesis. In particular, I adopt a situation-based framework (Kratzer, 1989; Elbourne, 2013) combined with an algebraic treatment of plurals in the style of Link (1983, 1998). Moreover, I choose to implement my solution

[8] Leslie (2007, 2008) recently argues against the standard approach on the grounds that it cannot accommodate the truth of ‘Ducks lay eggs’ without incorrectly predicting that ‘Ducks are female’ is also true. Furthermore, she argues that the standard approach incorrectly predicts that ‘Mosquitos carry the West Nile Virus (WNV)’ is false because less than 1% of mosquitos are WNV carries, even though native speakers of English judge it to be true. However, these considerations are more subtle than Leslie supposes. As I shall explain in Sect. 2.4, Cohen (1997, 1999a) and Asher and Pelletier (2013) compellingly argue that the standard approach can predict the truth of ‘Ducks lay eggs’, together with the falsity of ‘Ducks are female’, by utilising contextually-induced domain restriction and accommodation.

Accommodating minority generics like ‘Mosquitos carry the West Nile Virus’ is more difficult and a range of strategies have been offered. One strategy treats ‘Mosquitos carry the WNV’ as a ‘relative’ generic, which is true just in case a random choice of a mosquito is more likely to carry the WNV than a random choice of any other kind of insect (Cohen, 1999a); for criticism, see Asher and Pelletier (2013: 330–331). Another strategy takes such sentences as involving some kind of double genericity such that ‘Mosquitos carry the WNV’ is true just in case in the appropriate circumstances, mosquitos do normally carry the WNV (Asher and Pelletier, 2013: 331–332). And some theorists have argued that intuitions about ‘Mosquitos carry the West Nile Virus’ should not significantly inform semantic theorising about genericity (Sterken, 2015). I will not attempt to do justice to the complexity of this issue nor to adjudicate between these solutions.

in a normality-based, modal variation of the standard approach (cf. Krifka et al., 1995; Asher and Morreau, 1995; Eckardt, 2000; Asher and Pelletier, 2013). While these assumptions are widely shared and independently motivated, they do not represent the only way to cast the theory I develop, and the success of my basic argument is compatible with many other alternative implementations.[9]

The plan for this paper is as follows. Section 2 outlines four central commitments of the orthodox approach to characterising sentences. Section 3 carefully presents the problematic data involving generic conjunctions, argues against a uniform treatment of the phenomena, and outlines the shape of my solution. Section 4 draws upon and generalises some technical resources concerning plurals and conjunctions to accommodate generic conjunctions. Section 5 illustrates how the resulting theory provides a satisfactory account of the problematic data that is in keeping with the central commitments of the orthodoxy. Section 6 argues that the theory is promising for other puzzles of generic predication, namely, collective predications and copredications. Section 7 compares my theory with how Nickel's semantically revisionary theory of generics deals with these sentences. I argue that his revisionist semantics is actually ill-equipped to account for the data, not least because the phenomena in question are not specific to generics. Section 8 concludes.

## 2 The orthodoxy

The orthodox approach is a broad church consisting of different concrete proposals for the semantics of characterising sentences. Nevertheless, each version of the orthodoxy is committed to the following claims that together form the common ground among the orthodoxy: (i) the semantic interpretation of characterising sentences have a tripartite quantificational structure involving a generic quantifier, (ii) that the quantificational force of characterising sentences is quasi-universal, (iii) they involve an intensional element, and (iv) their predicate induces a restriction on the domain of quantification. This section outlines these commitments.

### 2.1 Logical form

According to the orthodox approach, characterising sentences have a tripartite quantificational structure involving a phonologically null variable-binding operator, usually called 'Gen'. The generic operator *Gen* is typically treated as an adverb of quantification, which is in turn usually analysed in the style of Lewis (1975).[10] More specifically, *Gen* is analysed as a quantifier that relates two open sentences called

[9] For other approaches to pluralities, see the set-theoretic approach (Winter, 2001) or the plural logic approach (Yi, 2005, 2006; Moltmann, 2013; Oliver and Smiley, 2013). The ideas in this paper can be adapted to such frameworks.

[10] See, for example, Krifka et al. (1995), Pelletier and Asher (1997), Mari et al. (2013b). I should note that there is a competing account of the semantics of adverbs of quantification as quantifiers over situations, pioneered by Berman (1987) and adopted by von Fintel (2004), Heim (1990), Elbourne (2005), Elbourne (2013). When I give my positive proposal in Sects. 4 and 5, I will adopt this alternative account, but since the Lewisian view is more familiar in the literature, I shall stick with it here for
Footnote 10 continued

the restrictor clause and the matrix/scope clause. The matrix clause makes the main assertion of the characterising sentence, specifying the property attributed to the relevant members of the domain. The restrictor clause states the restricting cases relevant to the matrix. *Gen*, then, unselectively binds any free variables in its scope, whether the variables range over individuals, worlds, (spatial-temporal) locations, events, or situations. Consequently, characterising sentences receive the schematic logical form in (5), where the sentence material is somehow divided between the restrictor and the matrix, and *Gen* binds any free variable in its scope:

(5) $\mathbf{Gen}\ x_1, \ldots, x_i[\mathbf{Restrictor}(x_1, \ldots, x_i)][\exists y_1, \ldots, y_j\ \ \mathbf{Matrix}(\{x_1\}, \ldots, \{x_i\}, y_1, \ldots, y_j)]$

where $x_1, \ldots, x_i$ are the variables to be bound by Gen, $y_1, \ldots, y_j$ are the variables to be bound existentially with scope just in the Matrix, $\phi[\ldots x_m \ldots]$ is a formula where $x_m$ occurs free, and $\phi[\ldots \{x_m\} \ldots]$ is a formula where $x_m$ possibly occurs free. For example, the characterising sentence in (6a) receives the (significantly simplified) logical form as in (6b):[11]

(6) a. Ravens are black.
  b. **Gen** $x$ [$x$ **are ravens**][$x$ **are black**]

In (6a), the bare plural *ravens* contributes the restrictor clause and the predicate *are black* contributes the matrix clause. The generic operator *Gen* is then introduced to bind the unbound variables.

Defenders of the orthodoxy may remain neutral on how the tripartite structure is generated and what is the precise procedure for mapping the material in the sentence to the restrictor and matrix. Nevertheless, this procedure is likely to be a focus-related phenomenon and/or to involve an independently-motivated movement operation.[12] Importantly, defenders of the orthodoxy may remain neutral about whether the subject bare plurals of characterising sentences denote kinds or contribute predicates to the semantic value of the sentence, so long as the resulting implementation produces a tripartite structure.[13]

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expository purposes. When considering the central commitments of the orthodoxy, all that matters is the commitment to the existence of a generic operator *Gen*. For example, the standard approach need not necessarily treat *Gen* as a quantificational adverb; it may act like a quantificational determiner like *all*, *some*, *the* or *a*. However, for exegetical reasons, we shall ignore this complication, since identical problems arise for this approach.

A minority of theorists hold a kind-predication approach to characterising sentences according to which characterising sentences involve predications of properties to kinds; see, for example, Carlson (1977a, b), Chierchia (1998), Liebesman (2011), Teichman (2016). Since our focus concerns majority-based theories, consideration of kind-predication accounts are outside the scope of this paper.

[11] Strictly speaking, the proposition expressed will involve some indexing to other contextually salient parameters such as times, locations, worlds, events, or situations. As mentioned before, the generic operator *Gen* will bind any such free variable in its scope. Consequently, this framework is extremely flexible and can be implemented in event semantics and situation semantics. For ease of exposition, I shall omit this sensitivity to times, locations, events, situations, and so on.

[12] For further details, see, e.g., Chierchia (1995), Rooth (1995), Asher and Pelletier (2013).

[13] For theories that combine kind-referring bare plurals with tripartite quantificational structure, see Chierchia (1998), Moltmann (2013), Nickel (2016), Teichman (2016).

## 2.2 Quasi-universal quantificational force

The second core commitment is that the semantics of characterising sentences involves quasi-universal quantificational force. It is well known that generics are not universal generalisations, since they permit exceptions. Nevertheless, despite their exception-permitting behaviour, most theorists agree that generics have a quasi-universal flavour, giving voice to generalisations about an actual or hypothetical majority of a kind. Consider, for example, the following sentences:

(7) a. Ravens are black.
b. Mary [smokes]$_f$ after dinner.

These sentences allow exceptions: (7a) is true even though some ravens are albino and (7b) is true even if Mary sometimes does things other than smoke after dinner. But despite permitting exceptions, they have a quasi-universal flavour, typically requiring a majority of the relevant instances to satisfy some property. Most of the relevant ravens need to be black for (7a) to be true, and if Mary usually does things other than smoking after dinner, (7b) would be false.

Different versions of the orthodoxy encode the quasi-universal character of generics in different ways. Normality-based accounts typically deploy universal quantification over normal individuals or normal worlds. For example, Krifka et al. write that:

> in order to capture the quasi-universal force of characterising sentences, we will want to employ a necessity operator in our representation. [For example, the sentence 'A lion has a bushy tail' states that] everything which is a lion in the worlds of the modal base is such that, in every world which is most normal according to the ordering source, it will have a bushy tail. …[This representation] does not require that every lion has a bushy tail, not even of those lions in [the modal base worlds]. It merely states that a world which contains a lion without a busy tail is less normal than a world in which that lion has a bushy tail. (Krifka et al., 1995: 52).

Similarly, Asher and Morreau write:

> [$\ulcorner\phi'$s are normally$\psi$'s$\urcorner$] is true just in case for every individual $\delta$, if we look at the worlds where $\phi\underline{\delta}$ holds along with everything else which, in w, is normally the case where $\phi\underline{\delta}$ holds, we find that $\psi\underline{\delta}$ holds. (Asher and Morreau, 1995: 313)

Probability-based versions of the orthodoxy typically deploy universal or majority-based quantification over all suitable smoothed out admissible temporal segments of possible worlds that extrapolate from the current history so far. For example, Cohen provides the following truth-conditions:

> Let $Gen[\psi][\phi]$ be a sentence, where $\psi$ and $\phi$ are properties.
> Let $A = \text{ALT}(\phi)$, the set of alternatives to $\phi$. Then
> $Gen[\psi][\phi]$ is true iff $P(\phi|\psi \wedge \bigvee A) > 0.5$ (Cohen, 1999a: 37)

where $P$ is a frequentist probability function. Given frequentism, this amounts to the claim that the frequency of $\phi$s in a suitable reference class of $\psi$'s that also satisfy one of the alternatives associated with $\phi$ is greater than 0.5. That is, 'most' such $\psi$s are $\phi$s.

### 2.3 Intensionality

The third feature of the orthodoxy is that the semantics of characterising sentences involves an intensional element. This element captures the inherently intensional feature of characterising sentences which poses problems for purely extensional analyses. Consider the following well-known examples:

(8) a. Mary handles the mail from Antarctica.
b. Members of this club help each other in emergencies.

Sentence (8a) may be true even if there has never been any mail from Antarctica, just so long as handling such mail is part of Mary's employment contract. For example, we can imagine someone who doesn't know whether any mail has arrived from Antarctica referring us to Mary by saying (8a). Similarly, (8b) may be true even if no emergencies have ever occurred, so long as, say, such an obligation is part of the club's code of conduct.

Every version of the orthodox approach can accommodate the intensional aspect of these generics because, in one way or another, they do not presuppose actual instances of mail from Antartica or emergencies. Instead, their proposed truth-conditions ask us to look at what happens normally or in certain future continuations of the current history. On these approaches, then, (8a) suffices to be true just so long as, if there were mail from Antartica, Mary would normally or most likely handle it. Similarly, (8b) is true just in case, if there were emergencies, the members of this club would normally or more likely help each other.

### 2.4 Contextual restriction

The fourth feature of the orthodox approach is that it postulates an additional contextual restriction, often induced by the predicate, which helps to accommodate troublesome sentences like (9):[14]

(9) Ducks [lay eggs]$_f$.

While native speakers of English judge that the sentences in (9) are true, naïve versions of the orthodox approach incorrectly predict they are false. For not all normal ducks lay eggs, given normal male ducks certainly don't, and since only female ducks lay eggs, the conditional probability that an arbitrary individual will lay eggs, given that it is a duck is not greater than 0.5.

Defenders of the orthodoxy typically account for sentences like those in (9) by arguing that additional material may enter the restrictor, such as through the focus-sensitive nature of generics. It has long been observed that prosody affects the division of content to the restrictor and the matrix clauses of generic sentences. Research

[14] See, for example, Carlson (1977a, 38ff.).

on prosody and generics suggests that focused material is selected for the matrix clause of focus-sensitive constructions, while the backgrounded material contributes to the restrictor. This follows fairly standard assumptions about how to divide content between the restrictor and matrix clauses in generic sentences.[15] Since generics are like other focus-sensitive constructions, the restrictor in (9) should also include the disjunction of alternatives to the prosodically prominent element, namely, the focus interpretation of the sentence (9). For example, in (9), the focused material is the predicate *lay eggs* and so the restrictor of the sentence will include a disjunction over alternatives to egg-laying, namely, alternative modes of reproduction, like birthing live young, reproducing via mitosis, and so on. Again, different mechanisms have been proposed for handling this process, but we may informally state the resulting truth-conditions for (9) as follows:

(10) a. (9) is true iff all normal ducks that produce offspring in some way or other lay eggs.
b. (9) is true iff the conditional probability that an arbitrary individual lays eggs, given that it is a duck that produces offspring in some way or other, is greater than 0.5.

These truth-conditions are empirically adequate.

### 2.5 Summary

In summary, these four features of the orthodoxy contribute to an empirically powerful theory and help to accommodate a wide range of generic sentences. Almost every extant semantic theory of generic sentences subscribes to (some variant of) the standard approach. However, as we will see in the next section, the orthodoxy has difficulty accommodating characterising sentences that involve phrasal conjunctions.

## 3 Generic conjunctions

Let us return to the generic conjunctions in (2)–(4), repeated here:

(2) a. Elephants live in Africa and Asia.
b. Cardinals are red and lay eggs.
c. Humans are male and female.

(3) Mary smokes [cigars and cigarettes]$_f$ after dinner.

(4) a. The/*an elephant lives in Africa and Asia.
b. The/*a cardinal is red and lays eggs.
c. The/*a human is male and female.

As we can see, the data cover a broad range of syntactic positions, none of which seem to be accommodated by the standard approach. Each of the sentences in (2)–(4) involve different kinds of phrasal conjunctive coordination and/or different kinds

[15] See, for example, Chierchia (1995), Krifka (1995), Rooth (1995), Cohen (1999a).

of subject terms: (2a) involves the coordination of two determiner phrases in object position of a transitive verb; (2b) involves the coordination of two verb phrases which involve different topics; (2c) involves adjectival coordination; (3) involves noun phrase coordination in a habitual sentence; and (4) involves definite and indefinite singular versions of the sentences in (2).

This section explores three natural strategies for accommodating the data and argues that none are wholly adequate in rescuing the standard approach. It will emerge that the phenomena in question are less uniform than appearances first suggest and that different strategies may need to be pursued to accommodate the full breadth of data. To streamline the presentation, I shall focus on (2) and (3), although similar remarks apply to the sentences in (4). I will conclude this section by arguing that the phenomena in question are not even isolated to characterising sentences: the phenomena arise in non-generic constructions and so an adequate solution should not be specific to generic sentences.

### 3.1 Three proposals

*Strategy 1. Phrasal Coordination*

The first strategy provides a phrasal analysis of the coordinations in (2) and (3). According to this approach, the highest VP node that the subject terms in (2) and (3) c-command will denote a complex predicate, such as the following (or their intensional counterparts):[16]

(11) a. $\lambda x.[\text{live.in}(x)(\text{Africa} \oplus \text{Asia})]$
b. $\lambda x.[\text{red}(x) \wedge \exists y[\text{eggs}(y) \wedge \text{lay}(x)(y)]]$
c. $\lambda x.[\text{male}(x) \wedge \text{female}(x)]$
d. $\lambda x.\exists y \exists z \exists z'[\text{cigars}(z) \wedge \text{cigarettes}(z') \wedge y = z \oplus z' \wedge \text{smokes}(x)(y)]$

The crucial observation is that these denotations cannot figure in the interpretation of the sentences in (2) and (3) without predicting that it is characteristic for elephants to have residencies on two continents, for cardinals to both lay eggs and be red, for a human to be both male and female, and for Mary to simultaneously smoke cigars and cigarettes. But the sentences in (2) and (3) say no such thing, nor does any normal or statistically probable elephant, cardinal, or human have such properties. Consequently, the first strategy is incompatible with the standard approach.

*Strategy 2. Sentential Coordination*

The second strategy attempts to treat each sentence in (2) and (3) as elliptical for its counterpart sentential coordination, as in (12):[17]

(12) a. Elephants live in Africa and elephants live in Asia.

[16] Informally, '$a \oplus b$' roughly means 'the sum of $a$ and $b$'. For a more precise formulation, see Sect. 4.

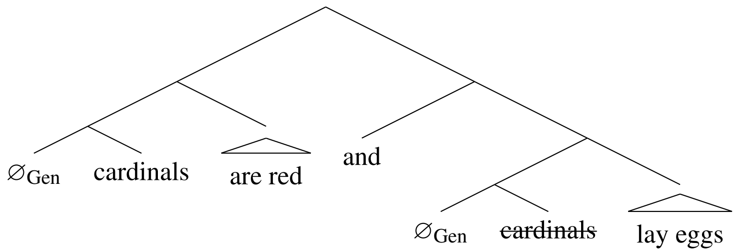
[17] Note that Nickel's revisionist proposals follow this strategy (cf. Nickel, 2008, 2016), citing Ariel Cohen's suggestion concerning 'Peafowl lay eggs and have colourful tail-feathers' as a precedent (Cohen, 1999b: 113). See Sect. 7, for further discussion of how Nickel's theory falls foul to the problems outlined in this section.

b. Cardinals are red and cardinals lay eggs.
c. Humans are male and humans are female.
d. Mary smokes cigars after dinner and Mary smokes cigarettes after dinner.

According to this strategy, which we may call the *sentential coordination strategy*, the generic conjunctions in (2) and (3) are glossed as the sentential conjunctions in (12), which are assumed to be truth-conditionally equivalent. While contemporary syntactic theory has disavowed theories of syntax (like Transformational Grammar) that straightforwardly allow for the LFs of the sentences in (2) and (3) to be essentially those of the sentences in (12), defenders of the sentential coordination strategy can argue that generic conjunctions are elliptical constructions for the corresponding sentential conjunctions.

The sentential coordination strategy is most plausible for cases of ellipsis that result in VP coordinations, such as in (2b), since NPs can undergo PF deletion when there is an explicit linguistic antecedent. Thus, I propose that (2b) could have the simplified LF in (13), where ~~struckthrough~~ text represents NP-deletion at the level of PF:[18]

(13)




Then, given that the conjuncts have different predicate-induced restrictions, the standard approach will predict that (2b) is true iff all/most cardinals whose colour reflects pressure from sexual selection are red and all/most cardinals which produces offspring in some way or another lay eggs. (Indeed, I will develop a version of this solution for (2b) in Sect. 5.2.) So far, so good.

The trouble with this strategy is that, when it is paired with the orthodox approach, it only makes correct predictions about the truth-conditions of (12b); it makes incorrect predictions about the other sentences. For example, the modal version of the standard approach predicts that (12a) iff all normal elephants live in Africa and all normal elephants live in Asia. (Alternatively, in a probabilist key, (12a) is true iff the probability of living in Africa, conditional on being an elephant is greater than 0.5, and the probability of living in Asia, conditional on being an elephant is greater than 0.5.) But, in the absence of international elephants, these truth-conditions are clearly inadequate. Similar remarks apply to the other sentences. Consequently, while the conjunction coordination strategy is appealing for (12b), it does not provide a *general* solution for reconciling the orthodoxy with the problematic data.

However, there is strong reason to reject the sentential coordination strategy as a general solution across the board, namely, the deletion strategy does not generalise to

[18] One might object to this proposal on the grounds that NP-deletion must be preceded by a genitive phrase or some determiner other than *no*, *every*, *a*, and *the* (cf. Lobeck, 1995: 42–45), and no such determiner is present in our data. But, in (13), the deleted *cardinals* is preceded by the generic operator, here represented as '$\varnothing_{Gen}$', which is present at LF, even though it is unpronounced at PF.

the other generic conjunctions, and it is unclear whether there is any other principled syntactic mechanism that generates the required interpretations. The deletion strategy does not generalise to the other sentences because the phrasal coordinations of those sentences are *constituents*, groups of words that function as a single unit within the syntactic structure. The constituent structure of the phrasal coordinations can be identified by the following constituency tests:

(14) **Fragment Answers**: only a constituent can answer a question while also retaining the meaning of the original sentence.

a. Elephants live in Africa and Asia.
→ Q: Where do elephants live? A: In Africa and Asia.[19]
c. Humans are male and female.
→ Q: What sexes are humans? A: Male and female.
d. Mary smokes cigars and cigarettes after dinner.
→ Q: What does Mary smoke after dinner? A: Cigars and cigarettes.

(15) **Topicalisation**: only a constituent can be relocated at the beginning of the sentence.

a. Elephants live in Africa and Asia.
→ In Africa and Asia, elephants live.
c. Humans are male and female.
→ Male and female, humans are.
d. Mary smokes cigars and cigarettes after dinner.
→ Cigars and cigarettes, Mary smokes after dinner.

(16) **Clefting**: only a constituent can appear in the frame "____ is/are/who/what/where/when/why/how…".

a. Elephants live in Africa and Asia.
→ In Africa and Asia is where elephants live.
c. Humans are male and female.
→ Male and female are what humans are.
d. Mary smokes cigars and cigarettes after dinner.
→ Cigars and cigarettes are what Mary smokes after dinner.

Since passing a constituency test is a sufficient (though not a necessary) condition for being a constituent, these coordinations are constituents. Constituents do not admit of phonologically deleted material and cannot be split in the manner predicted by the sentential coordination strategy.[20] Consequently, even though the sentential coordi-

[19] Constituency tests for DPs embedded under a preposition typically result in the preposition being moved as well.

[20] Compare (14a)–(16a) to the following minimal pairs:

(i) Where do elephants live? A: #In Africa and elephants live in Asia.
(ii) #In Africa and elephants live in Asia, elephants live.
(iii) #In Africa and elephants live in Asia is where elephants live.

Given that the phrasal coordinations are constituents, if the deletion strategy were correct for (2a), then (i)–(iii) would be felicitous. But they are not. So the deletion strategy is incorrect for (2a).

nation strategy provides an acceptable solution for (2b), in light of these constituency tests, it cannot provide a *general* account of generic conjunctions, orthodoxy or not. Nevertheless, one can easily observe that, when the constituency tests are applied to (2b), it fails those tests. This strongly suggests that (2b) is different from the other sentences insofar as the conjunction is sentential and does not form a constituent. This, in turn, suggests that the data should not be given a uniform account: the fact that (2b) does not pass any constituency tests suggests that it should not receive the same treatment as the other generic conjunctions.

*Strategy 3. The 'And-as-Or' Hypothesis*

Lastly, it is worth considering a strategy on which the conjunctions in (2) should be interpreted as disjunctions.[21] According to this view, the truth-conditions of (2a) can be roughly stated as follows:

(17) 'Elephants live in Africa and Asia' is true iff in a suitable domain, suitably many elephants live in Africa *or* Asia.

Call this the *and-as-or hypothesis*.

While this hypothesis maintains the simple syntactic analysis of the verb phrase, it faces a number of challenges. First, the hypothesis seems to assume that *and* is ambiguous in meaning, that is, it can mean the usual conjunctive Boolean operator (and its generalisations), as well as the disjunctive Boolean operator. One consideration against this proposal is that *or* plausibly competes with *and*, which is in some sense stronger, and so one would expect a speaker to say the weaker sentence, if that's all that they're in a position to assert. Since the hypothesised speaker of (2)–(4) used the stronger expression, one would assume that they meant the stronger claim.

Second, it makes potentially questionable predictions about the validity of certain inferences, such as disjunction-introduction, which is semantically valid for any disjoinable type. For example, if the sentence 'John is at home' is true, then, trivially, the sentence 'John is at home or in his office' is true. Consequently, the *and*-as-*or* hypothesis validates the inference from (18a) to (18b):

(18) a. Elephants live in Africa and Asia.
b. Elephants live in Africa, Asia, and Antarctica.

However, this prediction does not seem to be born out in practice. If *and* could be interpreted as *or*, then there should be contexts, however artificial, in which the inference from (18a) to (18b) would be truth-preserving. And while there are contexts in which native English speakers, who are acquainted with the validity of disjunction introduction, recognise that the inference from 'John is at home' to 'John is at home or in his office' is valid, they do not seem to recognise the inference from 'Elephants live in Africa and Asia' to 'Elephants live in Africa, Asia, and Antarctica' as valid.

Third, generic conjunctions do not carry the standard implicatures associated with disjunction. Consider the various conclusions that one would normally draw from the assertion of a disjunctive sentence like (19):

[21] While one might have imagined any suggestion that *and* should be interpreted as *or* would give enough reason to pause, this strategy has been suggested to me with enough frequency to warrant discussion. Thanks to an anonymous reviewer for urging me to clarify my argument and position with respect to this proposal here and throughout the remainder of the paper.

(19) John is at home or in his office.

a. $\rightsquigarrow$ Either John is at home or John is in his office
b. $\rightsquigarrow$ It is not the case that John is both at home and in his office.
c. $\rightsquigarrow$ The speaker doesn't know which is true.

Only (19a) follows from the classical truth-functional account of disjunction, but the other conclusions can arguably be inferred using Gricean implicatures. The important observation is that the corresponding generic conjunction, like (20), does not carry these implicatures.[22]

(20) Zarpies live in Africa and Asia.

a. $\not\rightsquigarrow$ Either Zarpies live in Africa or Zarpies live in Asia.
b. $\not\rightsquigarrow$ It is not the case that Zarpies each live in Africa and live in Asia.
c. $\not\rightsquigarrow$ The speaker doesn't know which is true.

Under normal conditions, (20) conveys that at least some Zarpies live in Africa and at least some live in Asia, and that the speaker knows this.

However, despite these considerations, the *and*-as-*or* hypothesis may enjoy some support, at least once equipped with a suitable explanation of the differing pragmatic profiles of explicit *and* and *or*. After all, the difference between judgments that a sentence is false, rather than just pragmatically infelicitous, is notoriously difficult to pin down, even using experimental methods. Furthermore, the positive proposal I pursue is, in some ways, remarkably similar to the *and*-as-*or* hypothesis, albeit that the former, but not the latter, validates the entailment from 'Elephants live in Africa and Asia' to 'Africa and Asia each have at least some normal elephants living in them'. Consequently, while in the interests of concreteness I pursue and develop a former proposal that validates this inference, I ultimately wish to leave open whether this entailment should be validated. To make the proposed analysis easier to compare to other approaches, I shall signpost at opportune moments how the technical machinery can be adapted by proponents of the *and*-as-*or* hypothesis to make their proposal precise.

### 3.2 A sketch of the proposal

I want to finish this section by highlighting that the phenomena underlying the problem of generic conjunctions is more pervasive than the opponents of the orthodoxy have supposed. Going at least as far back as Scha (1981), theorists have noticed that the phenomena arise in non-generic constructions. For example, certain sentences involving transitive verbs with definite or indefinite plural arguments, such as (21a), also permit *cumulative* readings like the one paraphrased in (21b).[23]

[22] Here I appeal to the novel natural kind term *Zarpie* to control for any influence that the reader's background knowledge may have.

[23] For discussion of the complexities of singular predicate conjunction, see Lasersohn (1995) and Krifka (1990).

(21) a. 600 Dutch firms use 5,000 American computers. (Scha, 1981)
b. 600 Dutch firms each use at least one American computer and 5,000 American computers are each used by at least one Dutch firm.

Indeed, non-generic contexts can give rise to similar kinds of cumulative readings that the sentences in (2) do. For example, the sentences in (22a)–(25a) can clearly have the readings paraphrased in (22b)–(25b):[24]

(22) a. John and Mary lift the bicycle and the football.
b. Each of John and Mary lift at least one of the bicycle and the football, and each of the bicycle and the football are lifted by at least one of John and Mary.

(23) a. The men love Berlin and New York.
b. The men each love at least one of Berlin and New York, and Berlin and New York are each loved by at least one of the men.

(24) a. The birds are swimming and flying. (Winter, 2001)
b. The birds are each doing at least one of swimming and flying and at least one bird is swimming and at least one bird is flying.

(25) a. The women sanded and polished the table.
b. The women each either sanded or polished the table and at least one woman sanded the table and at least one woman polished the table.

Given that cumulative readings arise for both generic and non-generic conjunctions, it is plausible that a similar mechanism is responsible for these readings in both cases. Indeed, we should be suspicious of accounts of generic conjunctions that have nothing to say about non-generic cumulative readings and, conversely, accounts of the non-generic conjunctions that cannot be suitably extended to generic conjunctions. Uniform explanations of related phenomena are preferable to variable explanations that posit different accounts for each case.

In the following section, I propose a formal semantics which explains how cumulative readings arise across the range of sentences we have considered, in both generic and non-generic contexts. To illustrate how this theory will work and to see the underlying mechanism in play, let us consider (22a), the most simple sentence exhibiting the phenomenon. On a cumulative reading, this sentence is true just in case John and Mary each lift at least one of the bicycle and the football, and the bicycle and the football are each lifted by at least one of John and Mary. I propose that this sentence is true of overall situations with a complex mereological structure, one that involves a situation, $s_1$, in which John lifts the bicycle and a situation, $s_2$, in which Mary lifts the football (or vice versa). Such an overall situation, as represented in Fig. 1, would be one in which John and Mary (represented by John $\oplus$ Mary) lift the bicycle and the football (represented *mutatis mutandis*). This captures the cumulative reading of (22a) and I propose that generic conjunctions should be understood in much the same way,

[24] Interestingly, the sentences in (23a)–(25a) are not equivalent to their sentential conjunction counterparts. For example, 'The birds are swimming and the birds are flying' is false in any situations in which (23a) is true, at least if the two occurrences of 'the birds' have the same denotation. Consequently, since these sentences cannot be analysed in terms of the sentential coordination strategy, this is another reason to reject that strategy in full generality.

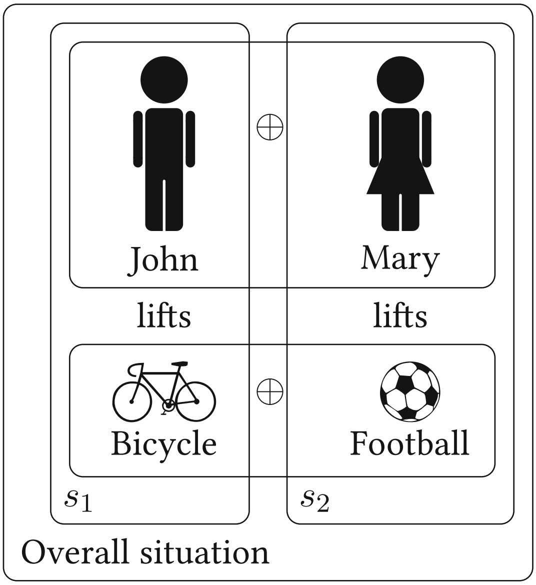



**Fig. 1** 'John and Mary lift the bicycle and the football'

albeit with whatever additional complexity is needed to capture the generic component. In particular, the sentence 'Elephants live in Africa and Asia' is true just in case, in every world which is like ours with respect to its causal, statistical, or dispositional dependencies and regularities, the normal elephants in those worlds cumulatively live in Africa and Asia, that is, all of the normal elephants live in at least one of Africa and Asia, and each of Africa and Asia have at least one normal elephant living in it.[25]

With this sketch in mind, let us turn to developing this proposal in detail. The overall theory aims to satisfy the following three conditions that any adequate account of generic conjunctions should meet: (i) it should analyse generic conjunctions that pass the constituency tests in terms of phrasal coordinations rather than sentential coordinations, (ii) it should not generate implicatures like in (20), and (iii) it should have some principled explanation of cumulative readings of non-generic phrasal conjunctions.

## 4 Structured genericity

How can we account for generic conjunctions while respecting these conditions? One simple explanation would be to base the truth-conditions for generic conjunctions on the cumulative readings for sentences (22)–(25). On this proposal, generic conjunctions are true just in case every member of the relevant kind satisfies some 'part' of the complex predicate and each 'part' of the complex predicate is satisfied by some member of the kind. This would immediately explain why the sentence 'Elephants

[25] It is exactly this cumulative reading that proponents of the *and*-as-*or* hypothesis will reject. Instead, they will hold that the sentence 'Elephants live in Africa and Asia' is true just in case, in every world which is like ours with respect to its causal, statistical, or dispositional dependencies and regularities, the normal elephants in those worlds live in either Africa *or* Asia.

live in Africa and Asia' is true, since some of the normal elephants live in Africa and the others live in Asia. This would also explain why the sentence 'Elephants live in Africa, Asia, and Antarctica' is false, since no normal elephants live in Antarctica.[26]

This explanation might seem incompatible with the orthodoxy, given its commitment to a majority-based semantic analysis of generics. But I will argue that this explanation is the correct one and that it is compatible with the orthodoxy. The reason why extant versions of the orthodoxy fail to make the right predictions is that their treatment of genericity does not reflect the mereological structures to which natural language seems committed. Once we accept that plural morphology tracks these structural properties of the domain of discourse, the problems of generic conjunctions disappear.

In this section, I sketch such a theory. While the basic idea could be implemented in different ways, my theory, which I call the **structured theory** of generics, combines two ideas. The first idea concerns the structural properties of the ontological types that undergird our semantic framework. I adopt an algebraic treatment of plurality that models the structure of individuals and situations in mereological terms. The second part of theory concerns the meaning of generics. I propose that generic sentences involve a normality-based, modal semantics, according to which *Gen* ranges over contextually restricted possibilities and which carries information about the mereological structure of the denotations of their constituents.[27]

In the rest of this section, I provide a unified perspective of these domains. I will begin by outlining my preferred treatment of plurality in an algebraic semantics, which will provide us with the resources to explain cumulative readings of non-generic conjunctions. I will then explain my preferred theory of generic sentences. These subsections explain two central pieces of the framework and should be read by anyone unfamiliar with mereology or algebraic semantics. While the semantic definitions are given alongside intuitive informal parses and explanations, they may be omitted by readers wishing to see how the theory works, but who don't feel up to formal detail at first. Lastly, I will spell out a more precise ontological framework and semantics assumptions in detail; these may also be omitted on a first read by those wishing to get straight to the action. The next section explains how the resulting framework makes good predictions about generic conjunctions, where informal parses are also provided alongside the semantic definitions.

### 4.1 Algebraic semantics

Let me begin by outlining the theory of plurality and distribution that I will adopt in this paper. This theory is based on the work of Link (1983, 1998) and further

[26] Proponents of the *and*-as-*or* hypothesis will explain this datum by arguing that 'Elephants live in Africa, Asia, and Antarctica' is pragmatically misleading, rather than false. They might say that, while it is true that elephants live in Africa, Asia, *or* Antarctica, there is something stronger one could say instead, namely, that elephants live in Africa or Asia.

[27] While these ideas best highlight the general approach that I have in mind, analogous frameworks that incorporate set-theoretic or plural logic approaches to plurality, or which adopt alternative semantics for generics will make similar predictions.

developed by subsequent authors.[28] This subsection outlines this theory and how it explains cumulative readings of non-generic conjunctions.

According to this theory, which has become standard when theorising about plurality in natural language, plural expressions like *John and Mary* or *the Beatles* are taken to denote *pluralities* or *collections*, which are in turn treated as mereological sums of individuals.[29] A central motivation for this theory is to account for distributive and collective predication.[30] Distributivity and collectivity can be viewed as properties of predicates. For example, certain predicates, such as *smokes* or *has a guitar*, have distributive interpretations in the sense that whenever several people smoke or have a guitar, each of them smokes and each have a guitar. Other predicates, such as *met* or *are numerous*, have collective interpretations just in the sense they are not distributive in this way.[31] To illustrate the phenomena, consider the following sentences:

(26) **Distributive predicates**

a. The Beatles smoke.
b. John and Paul have a guitar.

(27) **Collective predicates**

a. The Beatles are numerous.
b. Ringo and George met.

Sentence (26a) entails that each member of the Beatles smoke, while (27a) does not entail that each of the Beatles is numerous. Similarly, (26b) entails that both John and Paul have a guitar, while (27a) does not entail that each of Ringo and George met.

The mereological account of plurality and distributivity, which I will adopt here, is based on classical extensional mereology (CEM).[32] According to this approach, the domain of individuals is ordered by a parthood relation $\preceq$, which is taken to be a *weak*

[28] See, a.o., Scha (1981), Landman (1989a, b), Krifka (1998), Champollion (2017).

[29] There are other ways to model the denotations of plural expressions, such as using set theory or plural logic. I prefer a mereological approach over set theory because it permits a uniform semantic typing across the singular–plural divide. For example, it treats the denotations of singular and plural terms as being of the same semantic type, namely, type $e$. The set-theoretic approach, on the other hand, requires that plural expressions are typed at a higher level than their singular counterparts. For example, if singular terms have $e$-type denotations, then plural terms have $\langle e, t\rangle$-type denotations. This complication percolates across grammatical categories, and thus requires type-shifting operators to ensure that composition runs smoothly. It is more difficult to make a case for the mereological approach over plural logic, given the existence of Russell-style paradoxes for mereological fusions (Oliver and Smiley, 2013). While this is an issue that deserves serious philosophical thought, I will nevertheless appeal to mereology under the assumption that all of the relevant mereology talk can be translated in a language of plural logic with no loss in explanatory power.

[30] For other motivations for algebraic semantics, see, e.g., Link (1998).

[31] Although, see Winter (2001, 2002), for criticism of this way of distinguishing distributive and collection predicates. See Champollion (2017: 72–75) for a recent survey.

[32] For two excellent surveys of Classical Extensional Mereology and other mereological systems, see Simons (1987) and Varzi (2016).

*partial order*.[33,34] (Other domains that will be introduced later, such as situations, are assumed to ordered by a parthood relation as well.) So, in addition to the individuals John and Paul, there is also their individual sum, the plural object John $\oplus$ Paul. More generally, whenever you have a collection of individuals, you can fuse them together to get their sum. More carefully, a *sum* of (the things in) a set $P$ is that which has as parts everything in $P$ and whose parts each overlap with something in $P$. Formally, we can capture this notion of a *sum* as follows, where $x \circ y$ (read: $x$ and $y$ overlap) abbreviates $\exists z(z \preceq x \wedge z \preceq y)$:

(28) $\text{sum}(x, P) =_{def} \forall y(P(y) \rightarrow y \preceq x) \wedge \forall z(z \preceq x \rightarrow \exists z'(P(z) \wedge z \circ z'))$

Given that the parthood relation $\preceq$ is a partial order, every non-empty subset is guaranteed to have a unique sum. Then we can write '$\bigoplus P$' for the mereological sum of all entities to which $P$ applies:[35,36]

(29) $\bigoplus P =_{df} \iota z \text{sum}(z, P)$

(This is the generalisation of the binary operation '$x \oplus y$' ($=_{df}\ \iota z[\text{sum}(z, \{x, y\})]$), which is the case where $P$ applies to only the two entities $x$ and $y$.)

Within this mereological way of thinking about pluralities, collective predications, such as those in (27), are straightforwardly understood in terms of the predication of properties directly to pluralities or individual sums. For example, the sentence 'Ringo and George met' is true because the individual sum Ringo $\oplus$ George instantiate the property of meeting. Contrastingly, distributive predication is usually understood as introducing a covert distributivity operator that shifts the verb phrase denotation to a distributive interpretation (Link, 1987). More specifically, it takes any verb phrase denotation to one which holds of any individual whose atomic parts each satisfy that verb phrase denotation, where $x$ is an atomic part of $y$ (i.e., $x \preceq_{\text{atom}} y$) just in case $x$ is a part of $y$ and $x$ has no parts itself.

(30) $[\![\text{D}]\!] = \lambda P.\lambda x.\forall y[y \preceq_{atom} x \rightarrow P(y)]$

To see the distributivity operator in action, observe that (26a) and (26b) are true iff each of the Beatles smoke and each of John and Paul have a guitar. So, taking $\bigoplus[\![\text{Beatles}]\!]$

[33] A relation $R$ is a weak partial order just in case it is reflexive ($\forall x Rxx$), anti-symmetric ($\forall x \forall y(Rxy \wedge Ryx \rightarrow x = y)$), and transitive ($\forall x \forall y \forall z(Rxy \wedge Ryz \rightarrow Rxz)$).

[34] The notion of 'parthood' is highly ambiguous and vague. There are at least three notions of parthood that should be distinguished, namely, a rich, a material, and an austere (or 'thin-blooded') notion. According to the rich notion, parts may compose some complex whole, which is organised by a number of complex extra-logical relations; see, perhaps, Friederike Moltmann's notion of an integrated whole (Moltmann, 1997). According to the material notion, wholes are composed of those parts that constitute the very matter from which they are composed. Such notions figure in classic philosophical discussions about constitution and identity; see Moltmann (1997), for a survey of this literature. According to the austere notion, the meaning of 'parthood' does not go beyond what can be expressed in strictly logical terms.

[35] Uniqueness is characterised by the following constraint: $\forall P[P \neq \varnothing \rightarrow \exists! z \text{sum}(z, P)]$. There are some reasons to think that uniqueness is an undesirable feature in general. For example, we may want to allow for different committees composed of the same members, which would be forbidden by uniqueness. However, for present purposes, I treat uniqueness as a harmless idealisation, since we can always adopt a richer mereology at some later point with suitable amendments to our definitions.

[36] The iota operator $\iota$ forms expressions of type $e$, following Peano (1906) and contrary to the practice of Whitehead and Russell (1925).

to be the individual sum of the Beatles, John $\oplus$ Paul to be the sum of John and Paul, the plural individual denoted by *John and Paul*, and taking the verb phrases *smokes* and *have a guitar* to denote the properties $\lambda x.\text{smoke}(x)$ and $\lambda x.\exists y[\text{guitar}(y) \wedge \text{has}(x)(y)]$, the truth-conditions of (26a) and (26b) are given as follows:

(31) a. $[\![(26a)]\!] = 1$ iff $\forall x[x \preceq_{\text{atom}} \bigoplus [\![\text{Beatles}]\!] \rightarrow \text{smoke}(x)]$
b. $[\![(26b)]\!] = 1$ iff $\forall x[x \preceq_{\text{atom}} \text{John} \oplus \text{Paul} \rightarrow \exists y[\text{guitar(y)} \wedge \text{has}(x)(y)]]$

To explain cumulative predication, it is important to see that this kind of mereological structure is not confined to just the domain of individuals: properties and relations can also be thought of as forming these kinds of algebras. To see this, we first introduce the star operator $*$ as defined in Link (1983), which applies to a predicate $P$ and gives us *algebraic closure* of a set $P$, that is, the set that contains the sum of all and only the things to which $P$ applies:

(32) **Algebraic closure for sets**
The algebraic closure $^*P$ of a set $P$ is defined as follows:

$$^*P =_{df} \{x : \exists P' \subseteq P[x = \bigoplus P']\}$$

According to this definition, $x \in {}^*P$ just in case $x$ consists of one or more atomic parts and $P$ holds of each of them. For example, the individual sum John $\oplus$ Paul is in $^*[\![\text{Beatle}]\!]$, since both John and Paul are Beatles, but John $\oplus$ Elton isn't, since Elton isn't a Beatle.

To generalise the notion of an algebraic closure to relations, we must introduce the notion of a *generalised pointwise sum*, which allows us to construct the sum of a relation, that is, the tuple consisting of the pointwise sum of its positions.

(33) **Generalised pointwise sum**
For any non-empty $n$-place relation $R^n$, its sum, $\bigoplus R^n$, is defined as the tuple $\langle z_1, \ldots, z_n \rangle$ such that each $z_i$ is equal to:

$$\bigoplus \{x_i : \exists x_1, \ldots, x_{i-1}, x_{i+1}, \ldots, x_n[R^n(x_1, \ldots, x_n)]\}$$

***Example.*** If $R^2 = \{\langle 1, 2 \rangle, \langle 3, 4 \rangle\}$, then its generalised pointwise sum $\bigoplus R^2$ will be:

$$\bigoplus R^2 = \langle 1 \oplus 3, 2 \oplus 4 \rangle$$

Intuitively, the generalised pointwise sum of $R^n$ is the tuple whose first element is the sum of all the first elements of all the tuples in $R^n$, whose second element is the sum of all the second elements of all the tuples in $R^n$, …, and whose $n^{\text{th}}$ element is the sum of all the $n^{\text{th}}$ elements of all the tuples in $R^n$.

We then define the *algebraic closure to a relation R of arbitrary arity* as the relation containing the generalised pointwise sum of every subset of $R$, where $\overrightarrow{x}$ ranges over sequences (Vaillette, 2001):

(34) **Algebraic closure for relations**
The algebraic closure $^*R$ of a non-functional relation $R$ is defined as:

$$^*R = \{\overrightarrow{x} : \exists R' \subseteq R[\overrightarrow{x} = \bigoplus R']\}$$

***Example.*** If $R = \{\langle 1, 2\rangle, \langle 3, 4\rangle, \langle 5, 6\rangle\}$, then its algebraic closure $^*R$ will be:

$$^*R = \left\{\begin{array}{c} \langle 1, 2\rangle, \langle 3, 4\rangle, \langle 5, 6\rangle, \\ \langle 1 \oplus 3, 2 \oplus 4\rangle, \langle 3 \oplus 5, 4 \oplus 6\rangle, \langle 1 \oplus 5, 2 \oplus 6\rangle, \\ \langle 1 \oplus 3 \oplus 5, 2 \oplus 4 \oplus 6\rangle \end{array}\right\}$$

This allows us to explain how certain transitive verb denotations can be distributive in both of their argument positions. For example, *lift, the algebraic closure of ⟦lift⟧, is distributive in both of its argument positions, and so the following entailments hold:

(35) a. $\forall x \forall y[^*\text{lift}(x)(y) \rightarrow \forall x'[x' \preceq_{atom} x \rightarrow \exists y'[y' \preceq y \wedge \text{lift}(x')(y')]]]$
b. $\forall x \forall y[^*\text{lift}(x)(y) \rightarrow \forall y'[y' \preceq_{atom} y \rightarrow \exists x'[x' \preceq x \wedge \text{lift}(x')(y')]]]$

We are finally in a position to see how cumulative readings, such as that for (22a), can be derived. Taking *John and Mary* to denote $j \oplus m$ and *the bicycle and the football* to denote $\iota z[\text{bicycle}(z)] \oplus \iota z[\text{football}(z)]$, the meaning of (22a) is as follows:

(36) ⟦(22a)⟧ = 1 iff

$\forall x[x \preceq_{atom} j \oplus m \rightarrow \exists y[y \preceq_{atom} \iota z[\text{bicycle}(z)] \oplus \iota z[\text{football}(z)] \wedge \text{lift}(x)(y)]]$
and

$\forall x[x \preceq_{atom} \iota z[\text{bicycle}(z)] \oplus \iota z[\text{football}(z)] \rightarrow \exists y[y \preceq_{atom} j \oplus m \wedge \text{lift}(y)(x)]]$

which is exactly the kind of situation depicted in Fig. 1.[37]

This suffices to give a sense of the original motivation for admitting pluralities as mereological sums into our ontology. In a moment, I will return to the question of

[37] Proponents of the *and*-as-*or* hypothesis can adopt much of this framework by adopting the following alternative lexical entry for the distributivity operator:

(i) $[\![\text{D}]\!] = \lambda P.\lambda x.\exists y[y \preceq_{atom} x \wedge P(y)]$

This would allow us to retain the assumption that *lift is distributive in both argument positions, while not validating the kinds of cumulative inferences in (18) and (35). Instead, the following entailments would hold:

(ii) a. $\forall x \forall y[^*\text{lift}(x)(y) \rightarrow \exists x'[x' \preceq_{atom} x \wedge \exists y'[y' \preceq y \wedge \text{lift}(x')(y')]]]$
b. $\forall x \forall y[^*\text{lift}(x)(y) \rightarrow \exists y'[y' \preceq_{atom} y \wedge \exists x'[x' \preceq x \wedge \text{lift}(x')(y')]]]$

An alternative suggestion for working out the *and*-as-*or* hypothesis in detail would be to provide a recursive definition of a generalised disjunction (analogous to that in (52)), together with an alternative distributivity operator and an explanation of how and when explicit *and* means generalised disjunction. Theorists who find the *and*-as-*or* hypothesis favourable may freely adopt either of these suggestions for the remainder of the paper, amending the proposal as we go.

how to spell out these ideas compositionally. But what is important for now is for us to appreciate that this general kind of algebraic structure pervades the ontology of natural language.

### 4.2 A modal account of generics

Let us now turn to the generic component of the structured view. My theory of generics builds on the central ideas of the modal version of the orthodoxy. But it is couched in a situation-theoretic framework and augments the modal truth-conditions with a pragmatic story about how the restrictor of the generic operator is contextually determined by a discourse topic or question-under-discussion. This subsection outlines these aspects of the theory in turn.

This paper uses a version of situation semantics based mostly on Kratzer's (1989) system in which situations are taken to be parts of possible worlds.[38,39] More precisely, we can think of situations in terms of one or more individuals having one or more properties or standing in one or more relations at some spatiotemporal location (Barwise and Perry, 1983: 7). In keeping with the algebraic framework of the previous section, the set of situations is mereologically structured by the parthood relation $\preceq$, which forms a partial ordering on the set of situations. It is useful to think of situations and worlds in the spirit of Lewisian modal realism, that is, as concrete entities stretched out over space-time (Lewis, 1986). According to this conception, a world is thought of as a maximal *connected* object, where an object is connected only if any two of its parts bear some spatio-temporal relation to one another. This stipulation allows us to retain a classical extensional mereology, while also having a well-defined conception of worlds.[40]

We will also make use of the notion of a *minimal situation*. Intuitively speaking, the minimal situations which support a proposition $p$ are those situations that contain the smallest number of individuals, properties, or relations to support that proposition. For example, the minimal situations that support the proposition that John and Paul sing are those situations that contain just John and Paul plus the property of singing, which they each instantiate; no other individuals, relations, or properties are present. Formally, we define the notion of a set of minimal situations as follows:

(37) For any set of situations $S$, the set of minimal situations in $S$, $\min(S)$, is defined as follows:

$$\min(S) = \{s \in S : \forall s' \in S, s' \preceq s \rightarrow s' = s\}$$

[38] See also Barwise and Perry (1983), Heim (1990), Elbourne (2005, 2013).

[39] Situation semantics has arguably led to substantial progress in numerous domains, such as the treatment of naked infinitives (Barwise and Perry, 1983), pronouns and anaphora (Heim, 1990; Elbourne, 2005), and conditionals (Kratzer, 1989), among other topics. Nevertheless, a comprehensive survey of situation semantics is outside the scope of this paper.

[40] See Sect. 4.3.1, for details.

The semantic value of a declarative sentence is thought of as (the characteristic function of) a set of situations, and declarative sentences are evaluated for truth relative to a situation in the usual way.

Let us now turn to the central assumptions that I will make about the generic operator *Gen*.[41] Following Krifka et al. (1995), we treat the generic operator *Gen* as an adverb of quantification, which essentially denotes a generalised quantifier over situations. More specifically, we make the following assumptions about its analysis:[42]

(i) The generic operator *Gen* adjoins to its restrictive part RES, which denotes (the characteristic function of) a set of propositions, to form a restricted quantifier [Gen RES]. The restrictor RES typically takes the form of a *when*/*if*-clause or covert contextual variable and, intuitively speaking, denotes a question, which can be thought of a function of type $\langle\langle s, t\rangle, t\rangle$, that is, as (the characteristic function of) the set of propositions which count as answers to that question. Then, the intuitive interpretation of [Gen RES], relative to a situation $s$, is "for every contextually salient situation $s'$ relative to $s$ such that $s'$ has a property that answers the question expressed by RES, there exists a situation $s''$ such that $s'$ is a part of $s''$ and …$s''$ …".

(ii) The restrictive quantifier [Gen RES] then adjoins to its matrix SCOPE to form a predicate of situations. The intuitive interpretation of [[Gen RES] SCOPE], relative to a situation $s$ is "to be a minimal situation $s_0$ such that for every contextually salient situation $s'$ relative to $s$ such that $s'$ has a property that answers the question expressed by RES, there exists a situation $s''$ such that $s'$ is a part of $s''$ and $s''$ has the property expressed by SCOPE".

(iii) When the restrictive part RES is phonologically absent, the covert restriction is represented by a contextual variable $C$, the value of which is a function from situations to sets of propositions, that is, $\langle s, \langle\langle s, t\rangle, t\rangle\rangle$. Many factors contribute to fixing the value of this context variable, including the question-under-discussion, focus structure and prosody, topic–comment structure, the contextually salient alternatives to the semantic contribution of the predicate, and other contextual features.[43]

Thus, the general logical form of generic sentences is as follows:

(38) [[Gen RES] SCOPE]

where RES denotes a function of type $\langle\langle s, t\rangle, t\rangle$, SCOPE denotes a function of type $\langle s, t\rangle$, and *Gen* denotes a function of type $\langle\langle\langle s, t\rangle, t\rangle, \langle\langle s, t\rangle, t\rangle\rangle$.

Before providing the lexical entry for *Gen*, I should elaborate on two key features of its semantics, namely, its modal component and how the value of the contextual

41 This part of the theory draws on normality-based accounts of genericity, such as, a.o., those in Krifka et al. (1995), Asher and Morreau (1995), Eckardt (2000), but some details, including the precise formulation of the lexical entry of the generic operator, are novel.

42 Here we follow Berman's (1987) treatment of adverbs of quantification. See, also, von Fintel (2004), Heim (1990), Elbourne (2005, 2013). This treatment contrasts with the more familiar treatment of adverbs of quantification as 'unselective binders' in the sense of Lewis (1975) introduced in Sect. 2.

43 For a survey of how these features affect the value of the contextual variable, see, a.o., Chierchia (1995), Cohen (1997), von Fintel (2004), Krifka (1995), Rooth (1985, 1995).

variable is determined. The account of genericity that I adopt treats *Gen* as denoting a generalised quantifier over a contextually restricted set of situations. In particular, the contextually salient situations over which *Gen* quantifies should be thought of as being within the *dispositional orbit* of the evaluation situation $s$. That is, they should be thought of as those situations whose worlds are like the world of the evaluation situation $s$, $w_s$, with respect to causal, statistical, or dispositional dependencies and regularities, but which may differ from $w_s$ with respect to specific isolated facts (Eckardt, 2000). (There are other ways to think about $B$ depending on the specific modal commitments of one's theory.)

To encode this notion formally, we make use of an operator $B$, a function from situations to sets of situations characterised by an accessibility relation $\approx$ holding between worlds just in case they are alike with respect to causal and statistical dependencies and regularities:

(39) $B(s) = \{s' \in S : w_{s'} \approx_s w_s\}$

In English: the dispositional orbit of $s$, $B(s)$, is that set of situations whose worlds are like $w_s$ with respect to causal, statistical, and dispositional dependencies and regularities. The evaluation of a generic sentence will consequently depend on what goes on in such situations.

The second component of the semantics that I wish to elaborate on is how the value of contextual variable $C$ is determined. For concreteness, I propose to take the value of contextual variable $C$ to be a function from situations to the semantic value of a contextually salient question-under-discussion. More specifically, I assume that the question-under-discussion will ask what property amongst a range of contextually determined alternatives is had by the normal instances of the kind in question. For example, in typically contexts in which the sentences 'Ravens are black' and 'Elephants live in Africa and Asia' are asserted, it is the colour and location of ravens and elephants which is under discussion, and so the questions-under-discussion are 'What colour are the normal ravens?' and 'Where do the normal elephants live?', respectively. The semantic values of these questions will further constrain the situations over which the generic quantifier ranges.

This idea is formally implemented as follows. Following Hamblin (1973), the semantic value of a question is taken to be a set of propositions, namely, the set of possible true or false answers to it. Furthermore, following Eckardt (2000), the notion of 'normal $\phi$' is characterised using a family of functors which map all $n$-ary properties $P^n$ to their normal parts $N(P^n)$:

(40) $N^n : S \times D^n \mapsto S \times D^n$

For all situations $s$, $N^n(P^n)(s)$ is the set of all those $n$-tuples $\langle a_1, \ldots, a_n \rangle$ that are the normal $P$'s in $w_s$. Since the normal $P$'s are required to be $P$'s, I assume that for all $s$, $N^n(P^n)(w_s) \subseteq P(w_s)$. Then, assuming that $\iota x.N(\text{ravens})(x)(s^*)$ refers to the normal ravens in $w_{s^*}$ (if there are any), the semantic value of the question 'What colour are normal ravens?' will be the following set of propositions:

(41) $\{\lambda s.R(\iota x.N(\text{ravens})(x)(s))(s) : \forall R : R \in \text{ALT}(\lambda x.\lambda s.\text{black}(x)(s))\}$

where $\text{ALT}(\lambda x.\lambda s.\text{black}(x)(s))$ is the set of alternatives to being black (e.g., being black, being red, being green, being blue, and so on; for technical reasons being black is a trivial alternative to being black). Consequently, something like (41) will serve as the value of the restrictor variable $C$ in the sentence 'Ravens are black'.

Since the generic operator will ultimately relate two sets of situations, and a set of propositions is the wrong semantic type to restrict a quantifier, we take the *union* of this set of propositions to constrain the generic operator. As a result, the lexical entry for *Gen* involves a mechanism to get the union of a set of propositions. With the present example, the union of the set in (41) corresponds to the set of minimal situations $s$ such that the normal ravens in $s$ are coloured in some way or other, that is, $\min(\lambda s.\text{coloured}(\iota x[N(\text{ravens})](x)(s))(s))$.

So, without further ado, I present the formal lexical entry for *Gen*:

(42) $[\![\text{Gen}]\!] = \lambda C_{\langle s,\langle\langle s,t\rangle,t\rangle\rangle}.\lambda p_{\langle s,t\rangle}.\lambda s.\forall s'[s' \preceq s \wedge s' \in B(s) \wedge s' \in \bigcup\min(C(s)) \rightarrow \exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge \min(p)(s'') = 1]]$

In English: for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and that $\bigcup\min(C)(s') = 1$, then is a situation $s''$ that is a minimal situation such that $s' \preceq s''$ and $s'' \preceq s$ and $p(s'') = 1$. That is, every minimal situation, which is part of a world alike to $w_s$ with respect to causal, statistical, and dispositional dependencies and regularities and which has a property that answers the question posed by $C$, is such that it can be minimally extended to have the property $p$.

It will be useful to follow an innovation from Elbourne (2013) and strip out the existential quantifier over situations in the consequent of the conditional of (42) from the lexical entry for *Gen* to give (43) and instead represent the existential quantification by introducing a new covert morpheme QA, the meaning of which is given in (44):

(43) $[\![\text{Gen}]\!] = \lambda C_{\langle s,\langle\langle s,t\rangle,t\rangle\rangle}.\lambda p_{\langle s,\langle s,t\rangle\rangle}.\lambda s.\forall s'[s' \preceq s \wedge s' \in B(s) \wedge s' \in \bigcup\min(C(s)) \rightarrow \min(p)(s)(s') = 1]$

(44) $[\![\text{QA}]\!] = \lambda p_{\langle s,t\rangle}.\lambda s.\lambda s'.\exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge p(s'') = 1]$

Splitting up quantification in this way has useful empirical consequences in the analysis of anaphora and, consequently, the interpretation of bare plurals later on. In particular, it allows certain situation pronouns in the matrix scope to, in effect, be bound by the restrictor.

On this approach, then, unembedded mono-clausal characterising sentences typically have the following syntactic structure, where $\delta$ stands for the sentence with the generic operator removed:

(45) [[Gen C][QA $\delta$]]

To see how these ideas work in practice, let us consider a simple case. Consider the sentence (46a), which I assume has the (much simplified) syntactic structure in (46b), and is interpreted as in (46c).[44]

(46) a. Ravens are black.

[44] For a precise articulation of the syntactic mechanisms behind this approach to adverbs of quantification, see Elbourne (2016).

b. $[[\varnothing_{\text{Gen}}\ \text{C}][\text{QA}\ [[\varnothing_{\text{the}}\ \text{ravens}][\text{are black}]]]]$
c. $\lambda s.\forall s'[s' \preceq s \wedge s' \in B(s) \wedge$
$s' \in \min(\lambda s^*.\text{coloured}(\iota x[N(\text{ravens})](x)(s^*))(s^*)) \rightarrow$
$\exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge s'' \in \min(\lambda s'.\text{black}(\iota x[\text{ravens}(x)(s')]))]]$

In English: (46a) is true in $s$ iff for every situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and the normal ravens at $s'$ are coloured at $s'$, then there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ and the ravens in $s'$ are black in $s''$. Equivalently, (46a) is true in $s$ iff, for all the situations which are part of worlds alike to $w_s$ with respect to causal, statistical, and dispositional dependencies and regularities, and which contain the normally coloured ravens in those worlds, those ravens are black. These truth-conditions are intuitively adequate.

The resulting semantics for the generic operator in (42) is called the **situation semantics** for generics. I will use the term **structured theory** to refer to the theory which results from combining this semantics with the specific approach to plurality from the previous section. All that remains to present is an explanation of how the truth-conditions for generic conjunctions are compositionally derived. These details are outlined in the following section.

## 4.3 The framework

### 4.3.1 Ontological ingredients

Let a *frame* $\mathcal{F} = \langle D, S, \preceq, W, \approx_s \rangle$ be a tuple consisting of:[45,46]

(i) a non-empty set, $D$, the *set of individuals*;
(ii) a non-empty set, $S$, the *set of situations*;
(iii) a partial order, $\preceq$, over $D \cup S$, the *parthood relation*, such that at least the following conditions are satisfied:

a. For no $s \in S$ is there an $x \in D$ such that $s \preceq x$;
b. For all $s \in S \cup A$, there is a unique $s' \in S$ such that $s \preceq s'$ and for all $s'' \in S$: if $s' \preceq s''$, then $s'' = s'$;

(iv) $W$ is a subset of $S$, *the set of possible worlds*, namely, the set of the maximal connected sums of situations;
(v) $\approx$ is an ordering over $W$ (an accessibility relation).[47]

Let $\wp(S)$ be the powerset of $S$, *the set of propositions*; a proposition $p$ is true at a situation $s$ iff $s \in p$.

[45] **Notation.** I shall follow the following notational conventions: $t$ for truth-values, $e$ for individuals and substances, and $s$ for situations. Functional types will be denoted as usual: if $\sigma, \tau$ are types, then $\langle \sigma, \tau \rangle$ is a type. $f$ for predicates of various functional types. $\theta$ and $\Theta$ for functions of type $\langle s, e \rangle$.

[46] The following theory draws heavily from Link's (1983, 1998) treatment of plurality and Champollion's presentation in his 2017; it diverges substantial from it by embedding the general algebraic approach in an intensional system; see also Scha (1981), Landman (1989a, b), Krifka (1998).

[47] For simplicity, we assume that the relevant accessibility relation is reflexive, symmetric, transitive, and so is a normal S5 modal logic.

Two remarks. First, the set of atomic (or singular) individuals and the set of atomic (or singular) situations are proper subsets of the set of individuals and the set of situations, respectively. $D$, $S$, and $D \cup S$ each form an algebra with the structure of a join sub-semi-lattice.[48] No situation is part of a singular individual, but singular individuals may be part of complex situations. Furthermore, every singular individual and situation is world-bound. Since every singular individual is related to a unique world, our representation in other worlds must be mediated by our counterparts (Lewis, 1968, 1986). I find these assumptions easier to incorporate into a compositional semantics, although they are not necessary for the present project.

Second, given that we are working with a classical extensional mereology, we cannot follow Kratzer (1989) in defining worlds as the set of maximal elements with respect to $\preceq$, since this would entail that there exists only one world, namely, $\bigoplus S$.[49] Rather than taking worlds as primitive, we prefer to define the set of worlds as those maximal connected sums of situations, where a situation is connected just in case for any of its parts they are spatiotemporally related.[50]

#### 4.3.2 What words mean

In this section, I outline how I will treat various types of linguistic constituents. In what follows, I will switch freely between set notation and predicate notation. That is I treat $x \in P$ as interchangable with $P(x)$. I also follow the well-established notation from Heim and Kratzer (1998) according to which a λ-expression of the form $[\lambda v : \phi \,.\, \alpha]$ denotes a function from $v$-type denotations to $\alpha$-type denotations. Those authors capture presuppositions through the use of partial functions; a colon indicates that we are dealing with a partial function, where the material $\phi$ after the colon but before the period marks the domain condition of the function, the conditions that must obtain for the function to apply.

**Nouns.** I analyse singular count nouns, such as *cat* and *table*, as sets of singular individual–situation pairs (or, in functional talk, functions from singular individuals to functions from situations to truth-values). I also assume that plural count nouns, such as *cats* and *tables*, denote the algebraic closure of their singular counterparts.

(47) $[\![\mathrm{N}_{pl}]\!] = {}^*[\![\mathrm{N}_{sing}]\!]$

Since individuals are world-bound, the arguments of nouns will carry an implicit counterpart function $\mathcal{C}_s$ mapping any suitable individual $x$ to its counterpart in the

[48] It is natural to think of the sum operation '$\oplus$' as the join operation of a join sub-semi-lattice; then '$\oplus$' is idempotent ($a \oplus a = a$), commutative ($a \oplus b = b \oplus a$), and associative ($a \oplus (b \oplus c) = (a \oplus b) \oplus c$).

[49] *Proof.* For all $s \in S$, let $w_s$ be the maximal element $s$ is related to by $\preceq$. Then, for any situations $s, s' \in S$, $w_s = w'_s$, since $s, s' \in S$, and so $s, s' \preceq \bigoplus S$, which is by definition the top of the join sub-semi-lattice. As far as I know, Dekker (2004) is the first to explicitly state this.

[50] Let us say that a situation $s^*$ is *connected* just in case, for any of its parts $s, s', s$, is spatiotemporally related to $s'$, ($s \sim s'$, for any spatiotemporal relation $R$). It is immediate that $\sim$ is a partial equivalence relation over $S$; that is, it is symmetric and transitive relation on $S$. Moreover, $\sim$ is an equivalence relation on the proper subset $S' \subset S$ such that $S' = \{s \in S : s \sim s\}$. Since $\sim$ is an equivalence relation on $S'$, we can define the equivalence class of an element $s \in S'$, $[s]$, as follows: $[s] = \{s' \in S' : s' \sim s\}$. Intuitively, the set of equivalence classes of $\sim$ form a partition over $S'$ into spatiotemporally isolated systems. Then let $W = \{\bigoplus[s] : \forall s \in S'\}$.

world of $s$, $w_s$.[51] I leave open what kind of counterpart relation is relevant, although note that if $x \prec w_s$ then $\mathcal{C}_s(x) = x$. Note that these counterparts do not figure directly in our compositional semantics and so I often omit them for readability.

**Definite Descriptions, Bare Plurals.** I analyse definite descriptions as referential expressions that refer to the maximal sum which satisfies their nominal descriptive content relative to a situation.[52]

(48) $[\![\text{the}]\!] = \lambda P_{\langle e,st\rangle}\lambda s : s \in S \wedge \exists x(P(x)(s) \wedge \forall y(P(y)(s) \rightarrow y \preceq x)).$
$\bigoplus\{x : P(x)(s)\}.$

For example, an utterance of a definite description *the cats* in a situation $s$ denotes the sum of all of the cats in $s$, if there are any. Following Elbourne (2013), I assume that the definite article takes two arguments, a noun phrase and a situation pronoun. Thus it has the following configuration:

(49) [[the NP] $s$]

Two cases are possible. First, the definite description could appear with referential situation pronouns denoting a particular restrictor situation. I assume that referential situation pronouns are present in the syntax but phonologically unarticulated. Second, the situation pronoun in the definite description is bound. Again, following Elbourne (2013), I will assume that this binding occurs with syntactically realised situation binders like $\Sigma_i$. Such assumptions are need to deal with syntactically complex sentences involving anaphora in the present framework.

Following Chierchia (1995), I assume that bare plurals in languages like English occur with a phonologically null but syntactically articulated determiner. However, unlike Chierchia, I assume that the semantics of this determiner functions essentially like the definite determiner does in English, although this does not mean that bare plurals inherit the distribution properties of definite determiners. There is no reason to suppose that phonologically unarticulated constituents have all the properties of their articulated semantic counterparts.

**Verbs.** I analyse verbs as (the characteristic functions of) sets of situations, and assume that the denotations of all verbs are closed under sum formation. This is an intensional version of a broadly neo-Davidsonian position that assumes that the verb denotations do not encode the argument positions, as in more traditional treatments of verb denotations.[53] This treatment has the theoretical advantage of exposing thematic roles to

[51] For a similar proposal, see Heim (2001), as reported by Sauerland (2014).

[52] This is essentially the Fregean account of definite descriptions, generalised to the case of plurals; see Elbourne (2013) for the singular case.

[53] It may seem awkward to treat verb denotations as functions from situations to truth-values, since it types verb denotations and declarative sentences in the same way. The intensional Neo-Davidsonian view results from substituting situations for events in the Neo-Davidsonian characterisation of the verb denotations as functions from *events* to truth-values. The motivation for this anti-relational treatment of verb denotations comes from its greater expressive power. Typing verbs as functions from events to truth-values is unproblematic because the resulting theory is extensional and so sentence meanings are taken to be truth-values, not propositions. However, in situation semantics, this results in verb denotations being assigned the same semantic value as sentences, which are taken to denote propositions (functions from situations to truth-values). Perhaps this awkwardness can be resolved by integrating events into situation semantics, but for the purpose of this paper, I consider this typing as no more embarrassing than other more standard forms of coincidentally identical typing.

the compositional semantics, rather than keeping them implicit in the lexical entry of the verb. I assume lexical cumulativity, that whenever two situations are in the denotation of a verb, then their sum is as well.[54] For present purposes, lexical cumulativity corresponds to the assumption that thematic roles are closed under fusion and that the denotations of verbs are closed under pointwise sum formation.

**Thematic Roles.** I analyse verb arguments using the notion of *thematic roles*, function from situations to individuals. Thematic roles represent the different ways that agents can participate in situations. I shall adopt a traditional and widespread view that thematic roles capture generalisations over shared entailments of argument positions of different predications, such as *agent*, which characterises the initiator of the situation's event, and *theme*, which characterises what undergoes the situation's event. Furthermore, for the purposes of compositionality, I shall assume that thematic roles have syntactic counterparts which relate verbs to their arguments.[55] The term *thematic role* shall be reserved for the semantic relation, while the term *theta role* shall be reserved for their syntactic counterparts. I assume thematic uniqueness, that each situation has at most one agent, one theme, and so on. Formally, thematic roles are functions of type $\langle v, e\rangle$.

Following Landman (2000), I assume that thematic roles are their own algebraic closures, a property which is known as *cumulativity* or *summativity of thematic roles*:

(50) **Cumulativity assumption for thematic roles**
For any thematic role $\theta$ and any subset $S$ in its domain:

$$\theta(\bigoplus S) = \bigoplus(\lambda x.\exists s \in S.\theta(s) = x)$$

Consequently, thematic roles are sum homomorphisms: $\theta(s_1 \oplus s_2) = \theta(s_1) \oplus \theta(s_2)$, for any thematic role $\theta$. In our models, the sum of any two singular situations is itself a situation. For example, if $s_1$ is a minimal situation consisting of John lifting the bicycle and $s_2$ is a minimal situation of Mary lifting the football, then $s_1 \oplus s_2$ is itself a situation, namely the minimal situation of John and Mary lifting the bicycle and the football. Given that thematic roles are sum homomorphisms, the agent of the sum situation is the sum of the agents of its parts, namely, $j \oplus m$ and the theme of the sum situation is the sum of the themes of its parts, namely, $\iota z[\text{bicycle}(z)] \oplus \iota z[\text{bicycle}(z)]$.

**Conjunction.** English, and many other languages, allow conjunction to coordinate a wide variety of syntactic categories, such as sentences, predicative adjectives quantificational nouns, verbs, and so on. To accommodate this phenomenon, it is natural to suggest that conjunction is defined as an operation that takes as argument a wide variety of logical types (Partee and Rooth, 1983). And given that we want to give an explanation of conjunctions of proper names in terms of plural individuals, we shall give an account in terms of non-boolean conjunction. Following Krifka (1990), we shall start with the recursive definition of a general inclusion relation '$\sqsubseteq$':

[54] See Scha (1981), Schein (1986, 1993), Lasersohn (1989), Landman (2000).

[55] One may think of the "little $v$" head as relating verbs to their external arguments, or agents; see Chomsky (1995).

(51) **Recursive definition of a generalised inclusion relation '$\sqsubseteq$'**

(i) if $\alpha, \alpha'$ are expressions of type $e$, then $\alpha \sqsubseteq \alpha'$ iff $\alpha = \alpha'$;
(ii) if $\alpha, \alpha'$ are expressions of type $t$, then $\alpha \sqsubseteq \alpha'$ iff $\alpha \rightarrow \alpha'$ (that is, the value of $\alpha$ is less than or equal to the value of $\alpha'$);
(iii) if $\alpha, \alpha'$ are expressions of type $\langle \sigma, \tau \rangle$, then $\alpha \sqsubseteq \alpha'$ iff for all $\beta \in D_\sigma$, $\alpha(\beta) \sqsubseteq \alpha'(\beta)$.

For example, when $\alpha, \alpha \in D_{\langle e,t \rangle}$, $\alpha \sqsubseteq \alpha'$ effectively amounts to set inclusion, $\alpha \subseteq \alpha'$. Then, we give the following definition for a generalised conjunction operator '$\sqcup$':

(52) **Recursive (partial) definition of a generalised conjunction '$\sqcup$'**

(i) if $\alpha, \alpha'$ are expressions of type $e$, then $\alpha \sqcup \alpha' = \alpha \oplus \alpha'$,
(ii) if $\alpha, \alpha'$ are expressions of type $t$, then $\alpha \sqcup \alpha' = \alpha \wedge \alpha'$,
(iii) if $\alpha, \alpha'$ are expressions of type $\langle \sigma, \tau \rangle$ and $\beta, \beta' \in D_\sigma$, then $\alpha(\beta) \sqcup \alpha'(\beta') \sqsubseteq \alpha \sqcup \alpha'(\beta \sqcup \beta')$.

This generalised conjunction will be used as the semantic value of *and*.
This concludes my presentation of the structured theory of generics. Aside from the statements of truth-conditions of sentences, the rest of the paper will be fairly informal. In Appendix A, I compile a sample of lexical entries and composition rules relevant to evaluating the claims I make.

## 5 Explaining generic conjunctions

With this exposition in hand, we can explore how the structured theory of generics makes sense of the variety of data concerning generic conjunctions. I begin by showing precisely how the structured theory explains generics involving object-DP coordination. The explanation proceeds in a principled and predicative way from our generalisation of algebraic semantics and their influence on the matrix clause. I then explain how other kinds of generic conjunctions are accommodated, although this discussion will be more informal, and I won't provide full details of the compositional process.

### 5.1 *Elephants live in Africa and Asia*

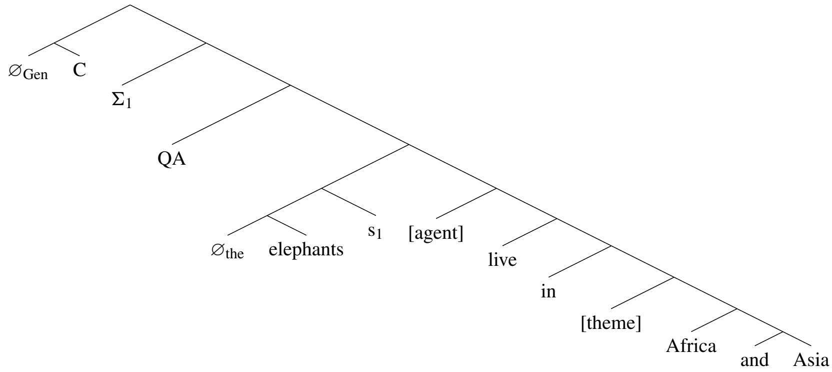
Recall the following generic conjunction:

(2) a. Elephants live in Africa and Asia.

Our aim is to show why the relevant reading of this sentence is true only if every normal elephant lives in at least one of Africa and Asia, and each of Africa and Asia has at least one normal elephant living there. To see this, let us suppose that the syntactic structure of (2a) is something like the (simplified) structure in (53):[56]

[56] Note that nothing essential hinges on this being exactly the right syntactic analysis of (2a), since we can adapt the relevant aspects of the semantics to fit the analysis delivered to us by our syntax.

(53)




Aside from being a characterising sentence, this is also a canonical example of a cumulative reading involving two plural NPs and a relation $R$ introduced by the verb. A cumulative reading of a distributive predicate $R$ licences the inference that $R$ relates every atomic part of the first plural NP to at least one atomic part of the second plural NP, and vice versa. If cumulative readings are modelled as scopeless relations—relations in which neither denotation takes scope over another—a rather lengthy calculation reveals that the LF in (53) has the truth-conditions in (54).[57] Assuming, as we have been doing, that the contextual variable will take the value of a suitable question-under-discussion, such as 'Where do normal elephants live?', that verbs and thematic roles are closed under sum formation, and that *live* is distributive down to atoms in both its agent and theme arguments, (54a) is equivalent to (54b).

(54) a. $\lambda s.\forall s'[s' \preceq s \wedge s' \in B(s) \wedge s' \in \bigcup\text{min}(\lambda s^*.\text{located}(\iota x[N(\text{elephants})](x)(s^*))(s^*))]$
$\exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge {}^*\text{live}(s'') \wedge {}^*\text{agent}(s'') = \bigoplus\{x : \text{elephant}(x)(s')\} \wedge {}^*\text{theme}(s'') = \text{Africa} \oplus \text{Asia}]$

b. $\Leftrightarrow \lambda s.1$ iff for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and $s' \in \bigcup\text{min}(\lambda s^*.\text{located}(\iota x[N(\text{elephants})](x)(s^*))(s^*))$,
there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ and the normal elephants $x$ of $w_{s'}$ are in $s'$ and they are such that, for some $y = \text{Africa} \oplus \text{Asia}$ in $s''$ such that,

for every $x' \preceq_{\text{atom}} x$, there is some $y' \in y$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is a normal elephant in $s'''$ and $y'$ is in $s'''$ and $x'$ lives in $y'$ in $s'''$,

and

for every $y' \preceq_{\text{atom}} y$, there is some $x' \preceq_{\text{atom}} x$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is an elephant in $s'''$ and $y'$ is in $s'''$ and $x'$ lives in $y'$ in $s'''$.

In English: (2a) is true at $s$ just in case for all the situations $s'$ which are part of the worlds alike to $w_s$ with respect to causal, statistical, and dispositional dependencies and regularities, and which contain the normally located elephants in those worlds, those

[57] See Appendix B, for the details of this computation.

elephants cumulatively live in Africa and Asia. That means every normal elephant lives in at least one of Africa and Asia and each of Africa and Asia have at least one normal elephant living in it. And this is exactly what we wanted: these truth-conditions are intuitively adequate.[58]

I want to reflect on two features of the structure theory of generics which strike me as particularly desirable. First, I want to emphasise that, unlike the *and*-as-*or* hypothesis considered in Sect. 3, the structured theory of generics does not predict that (2a) falsely entails that the sentence 'Elephants live in Africa, Asia, and Antartica'. This is because cumulative readings of distributive predicates license the inference that for every atomic part of the object DP of a relation $R$, there is some atomic part of the subject DP that is $R$-related to it. Consequently, on my proposed semantics, the sentence 'Elephants live in Africa, Asia, and Antartica' is true only if each of Africa, Asia, and Antartica has some normal elephant living in it. Formally:

(55) a. (=(18b)) Elephants live in Africa, Asia, and Antarctica.

b. $\lambda s.\forall s'[s' \preceq s \wedge s' \in B(s) \wedge s' \in \cup\text{min}(\lambda s^*.\text{located}(\iota x[N(\text{elephant})](x)(s^*))(s^*))]$
$\exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge {}^*\text{live}(s'') \wedge {}^*\text{agent}(s'') = \bigoplus\{x : \text{elephant}(x)(s')\} \wedge {}^*\text{theme}(s'') = \bigoplus(\{\text{Africa, Asia, Antarctica}\})]$

c. $\Leftrightarrow \lambda s.1$ iff for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and $s' \in \cup\text{min}(\lambda s^*.\text{located}(\iota x[N(\text{elephants})](x)(s^*))(s^*))$,
there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ and the normal elephants $x$ of $w_{s'}$ are in $s'$ and they are such that, for some $y = \bigoplus(\{\text{Africa, Asia, Antarctica}\})$ in $s''$ such that,
for every $x' \preceq_{\text{atom}} x$, there is some $y' \in y$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is an elephant in $s'''$ and $y'$ is in $s'''$ and $x'$ lives in $y'$ in $s'''$,
and
for every $y' \preceq_{\text{atom}} y$, there is some $x' \preceq_{\text{atom}} x$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is an elephant in $s'''$ and $y'$ is in $s'''$ and $x'$ lives in $y'$ in $s'''$.

In English: (2a) is true at $s$ just in case for all the situations $s'$ which are part of the worlds alike to $w_s$ with respect to causal, statistical, and dispositional dependencies and regularities, and which contain the normally located elephants in those worlds,

[58] Proponents of the *and*-as-*or* hypothesis can adopt much of the machinery used here together with the suggestions in ft. 37. One version of the resulting view predicts that (2a) is true iff:

(i) for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and $s' \in \cup\text{min}(\lambda s^*.\text{located}(\iota x[N(\text{elephants})](x)(s^*))(s^*))$,
there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ and the normal elephants $x$ of $w_{s'}$ are in $s'$ and they are such that, for some $y = \text{Africa} \oplus \text{Asia}$ in $s''$ such that,
for some $x' \preceq_{\text{atom}} x$, there is some $y' \in y$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is a normal elephant in $s'''$ and $y'$ is in $s'''$ and $x'$ lives in $y'$ in $s'''$,
and
for some $y' \preceq_{\text{atom}} y$, there is some $x' \preceq_{\text{atom}} x$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is an elephant in $s'''$ and $y'$ is in $s'''$ and $x'$ lives in $y'$ in $s'''$.

Since every such minimal situation has some normal elephant that lives in either Africa or Asia, the *and*-as-*or* hypothesis predicts that (2a) is true.

those elephants cumulatively live in Africa, Asia and Antarctica. Given these truth-conditions, it is immediately clear that sentence (55a) is false: there is some atomic individual in $\bigoplus(\{\text{Africa, Asia, Antarctica}\})$ such that there are no situations $s''' \preceq s''$ in which an elephant lives in it in $s'''$, namely, Antarctica. In other words, the structured theory of generics predicts that the sentence is false because Antartica does not have any normal elephants living there. Again, this is intuitively adequate: it is exactly for these reasons that we judge this sentence to be false.[59]

Second, I want to stress that the reasoning in both of these cases is perfectly general and the explanation of the cumulative nature of phrasal conjunction did not rely on any special mechanism concerning genericity. For it is exactly this structured theory of cumulative predication that can explain non-generic instances of the same phenomenon, as witnessed by (22), repeated below as (56):[60]

(56) (=(22)) John and Mary lifted the bicycle and the football.

a. $\lambda s.[^*\text{lift}(s) \wedge {}^*\text{agent}(s) = j \oplus m \wedge {}^*\text{theme}(s) = (\iota x.\text{bicycle}(x)(s) = 1 \oplus \iota x.\text{football}(x)(s) = 1)]$

b. $\Leftrightarrow$ Each of John and Mary lift at least one of the bicycle and the football, and each of the bicycle and the football are lifted by at least one of John and Mary.

Let us step back for a moment and appreciate how the mechanics of the structured theory of generics handles these cases. Recall the problem that generic conjunctions pose to majority-based accounts of generics. They seem to split the members into two groups in such a way that neither of which satisfy each aspect of a conjunctive property nor does a majority-based semantics predict that these groups may each satisfy just one conjunct of the complex property. But if we evaluate the conjunction as coordinating DPs and have an algebraic understanding of the structure of objects, events, and situations, then we can understand such generics as making a claim about complex situations, which have parts that together satisfy the relevant condition. Thus,

[59] According to the view explored in ft. 58, it is easy to see that the *and*-as-*or* hypothesis predicts that (18b) is also true. For on that view, (18b) is true iff:

(i) for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and
$s' \in \cup\text{min}(\lambda s^*.\text{located}(\iota x[N(\text{elephants})](x)(s^*))(s^*))$,
there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ and the normal elephants $x$ of $w_{s'}$ are in $s'$ and they are such that, for some $y = \bigoplus(\{\text{Africa, Asia, Antarctica}\})$ in $s''$ such that,

for some $x' \preceq_{\text{atom}} x$, there is some $y' \in y$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is an elephant in $s'''$ and $y'$ is in $s'''$ and $x'$ lives in $y'$ in $s'''$,

and

for some $y' \preceq_{\text{atom}} y$, there is some $x' \preceq_{\text{atom}} x$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is an elephant in $s'''$ and $y'$ is in $s'''$ and $x'$ lives in $y'$ in $s'''$.

Since every such minimal situation has some normal elephant that lives in Africa, Asia, or Antarctica, the *and*-as-*or* hypothesis predicts that (18b) is true. Thus, its proponents must adopt a pragmatic explanation of the infelicity of such sentences.

[60] In the interest of comparing the present proposal with the *and*-as-*or* hypothesis, it is worth observing that if the subject phrase *and* is interpreted as a disjunction, (56) is predicted to be true when just one of John and Mary lift the bicycle and the football. Any further direct comparison between these proposals will be left as an exercise for the reader.

we can accommodate these kinds of generic conjunctions (along with non-generic cumulative predications involving phrasal conjunction) without having to reject the standard approach to generics.

### 5.2 *Cardinals are red and lay eggs*

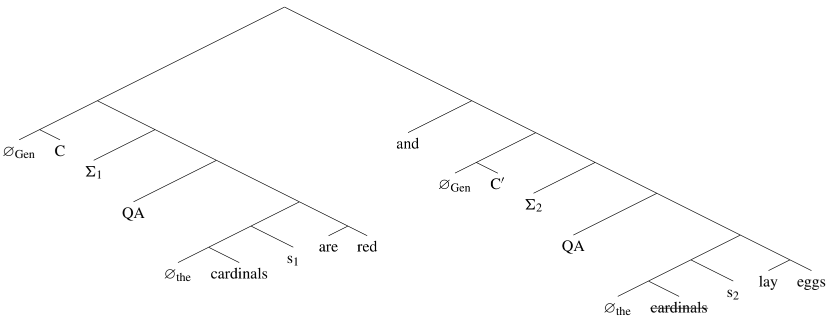
Recall that the problem with generic conjunctions involving VP coordination is that no majority of the kind satisfies either of the properties in question, nor are there any members of the kind that satisfy the conjunctive property. For example, in (2b), no cardinal is both red and lays eggs (since only the males are red and only the females lay eggs), and there is no majority of cardinals have any one of those properties.

(2) b. Cardinals are red and lay eggs.

In Sect. 3, I argued that (2b) can be accommodated through the sentential coordination strategy, although this strategy cannot account for the other sentences. Furthermore, I argued that (2b) should be treated differently to the other generic conjunctions on the grounds that it failed the constituency tests, while the other generic conjunctions didn't. Consequently, I will not be making use of the mereological component of the structured theory of generics here, but it is important to show how this sentence is accommodated regardless.

I assume that there are (at least) two possible syntactic structures for (2b), which I consider each in turn. The first possible syntactic structure is represented in (57):

(57)




This syntactic structure involves sentential coordination and the second occurrence of *cardinals* has been phonologically deleted using the kind of mechanism posited in Sect. 3. Furthermore, the generic operator *Gen* appears twice in the logical form, since on the grounds that *and* coordinates two characterising sentences, each with their own generic operator.

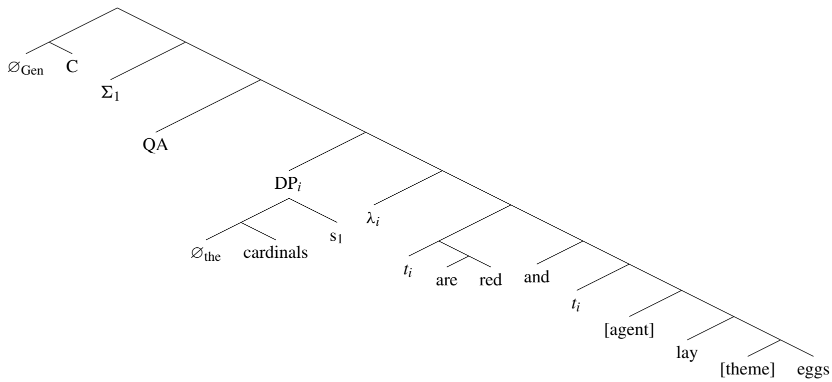
Following the strategy outlined in Sect. 3, I argue that this structure corresponds to the intuitively true reading of (2b). Recall that according to the structured theory of generics, the restrictor of a generic sentence is an anaphor whose reference is pragmatically determined by the context. In principle, there is no reason why the referent of the two anaphors $C$ and $C'$ must have the same value. Indeed, if the pragmatic mechanism for anaphor resolution is sensitive to the local predicates or focal stress of the sentence, the restrictor of the first conjunct may be determined by the alternatives to how colour may be reflected by pressure from sexual selection, whereas the restrictor of the second conjunct may be determined by alternatives to how cardinals produce offspring. If this is the case, then the sentential reading of (2b) is true in a situation $s$ iff:

(58) for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and
$s' \in \cup\text{min}(\lambda s^*.\text{coloured}(\iota x[N(\text{cardinal})](x)(s^*))(s^*))$,
there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ and the normal cardinals $x$ of $w_{s'}$ are in $s'$ and are such that:
for every $x' \preceq_{\text{atom}} x$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is red in $s'''$,
and for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and
$s' \in \cup\text{min}(\lambda s^*.\text{reproduction}(\iota x[N(\text{cardinal})](x)(s^*))(s^*))$,
there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ and the normal cardinals $x$ of $w_{s'}$ are in $s'$ and are such that:
for every $x' \preceq_{\text{atom}} x$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is lays eggs in $s'''$.

In English: this sentence is true just in case all normal cardinals whose colour reflects pressure from sexual selection are red and all normal cardinals which produce offspring in some way or other lay eggs. Thus, one can see how the truth of this reading is accommodated.

The second possible syntactic structure is represented in in (59):

(59)




The syntactic structure in this tree is taken to involve vP coordination.[61] According to this structure, the subject argument of both vPs are coindexed, and it can easily be verified that the λ-abstract in the VP position as the following denotation:

(60) $[\![ [\ \lambda_i\ [\ [\ t_i \text{ are red } ]\ [\text{ and } [\ t_i \text{ lay eggs } ]\ ]\ ]\ ]\ ]\!]$
$= \lambda x.\lambda s.[\text{red}(x)(s) \wedge {}^*\text{lay}(s) \wedge {}^*\text{agent}(s) \wedge {}^*\text{theme}(s) = x \wedge \exists y[{}^*\text{egg}(y)(s) \wedge {}^*\text{theme}(s) = y]]$

[61] For an account of how across-the-board extraction out of the conjunction results in long distance dependencies, see Kobele (2008).

That is, it denotes the property of being red and laying eggs. Consequently, our semantics predicts that on this reading (2b) is true at a situation $s$ iff:

(61) for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and $s' \in \cup\min(C(s))$,
there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ and the cardinals $x$ in $s'$ are such that:
for every $x' \preceq_{\text{atom}} x$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is red in $s'''$ and $x'$ lays eggs in $s'''$.

Since there are no cardinals that satisfy the predicate abstraction of (60), regardless of the question-under-discussion, this sentence is false.

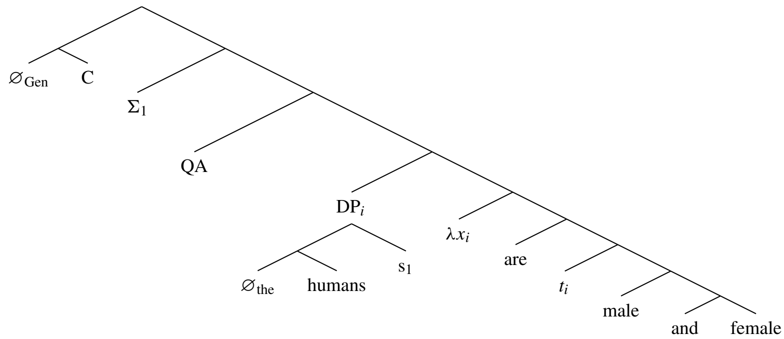
### 5.3 *Humans are male and female*

Let us now turn to generic conjunctions involve adjectival coordination, such as (2c):

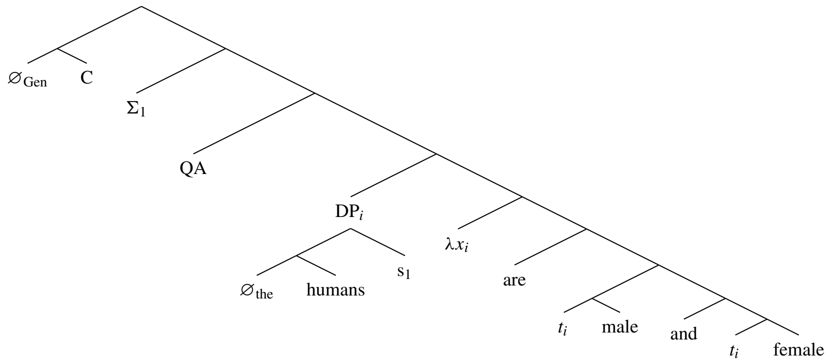
(2) c. Humans are male and female.

The structured theory accounts for these kinds of generic conjunctions by following a similar strategy as before. For sake of concreteness, I accept Stowell's (1978) analysis of copular sentences as small clauses and so assume that two possible syntactic structures for (2b) would be as follows:

(62) a.




b.



In (62a), a complex AP *male and female* is fed into the λ-abstract. Given our mereological semantics for *and*, the λ-abstract intuitively denotes the set of pluralities that have at least one male and female among them. Consequently, (62a) is true in a situation $s$ iff:

(63) for every minimal situation $s'$ such that $s' \preceq s$ and $s' \in B(s)$ and $s' \in \bigcup\min(C(s))$,
there is a minimal situation $s''$ such that $s' \preceq s''$ and $s'' \preceq s$ the humans $x$ in $s'$ are such that:
for every $x' \preceq_{atom} x$, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is a male in $s'''$ or $x'$ is a female in $s'''$,
and
there is at least one $x' \preceq_{atom} x$ such that, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is a male in $s'''$
and
there is at least one $x' \preceq_{atom} x$ such that, there is a minimal situation $s'''$ such that $s''' \preceq s''$ and $x'$ is a female in $s'''$.

Contrastingly, in (62b), we have a coordination of small clauses, out of which the subject is extracted across the board. This yields the predicate that denotes the set of pluralities that are both male and female. Since humans are not normally members of this set, it is no surprise that (2c) is false on this reading. Instead, I submit that (62a) is the reading of (2c) that is intended to be intuitively true, and that these truth-conditions are empirically adequate.

### 5.4 *The/*An elephant lives in Africa and Asia*

So far, I have argued that the structured theory of generics provides an elegant explanation for bare plural generic conjunctions, but I haven't said anything about how it handles generic conjunctions involving definite and indefinite singular subject terms. Recall that generic conjunctions with definite singular subjects, such as in (64), pattern with generic conjunctions with bare plural subjects, that is, they can be true even if nothing denoted by the subject terms have both of the predicated properties. Contrastingly, indefinite singular generic conjunctions, such as in (65), do not have this reading.

(64) The elephant lives in Africa and Asia
(65) *An elephant lives in Africa and Asia.

One might argue that these sentences present a problem for my proposal. For I crucially assume generic conjunctions require the subject term to involve a plurality over which the VP denotation can distribute. But definite singular generic conjunctions are syntactically singular and so there seems to be no plurality to do this work. Furthermore, even if an answer to the first problem was forthcoming, one might argue that nothing in my account explains the difference between definite and indefinite singular generic conjunctions.

It is outside the scope of this paper to exhaustively survey the variety of semantic analyses for definite singular DPs, but I would like to demonstrate how one plausible account of kind-denoting definite singular DPs, together with the structured view of genericity, can account for definite and indefinite singular generics. According to this proposal, kind-denoting readings of definite singular DPs denote kinds, which in turn are interpreted as the maximal sum of the members of that kind. For example, on its kind-denoting reading, the phrase *the elephant* denotes the maximal sum of the elephants. It is then plausible to suppose that the truth-conditions of characterising sentences with definite singular DPs are much the same as bare plural characterising sentences. In particular, properties can distribute over the plurality denoted by the subject DP in much the same way. For example, the sentence ‘The elephant has a trunk’ is true on its kind-denoting reading just in case all the normal members of the kind denoted by *the elephant* have a trunk.

This idea can be formally implemented in a compositional semantics by assuming that common nouns are ambiguous between denoting a property of an individual or a property of a kind (Dayal, 1999, 2004), and so definite singular DPs can either denote a singular individual or a singular kind. Suppose, for example, the common noun *elephant* is ambiguous between denoting the property of being an elephant and the property of being the kind Elephant. Then combined with given our lexical entry for the definite determiner *the*, and assuming a metaphysical conception of kinds according to which they are the fusion of all the individuals that fall under the relevant noun denotation, the denotation of *the elephant* on a kind-denoting reading is just the maximal sum of the elephants in each world, that is, the sum individual which has the property of being the kind Elephant.

An immediate consequence of this view is that kind-denoting noun phrases involve a kind of semantic plurality. Assuming that a kind has a *cumulative* property just in case all the normal members of that kind have a ‘part’ of the property in question and each ‘part’ of the property is had by at least some normal member, we can make immediate sense of definite singular generic conjunctions. According to this view, (64) would be true just in case every normal member of the kind Elephant lives in at least one of Africa and Asia and each of Africa and Asia has at least one normal member of the kind Elephant living in it. The underlying mechanism for deriving the cumulative reading is exactly the same as in bare plural generic conjunctions. The only difference is the treatment of subject term.

This explanation also has the advantage of explaining why (65) does not receive a cumulative reading: indefinite singular DPs do not involve plurality. Given the ambiguity hypothesis about common nouns, indefinite singular DPs have a kind-denoting reading, as well as an individual-level reading. On its kind-denoting reading, an indefinite singular DPs plausibly denote *subkinds*. For example, *an elephant* denotes a certain subkind of elephant as given by a taxonomy, such as the subkind African Elephant or the subkind Asian Elephant. Consequently, on the structured theory, (65) is true on its kind-denoting reading just in case there is a subkind, such as African Elephant, such that the normal members of the subkind cumulatively live in Africa and Asia. However, since no individual subkind of the kind Elephant cumulative lives in Africa and Asia—its only the subkinds African Elephant and Asian Elephant that *together* cumulatively live in Africa and Asia—the structured theory predicts that (65) is false on this reading. Furthermore, on its individual-level reading, the structure theory predicts that the sentence is true just in case each normal elephant lives in both Africa and Asia, which is false. Therefore, I submit that the structured theory of generics delivers the right predictions across the board, handling all kinds of generic conjunctions with the same broad mechanism that explains cumulative readings of non-generic conjunctions.

## 6 Beyond generic conjunctions

There is nothing, in principle, that restricts the predictions of the theory presented in this paper to generic conjunctions. Its scope concerns the variety of possible predications over pluralities, generic or not. Consequently, I wish to finish the presentation of the theory with some cursory remarks about how it might help with two outstanding issues.[62]

### 6.1 Collective predication

Krifka et al. make the following observation about collective predication: "if a predicate applies collectively to all existing objects belonging to a kind, the property can be projected from the objects to the kind" (Krifka et al., 1995: 78–80). For example, the following sentences seem to make true collective predications of linguists and Germans respectively:

(66) a. Linguists have more than 8,000 books in print.
b. The German customer bought 11,000 BMWs last year.

However, Krifka et al. also note that not every predicate which holds of a collection of objects belonging to a kind holds of the kind itself. Supposing that the average weight of a rabbit is 6 pounds, the sentence (67a) is true on its distributive reading, but, despite the fact that there are a lot of rabbits out there, the sentence (67b) does not have a true collective reading.

(67) a. Rabbits weigh 6 pounds.
b. Rabbits weigh over 5 tons.

More surprisingly, this pattern is not borne out in distributive and collective predications to non-generic subject terms. Suppose, for example, there are three basketball players, each weighing 220 pounds. Unlike (67), ascriptions of weight to the group of players permit both distributive and collective readings, as in (68) respectively.

(68) a. The players weigh 220 pounds.
b. The players weigh 660 pounds.

An explanation of these facts should be forthcoming.

While I do not have a developed theory that explains these facts, I suggest that it might have something to do with whether the sentence in questions requires us to look at all the actual individual instances of a kind or whether we are looking at possible

[62] Thanks to an anonymous reviewer for encouraging me to consider these issues.

individual instances of a kind across modal space. My suspicion is that tense, aspect, and other matters somehow conspire to anchor the dispositional orbits relevant to the analysis of the sentences in (66) to the actual world. For example, in (66b), the phrase *last year* acts as an explicit restriction to the actual world, and so we evaluate (66b) on the basis of whether the German consumers of the actual world bought 11,000 BMWs together in the previous year. Contrastingly, (67b) is given a *characteristic* collective reading, and so my theory would require us to look beyond our world to those alike with respect to causal, statistical, or dispositional dependencies and regularities, and see whether the collective weight of rabbits is characteristically over 5 tons. But it is not characteristic of rabbits that they collectively weigh over 5 tons. For looking across modal space, we are sure to find enough variation in the collective weight of the total amount of rabbits so that, in some world relevantly alike to ours, the collective weight of rabbits is under 5 tons. Thus, the present theory seems to bear out our predictions for this data set. Nevertheless, further exploration of the considerations which constrain collective predication, as well as the factors that constrain the contextually-determined dispositional orbit, is needed to fully extend the present theory to these cases.

### 6.2 Generic copredication

Before generic conjunctions entered the literature, the main concern that theorists raised about conjunctions in generics was the fact that generics could combine kind predications with characterisically-interpreted predicates, like in (69) (Carlson, 1977a; Schubert and Pelletier, 1987; Liebesman, 2011).

(69) a. Ducks lay eggs and are widespread throughout Europe.
     b. Diamonds are rare and valuable.

These sentences involve *copredication*—the phenomenon whereby a single determiner phrase appears with predicates with different selection preferences—and theorists have argued that they are problematic for the orthodoxy. For individual-level predicates like *lay eggs* are usually understood as denoting properties of individuals and kind-level predicates like *are widespread throughout Europe* are usually understood as denoting properties of kinds. Then, given that the orthodoxy typically postulates a uniform lexical entry for bare plurals as unambigiously contributing either a kind or a property, it is unclear what the bare plural NP *ducks* could denote so that it could successfully play both these roles.

While providing a full account of generic copredications is outside the scope of this paper, I want to suggest how these data points might be handled in the spirit of the present theory.[63] Let us begin by noting that generic copredication is not a unified phenomenon. For copredications like (69a) fail constituency tests, while those like (69b) do not. Witness the awkwardness of trying to topicalise or cleft the string *lay eggs and are widespread throughout Europe*, as contrasted with the comparative naturalness of *Rare and valuable, diamonds are*. Consequently, a natural explanation of (69a) is that it involves sentential coordination and NP-deletion, mirroring the sentential coordination strategy given for (2b), while (69b) requires a different explanation.

[63] For further discussion of generic copredications, see Cohen (2007), Nickel (2008, 2016), Asher and Pelletier (2013), Leslie (2015).

My favoured explanation of (69b) involves taking the generic operator *Gen* to originate in the verb stem.[64] This is supported by the observation that overt adverbs of quantification, such as *normally* and *usually*, can appear in a number of explicit positions, as observed in (70).

(70) (Normally/usually) diamonds (normally/usually) are (normally/usually) valuable.

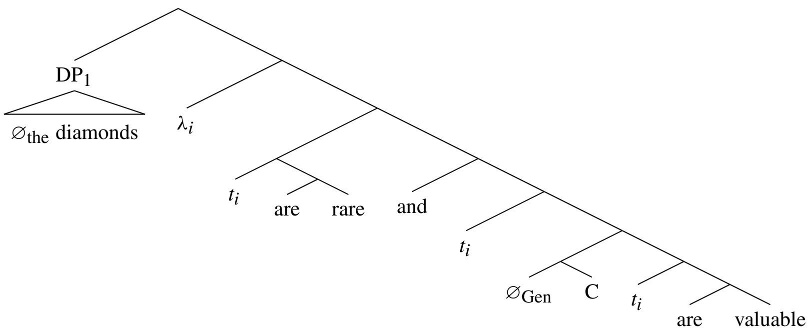
If *Gen* is an adverb of quantification, then it stands to reason that it too can appear any of these positions, which in turn raises the possibility that (69b) involves the coordination of two VPs, as in (62b).[65]

All that remains is to explain how the bare plurals *ducks* and *diamonds* can contribute both a kind and a sum-individual to the truth-conditions of these sentences. Exactly how this is achieved is a highly non-trivial task and far beyond the scope of this paper, but some recent advances that have been made in the literature on copredications may point the way forwards. One option is that bare plurals refer to complex objects that can be widespread as well as egg-layers (Liebesman and Magidor, 2019). Another option is that bare plurals refer to complex objects, a proper part of which is widespread and another proper part lays eggs (Gotham, 2015, 2017). A third option is that bare plurals refer to bare particulars that can be conceptualised in different ways, such that the appropriate predications hold (Asher, 2011; Asher and Pelletier, 2013). But this is not the place to adjudicate between these strategies; further exploration of the space of possible solutions is required here.

[64] This strategy is also pursued by opponents of the orthodoxy; see, for example, Nickel (2016, 122ff.).

[65] Elbourne (2016) suggests one way to fill in the technical details of this explanation. There he takes structures of the form [[Adv $\alpha$] $\beta$] to basically be VPs. The constituent $\beta$ (*diamonds are valuable*, in the case of (69b)) is a VP shell with a VP-internal subject. The constituent [Adv $\alpha$] ([$\varnothing_{\text{Gen}} C$]) is an adverbial phrase that adjoins the VP shell, above which is a T node. The VP-internal subject *diamonds* then raises to T, which allows for the coordination with *diamonds are rare*, as illustrated in the following simplified syntactic structure:

(i)



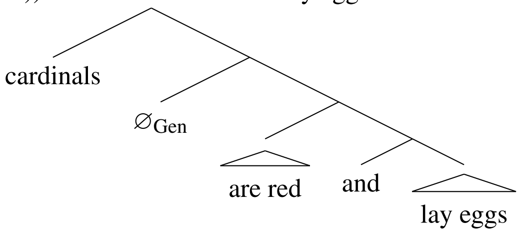
## 7 Alternative solutions

This concludes my exposition of the structured theory of generics. To close, I want to compare the structured theory with a prominent alternative approach to the data reviewed here, namely, Nickel's semantically revisionary theory of generics. I first introduce Nickel's theory, which I think is worth serious consideration, and argue that it does not adequately account for much of the data.

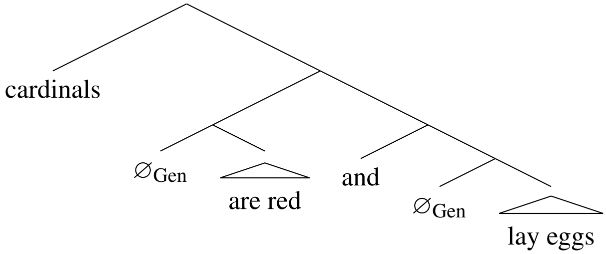
Let me begin by outlining the two key ideas to Nickel's theory.[66] The first idea is to reject the assumption that the generic operator is a determiner or a sentence-level adverb. More precisely, the generic operator adjoins to the left of a VP or V′, rather than to the left of an NP, IP, or I′ in a determiner position. Allowing the generic operator to left adjoin a VP or V′ means that each generic conjunction can be associated with two LFs, one involving a single generic operator taking scope over the topmost VP, and one involving two generic operators, each taking scope over only one conjunct respectively. For example, (71) will receive the following (simplified) LFs, the second of which is equivalent to the LF that 'Cardinals are red and cardinals lay eggs' will receive:

(71) (=(2b)) Cardinals are red and lay eggs.

(72) a.




b.




The second key idea of Nickel's theory is to replace the familiar majority-based semantics for characterising sentences with an existential analysis involving quantification over ways of being normal. For Nickel, characterising sentences of the form $\ulcorner$*Fs are G*$\urcorner$ are true at a context $c$ iff, roughly speaking, there is a way of being a normal $F$ that is salient in $c$, and all $Fs$ that are normal in that way are $G$. Formally, let us specify a fragment of English, together with Nickel's semantics for *Gen*, in (73) for the compositional analysis of (72b) as in (74):[67]

[66] The exposition of Nickel's view is somewhat complicated by the fact that he presents a different, though complementary, solution to the problem of generic conjunctions in his 2016 book from his original 2008 paper. My exposition combines both aspects in what I take to be the best representation of his view.

[67] See Nickel (2008, 2016: 255). Note Nickel remains neutral about whether kinds should be treated as abstract objects or further analysed as pluralities.

(73) a. $[\![\text{cardinals}]\!] = \text{cardinal}$
b. $[\![\text{red}]\!] = \lambda x_e.\text{red}(x)$
c. $[\![\text{lay}]\!] = \lambda x_e.\lambda y_e.\text{lay}(y)(x)$
d. $[\![\text{and}_{\langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle}]\!] = \lambda g_{\langle e,t\rangle}.\lambda f_{\langle e,t\rangle}.\lambda x_e.f(x) = g(x) = 1$
e. $[\![\text{Gen}]\!] = \lambda g_{\langle e,t\rangle}.\lambda y_k$.there is a way $w$ of being a normal $k$ that is salient in context $c$, and for every $x$, if $x$ is a member of $y_k$ and $x$ is normal in $w$, then $g(x) = 1$

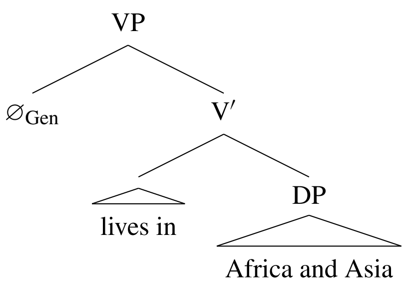
(74) $[\![(71)]\!]$ is true at a context $c$ iff there is a $c$-salient way $w_1$ of being a normal cardinal with respect to its colour, and all cardinals that are normal in $w_1$ are red, and there is a way $w_2$ of being a normal cardinal with respect to its mode of reproduction, and all cardinals that are normal in $w_2$ lay eggs.

These truth-conditions for (71) seem empirically adequate.

However, despite the innovations and elegance of Nickel's theory, it has a number of problems. The overarching worry I have about Nickel's theory is one about fit. Nickel's theory is tailor-made to handle generic conjunctions, and so it does not generalise to quasi-cumulative readings of phrasal coordination in non-generic environments. Once we take this larger data set into account, Nickel's theory appears quite *ad hoc*, which further motivates the general approach to phrasal conjunction I advocate for in this paper.

Furthermore, despite his claims, Nickel is unable to accommodate generic conjunctions that involve non-VP coordinations like (2a) and (2c). Nickel attempts to analyse generic conjunctions in terms of their sentential coordination counterparts. For example, he claims that 'Elephants live in Africa and Asia' is equivalent to 'Elephants live in Africa and elephants live in Asia'. But, as I argued in Sect. 3, there is no empirical basis for this analysis. And Nickel's theory is not well placed to analyse phrasal coordinations *in situ*. To see this, I will consider what Nickel's theory predicts about (2a) and (2c) in turn.

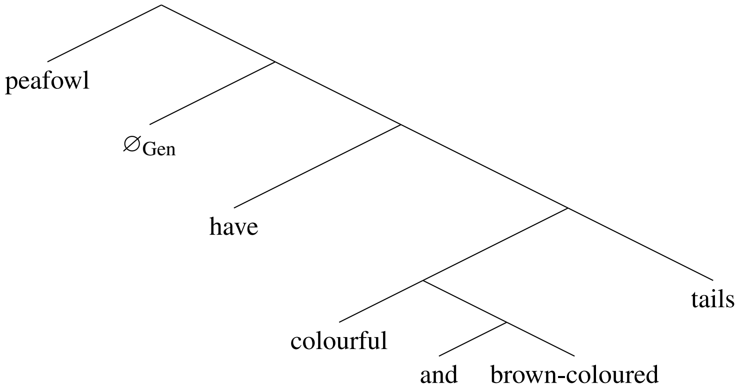
First, consider generic conjunctions involving DP coordinations in object position, such as *Elephants live in Africa and Asia*. Given that *Africa and Asia* is a constituent, the generic operator *Gen* must occupy a site on the verb stem that directly c-commands both *Africa* and *Asia*, as in the (simplified) syntax in (75):

(75)



Given (75), Nickel's theory predicts that (2a) (= 'Elephants live in Africa and Asia') is true iff there is a way of being a normal with respect to elephants' habitats and all elephants that are normal in that way live in Africa *and* Asia. Consequently, Nickel's semantics does not accommodate (2a).

Second, consider generic conjunctions involving adjectival coordination such as (76a). Given Nickel's VP-hypothesis, the only site for *Gen* would be as in (76b):

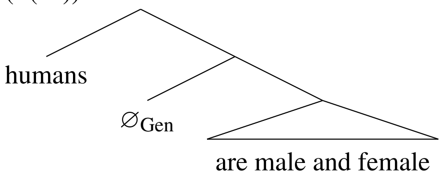
(76) a. Peafowl have colourful and brown-coloured tails.
b.




While (76a) is intuitively true, Nickel's theory predicts that it is false: its truth would require that a way of being a normal with respect to peafowl tails and every peafowl normal in that way has a colourful and brown tail. Consequently, Nickel's theory is unable to accommodate adjectival coordination.

Third, consider generic conjunctions involving NP coordination, such as (77a) (=(2c); 'Humans are male and female'). Again, the only available site for *Gen* as a distributivity operator in (77a) is as in (77b):

(77) a. (=(2c)) Humans are male and female.
b.




Given the LF in (77b), Nickel's theory predicts that (77a) is true iff there is a way of being a normal with respect to sex and all humans that are normal in that way are both male *and* female.[68] Again, this is inadequate.

More generally, the main problem arises from Nickel's assumption that generic conjunctions are uniformly covert sentential conjunctions, which I argued is syntactically unwarranted. But, without this assumption, it is hard to see how Nickel's theory delivers the right predictions about these sentences, since he can no longer assume that

[68] One might respond that 'Humans are male and female' is a surface structure abbreviation of 'Humans are male and are female', and the latter contains two possible sites for *Gen*. However, it is implausible that 'Humans are male and female' contains a covert *are* for a possible cite for *Gen*, since non-generic conjunctions of collective and distributive predicates do not have this possibility. Compare the following minimal pair:

(i) The children are surrounding the tree and skipping
(ii) ??The children are surrounding the tree and each skipping

If there were an implicit *are* in (i), then we would expect *each* in (ii) to be felicitous.

generic conjunctions can contain multiple generic operators. Short of an alternative explanation for generating his favoured LFs, this problem seems like a serious one.[69]

## 8 Conclusion

There is strong reason to believe that generic conjunctions can be accommodated from within the standard approach to generics. My chosen implementation draws on independently motivated algebraic and situation-theoretic resources to develop a modal version of the orthodoxy. As well as handling the data on generic conjunctions with grace, the structured theory of generics is a relatively conservative extension of the kind of semantics needed to handle non-generic plurals and anaphora more generally. That said, I believe that the general strategy can be transposed to other theories of generics and other treatments of plurals. Consequently, there is strong reason to reject any explanation of generic conjunction that relies on some *ad hoc* amendment to the semantics of the generic operator, since the phenomenon of cumulative conjunction is not specific to generics. And, unlike Nickel's semantics, the structured theory of generics delivers exactly this, since it forms part of a general account of cumulative conjunction across any domain. Proponents of revisionary accounts of generics are free to help themselves to the explanatory resources outlined in this paper. But I hope to have shown that generic conjunctions provide no pressing need to depart from an orthodox and semantically conservative approach to generic sentences.



## Appendix A: Semantics

Here I compile the lexical entries and compositional rules of the structured theory for ease of reference.

### A.1 Sample lexical entries

(78) a. $[\![\text{John}]\!] = j$

b. $[\![\text{elephant}]\!] = \lambda x_e.\lambda s.\text{elephant}(\mathcal{C}_s(x))(s)$

c. $[\![\text{elephants}]\!] = {}^*[\![\text{elephants}]\!] = \lambda x_e.\lambda s.{}^*\text{elephant}(\mathcal{C}_s(x))(s)$

d. $[\![\text{-s}]\!] = \lambda f_{\langle e,\langle s,t\rangle\rangle}.\lambda x_e.{}^*f(\mathcal{C}_s(x))(s)$

e. $[\![\text{an elephant}]\!] = [\![\text{elephant}]\!]$

f. $[\![\text{a(n)}]\!] = \lambda f_{\langle e,\langle s,t\rangle\rangle}.f$

[69] For further criticism of Nickel's theory, see Hoeltje (2017).

g. $[\![\text{the}]\!] = \lambda P_{\langle e,st\rangle}\lambda s : \exists x(P(x)(s) \wedge \forall y(P(y)(s) \rightarrow y \preceq x)).\bigoplus\{x : P(x)(s)\}$
h. $[\![[\text{the elephants}]\ s^*]\!] = \bigoplus\{x : {}^*[\![\text{elephant}]\!](x)(s^*)\}$, if defined
i. $[\![\text{in}]\!] = \lambda x_\tau.x_\tau$
j. $$[\![\text{and}_{\langle\tau,\langle\tau,\tau\rangle\rangle}]\!] = \begin{cases} \lambda x_e.\lambda y_e.x \oplus y & \text{if } \tau = e \\ \lambda q_t.\lambda p_t.\lambda s.p(s) = q(s) = 1 & \text{if } \tau = t \\ \lambda Q_{\langle\sigma,\tau\rangle}.\lambda P_{\langle\sigma,\tau\rangle}.\lambda s.\exists x_\sigma \exists y_\sigma [P(x)(s) \sqcup Q(y)(s) \sqsubseteq \\ P \sqcup Q(x \sqcup y)(s)] & \text{if } \tau = \langle\sigma,\tau\rangle \end{cases}$$
k. $[\![\text{live}]\!] = [\![\text{lives}]\!] = \lambda s.{}^*\text{lives}(s)$
l. $[\![[\text{agent}]]\!] = \lambda s.{}^*\text{agent}(s)$
m. $[\![[\text{theme}]]\!] = \lambda s.{}^*\text{theme}(s)$
n. $[\![\text{Gen}]\!] = \lambda C_{\langle s,\langle\langle s,t\rangle t\rangle\rangle}.\lambda p_{\langle s,\langle s,t\rangle\rangle}.\lambda s.\forall s'[s' \preceq s \wedge s' \in B(s) \wedge s' \in \cup\text{min}(C(s)) \rightarrow \text{min}(p)(s)(s') = 1]$
o. $[\![\text{QA}]\!] = \lambda p_{\langle s,t\rangle}.\lambda s.\lambda s'.\exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge p(s'')]$

## A.2 Rules (after Heim and Kratzer, 1998, 2004; Büring, 2005; Elbourne, 2013)

1. *Function Application*
   If $\alpha$ is a branching node and $\{\beta, \gamma\}$ the set of its daughters, then, for any assignment $g$, $\alpha$ is in the domain of $[\![.]\!]^g$ if both $\beta$ and $\gamma$ are, and $[\![\beta]\!]^g$ is a function whose domain contains $[\![\gamma]\!]^g$. In that case, $[\![\alpha]\!]^g = [\![\beta]\!]([\![\gamma]\!]^g)$.
2. *Predicate Modification*
   If $\alpha$ is a branching node and $\{\beta, \gamma\}$ the set of its daughters, then, for any assignment $g$, $\alpha$ is in the domain of $[\![.]\!]^g$ if both $\beta$ and $\gamma$ are, and $[\![\beta]\!]^g$ and $[\![\gamma]\!]^g$ are of type $\langle e, \langle s, t\rangle\rangle$. In that case, $[\![\alpha]\!]^g = \lambda x.\lambda s.[\![\beta]\!]^g(x)(s) = 1 \wedge [\![\gamma]\!]^g(x)(s) = 1$.
3. *Predicate Abstraction*
   For all indices $i$ and assignments $g$, $[\![\lambda_i\ \alpha]\!]^g = \lambda x.[\![\alpha]\!]^{g^{x/i}}$.
4. *Situation Binding*
   For all indices $i$ and assignments $g$, $[\![\Sigma_i\ \alpha]\!]^g = \lambda s.\lambda s'.[\![\alpha]\!]^{g^{s'/i}}(s)(s')$.
5. *Traces and Pronouns*
   If $\alpha$ is a trace or a pronoun, $g$ is a variable assignment, and $i \in \text{dom}(g)$, then $[\![\alpha_i]\!]^g = g(i)$.
6. *Lexical Terminals*
   If $\alpha$ is a terminal node occupied by a lexical item, then $[\![\alpha]\!]$ is specified in the lexicon.

We also need some type-shifting operations for when we need to shift the types of verbal projections and noun phrases. Following Landman (2000) and Champollion (2017), I shall assume the following type shifters that freely apply to thematic roles, verbal projections and noun phrases:

7. *Predicative type shifter*

   a. VP, then NP: $\lambda\theta_{\langle s,e\rangle}.\lambda V_{\langle s,t\rangle}.\lambda P_{\langle e,\langle s,t\rangle\rangle}.\lambda s.[V(s) \wedge P(\theta(s))]$
   b. NP, then VP: $\lambda\theta_{\langle s,e\rangle}.\lambda P_{\langle e,\langle s,t\rangle\rangle}.\lambda V_{\langle s,t\rangle}.\lambda s.[V(s) \wedge P(\theta(s))]$

8. *Referential type shifter*

   a. VP, then NP: $\lambda\theta_{\langle s,e\rangle}.\lambda V_{\langle s,t\rangle}.\lambda x_e.\lambda s.[V(s) \wedge \theta(s) = \mathcal{C}_s(x)]$
   b. NP, then VP: $\lambda\theta_{\langle s,e\rangle}.\lambda x_e.\lambda V_{\langle s,t\rangle}.\lambda s.[V(s) \wedge \theta(s) = \mathcal{C}_s(x)]$

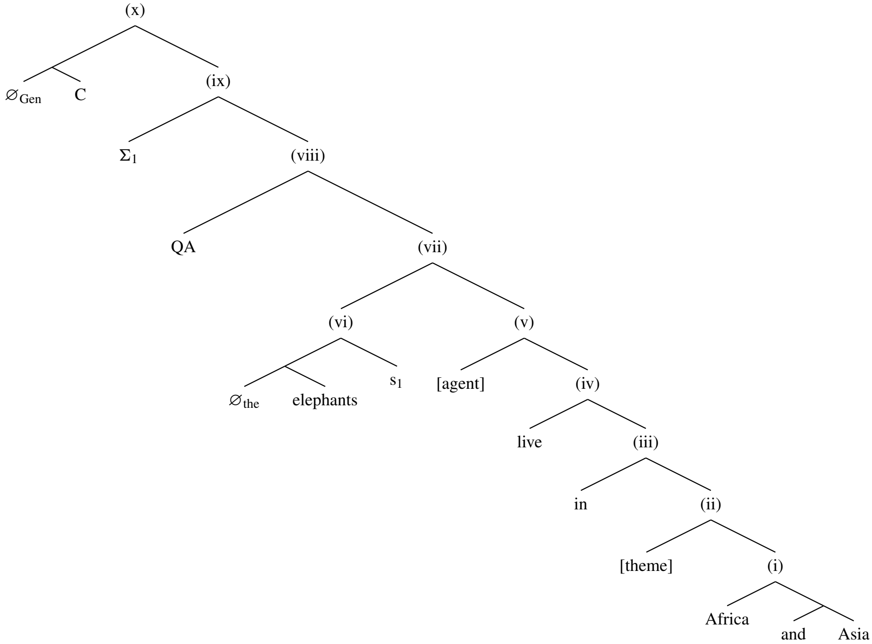
Lastly, we will make use of the following rule to operate on the metalanguage when doing derivations:

9. *$\beta$-Reduction*
   $[\lambda u_\tau.M](N_\tau) = [N/u]M$

## Appendix B: A generic conjunction

Here follows a calculation establishing the truth-conditions of a generic conjunction from Sect. 5.

(42)




(i) Function application
$a \oplus a'$
(ii) Referential type shifter, NP first
$\lambda V_{\langle s,t\rangle}.\lambda s.[V(s) \wedge {}^*\text{theme}(s) = \mathcal{C}_s(a \oplus a')]$
(iii) Vacuity
$\lambda V_{\langle s,t\rangle}.\lambda s.[V(s) \wedge {}^*\text{theme}(s) = \mathcal{C}_s(a \oplus a')]$
(iv) Function application
$\lambda s.[{}^*\text{live}(s) \wedge {}^*\text{theme}(s) = \mathcal{C}_s(a \oplus a')]$
(v) Referential type shifter, VP first
$\lambda x_e.\lambda s.[{}^*\text{live}(s) \wedge {}^*\text{agent}(s) = \mathcal{C}_s(x) \wedge {}^*\text{theme}(s) = \mathcal{C}_s(a \oplus a')]$
(vi) Function application
$\bigoplus\{x : \text{elephant}(x)(s_1)\}$

(vii) Function application
$\lambda s.[{}^{*}\text{live}(s) \wedge {}^{*}\text{agent}(s) = \mathcal{C}_s(\bigoplus\{x : {}^{*}\text{elephant}(x)(s_1)\}) \wedge {}^{*}\text{theme}(s) = \mathcal{C}_s(a \oplus a')]$

(viii) Function application
$\lambda s.\lambda s'.\exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge {}^{*}\text{live}(s'') \wedge {}^{*}\text{agent}(s'') = \mathcal{C}_{s''}(\bigoplus\{x : {}^{*}\text{elephant}(x)(s_1)\}) \wedge {}^{*}\text{theme}(s'') = \mathcal{C}_{s''}(a \oplus a')]$

(ix) Situation Binding
$\lambda s.\lambda s'.\exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge {}^{*}\text{live}(s'') \wedge {}^{*}\text{agent}(s'') = \mathcal{C}_{s''}(\bigoplus\{x : {}^{*}\text{elephant}(x)(s')\}) \wedge {}^{*}\text{theme}(s'') = \mathcal{C}_{s''}(a \oplus a')]$

(x) Function application
$\lambda s.\forall s'[s' \preceq s \wedge s' \in B(s) \wedge s' \in \cup\text{min}(\lambda s^{*}.\text{located}(\iota x[N(\text{elephants})](x)(s^{*}))(s^{*}))]$
$\exists s''[s' \preceq s'' \wedge s'' \preceq s \wedge {}^{*}\text{live}(s'') \wedge {}^{*}\text{agent}(s'') = \mathcal{C}_{s''}(\bigoplus\{x : {}^{*}\text{elephant}(x)(s')\}) \wedge {}^{*}\text{theme}(s'') = \mathcal{C}_{s''}(a \oplus a')]$

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