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The acquisition of generics

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It has been argued that the primary acquisition of genericity in early child speech poses a problem for standard quantificational approaches to generics and instead motivates the claim that generics give voice to an innate, default mode of generalising. This article argues that analogous puzzles involving the acquisition of A-quantifiers undermine the empirical support for a purely cognition-based approach to generics. Instead, these acquisition puzzles should be solved by generalising the core insight of the cognitive defaults theory to these expressions, reconciling formal semantic approaches with the role that cognitive development plays on lexical competence.

KEYWORDS
child language acquisition, generics, quantifiers, Sarah-Jane Leslie, Susan Gelman

1 | INTRODUCTION

When speakers want to communicate generalisations, they often use sentences like the following:

(1) a. Ravens are black.
b. The tiger is striped.
c. Ducks lay eggs.
d. A bishop moves diagonally.

These sentences are examples of characterising sentences, or *generics* for short. A defining feature of generics is that they manage to express propositions about regularities which summarise

groups of particular episodes or facts without the presence of an articulated quantifier or operator, such as *generally*, *typically*, or *all*, being responsible for generating the general content. For example, (1a) expresses a generalisation about ravens, such as the proposition that ravens are generally black, even though it does not contain any explicit expression responsible for generating that general content, such as *generally*.

The lack of a dedicated, phonologically articulated generic operator is no quirk of English either: No known language has any such phonologically articulated marker that is exclusively used to mark genericity (Behrens, 2005; Chierchia, 1998; Dahl, 1995; Dayal, 1999, 2004; Farkas & de Swart, 2007; Gerstner-Link, 1998; Krifka, 2004; Krifka et al., 1995). Nevertheless, there is a large degree of variation between how languages express genericity. Different languages employ different grammatical devices for expressing genericity. For example, in English, generic interpretations are compatible with bare plural, definite singular, and indefinite singular noun phrases, as witnessed by the sentences in (1), but not definite plurals (e.g., *the ravens are black*). In contrast, bare plurals in Romance cannot obtain a generic reading, only an existential one, but definite plurals can have a generic reading (e.g., *En la India se est/án extinguiendo *tigres/los tigres*) (de Swart, 2006; Laca, 1990; Longobardi, 1994, 2001). Furthermore, in articleless languages like Finnish, we find only "bare phrases" in the set of possible generic phrases (e.g., *korpit ovat mustia*). Languages also differ in the relative frequency with which the corresponding types of noun phrases are used generically, as well as the degree of contextual restrictions to which they are subject. For example, in English, generic uses of singular definites are less frequent and more constrained than in European languages such as French or (Modern) Greek, where the definite plural is most frequently used to express genericity.

The standard view of characterising sentences in formal semantics is that their logical form is essentially quantificational (Krifka et al., 1995). That is, despite the lack of any overt or pronounced elements responsible for their general content, generics are taken to have a tripartite structure consisting of a quantifier, a restrictor clause, and a nuclear scope (or matrix), akin to explicitly quantificational sentences like "Ravens are generally black" or "Most ravens are black". To bridge the theoretical gap between generics and overtly quantificational sentences, theorists typically posit a covert, phonologically null generic operator called "Gen" and provide it with a reductive semantic analysis in terms of quantification over suitably restricted domains of normal individuals, worlds, or histories (see, e.g., Asher & Morreau, 1995; Cohen, 1999a, 1999b; Eckardt, 2000; Greenberg, 2003; Krifka et al., 1995; Nickel, 2016; Pelletier & Asher, 1997; Sterken, 2015).

However, in recent years, it has become common to reject the standard view and instead claim that generics are properly understood through the lens of cognition (Cohen, 2004; Collins, 2015; Leslie, 2007, 2008; Prasada, 2010; Prasada et al., 2013; Prasada & Dillingham, 2006, 2009). A central argument for this approach draws upon empirical work in psychology and language acquisition to argue that the primary acquisition of genericity in early child speech raises problems for the standard view. In particular, Leslie (2007, 2008) draws upon empirical studies to claim that young children grasp and produce generics far quicker and more readily than they do more well-understood and mathematically well-behaved explicit quantificational determiners. If generics are correctly analysed in quantificational terms, it is puzzling why children would acquire generics before explicit quantifiers, especially since children should have difficulty learning in the absence of a phonologically articulated constituent with which the phenomenon can be associated.

To explain this acquisition puzzle, Leslie argues for an approach to generics that emphasises cognitive matters over formal semantics. According to this approach, our cognitive system has

an innate, default mode of generalising and it is to these generalisations that generics give voice. Leslie links this idea to the *dual-process theory* of cognition developed by Kahneman and his collaborators, the theory according to which there are two systems of cognition, a fast, automatic, effortless lower-level system, which is called "System 1", and a slower, more effortful higher-level system, called "System 2" (Kahneman, 2011; Kahneman & Frederick, 2002). She argues that generics express the intuitive, default judgments issued by System 1, whereas quantificational statements express judgments made by System 2. On this picture, there is no mystery about how children learn truth-conditionally complex generics. Children already form the corresponding default generalisations from birth as part of their primitive and less cognitively-taxing System 1 judgments, the accuracy conditions of which are encoded into the truth-conditions of generics. Contrastingly, quantificational determiners express generalisations that involve the quantitative, statistical patterns made by System 2 judgments. Recalling and assessing statistical patterns are difficult tasks that require inhibitory processes to override default mechanisms. Consequently, quantificational determiners are predicted to be acquired later in development only after infants have developed enough cognitive sophistication to make System 2 judgments.

This article argues that the early acquisition of generics can and should be accommodated from within the standard view of their syntax and semantics. I begin by raising a novel problem for the cognition-based approach. I present evidence that other expressions bearing the hallmarks of quantification also emerge at around the same time in early child speech as generics are claimed to emerge. This evidence suggests that the problem of generic acquisition is part of a more general acquisition puzzle which involves explaining why children acquire certain quantificational expressions before others. These facts undermine the empirical support that the early acquisition of generics lends to the cognition-based approach, at least insofar as it is couched within a dual-process theory of cognition. For such an explanation is ill-equipped to account for the early acquisition of other forms of quantification. After all, if the late acquisition of quantificational determiners is meant to be explained in terms of their giving voice to cognitively more demanding System 2 judgments, then we should also expect these other forms of quantification to be acquired later as well.

We are left with the following puzzle: How do we best explain the acquisition data, while doing justice both to the genuine insights of the cognition-based approach and the empirical progress made by formal semantics?[1] How do we reconcile insights from formal semantics, language acquisition data, and general constraints from the development of other cognitive faculties? I suggest that the right approach to the acquisition puzzles involves decoupling the core idea that generics express default generalisations from its implementation within a dual-process theory of cognition. Once separated, we can explore how cognitive defaults can play a central role in explaining our lexical competence of a wider range of quantificational expressions. Theorists have already linked the development of our modal and temporal understanding to the development of other aspects of cognitive development, such as our theory of mind (Papafragou, 1998, 2000; Phillips & Cushman, 2017; Phillips & Knobe, 2018; Wagner, 2001; Weist, 1989). According to this synthesis between developmental psychology and formal semantics, semantic theorising is central to the investigation of lexical meaning, but cognitive development nevertheless shapes acquisition pathways by constraining how lexical meaning comes onboard. Explaining when and how these defaults drop out in favour of more cognitively sophisticated mechanisms requires us to pay careful attention to more general constraints on

[1]For another recent attempt at explaining the acquisition puzzle concerning generics, see Hinzen and Mattos (2023).

language acquisition. By extending this approach to generics, I hope to retain the motivated and theoretically exciting connection between generics and cognitive capacities, while also vindicating formal semantics.

This article is structured as follows. Section 2 outlines the problem of generic acquisition and argues that the asymmetry between children's performance with generics and explicit quantifiers may not be as pronounced as originally suggested. Section 3 explains how the cognition-based approach aims to resolve the acquisition problem. Section 4 argues that such an approach is unable to account for an analogous acquisition problem involving other quantificational expressions, like modals, tense, and aspect. Section 5 attempts to reconcile formal semantics and the cognition-based approach to explain not only the acquisition of generics, but also the acquisition of adverbs, modals, and tense. Section 6 concludes.

2 | THE PROBLEM OF GENERIC ACQUISITION

Leslie (2007, 2008) argues for a striking asymmetry between the acquisition of generics and explicit quantificational determiners in early child speech.[2] More specifically, generics seem less challenging for young children to produce and comprehend than quantificational determiners, even though the latter has proved much more amenable to semantic theorising than the former. This section begins by outlining the central tenets of the standard formal semantic approach to generic sentences (Section 2.1), before summarising and evaluating the findings surveyed by Leslie (Section 2.2) and presenting the problem they pose for the standard approach (Section 2.3).

2.1 | The quantificational approach to generics

It is generally agreed amongst linguists that *Gen* functions as an *adverb of quantification* in the sense of Lewis (1975).[3] That is, *Gen* relates two open formula: a *restrictor*, which specifies the domain about which the sentence makes its generalisation, and a *matrix*, which specifies the property attributed to the relevant members of the domain. The generic operator then binds any free variables in its restrictor and matrix. Consequently, the general logical form of a generic sentence is represented as follows (cf. Krifka et al., 1995, p. 26):

(2) Gen x_1, ..., x_i[**Restrictor**(x_1, ..., x_i)][$\exists y_1$, ..., y_j **Matrix**({x_1}, ..., {x_i}, y_1, ..., y_j)],

where x_1, ..., x_i are metavariables ranging over appropriate types to be bound by *Gen*, y_1, ..., y_j are metavariables ranging over appropriate types to be bound existentially with scope just inside the Matrix, φ(..., x_m, ...) is a formula with where x_m occurs free, and φ(..., {x_m}, ...) is a formula in which x_m may occur free. Any variables occurring free only in the matrix undergo existential closure and are bound by an existential quantifier (cf. Heim, 1982).

[2]For an overview of the psychological literature on generics, see Gelman (2010).

[3]The standard approach is compatible with *Gen* being a quantificational determiner (Pelletier & Asher, 1997), as well as a situation-based semantics for adverbs of quantification (Berman, 1987; Heim, 1990; von Fintel, 2004). For expository purposes, I focus on the Lewisian view as it is more familiar in the literature.

A central advantage of this approach is that it provides a convenient way of representing the various readings of generics like in (3) (cf. Krifka et al., 1995, pp. 23–30):

(3) Typhoons arise in this part of the Pacific.
   a. Gen *x*, *y* [*x* **are typhoons**][*y* **is this part of the Pacific** and *x* **arise in** *y*]
   b. Gen *x* [*x* **is this part of the Pacific**] ∃*y*[*y* **are typhoons** and *y* **arise in** *x*]

Without settling exactly how the logical forms in (3) are derived from the sentence material, we can see that in (3a) the plural *typhoons* contributes the restrictor and the predicate *arise in this part of the Pacific* contributes the matrix, while in (3b) it is the object noun phrase *this part of the Pacific* that contributes to the restrictor and the matrix is derived from the remainder (cf. Asher & Pelletier, 2013; Chierchia, 1995; Heim, 1982; Rooth, 1995).

Most contemporary theorists hold that the schema in (2) underwrites the logical form of generics. Nevertheless, substantial debate about how *Gen* should be semantically interpreted has led to the proliferation of increasingly sophisticated proposals. For example, modal-based approaches to generics typically deploy universal quantification over normal individuals or normal worlds (Asher & Morreau, 1995; Asher & Pelletier, 2013; Eckardt, 2000; Greenberg, 2003; Krifka et al., 1995; Nickel, 2016). Contrastingly, probability-based accounts 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 (Cohen, 1999a, 1999b). Each of these proposals attempt to provide a reductive semantic analysis of *Gen* in terms of more theoretically tractable quantification over suitably restricted domains, such as individuals, worlds, or world histories.

2.2 | Empirical evidence about the acquisition of generics

Let us now consider the empirical evidence reported in Leslie (2008) for the early acquisition of generics. To establish whether and when a word or concept has been successfully acquired, linguists appeal to production and comprehension studies involving children across a range of ages. Production studies suggest that generics are readily produced by young children from the age of 2 years, significantly before explicit quantifiers like *all*, *every*, and *some* (Gelman & Raman, 2003; Roeper et al., 2006). For example, Gelman et al. (2008) report data from a study of the developmental acquisition of generics by examining longitudinal transcripts of parent–child conversations from data provided by the Child Language Data Exchange System (CHILDES) project (MacWhinney & Snow, 1985; MacWhinney & Snow, 1990).[4] The study involved eight English-speaking children aged 2;0 to 3;7 at first recording who were followed to ages 3;1 to 4;11.[5] The study focused on transcripts for which the children's mean length of utterance (MLU) was 2.5 and above to ensure that children had enough command of syntax to express generics. Generics were identified using the procedure reported in Gelman (2003); a computer algorithm was used to identity all utterances with plural nouns, mass nouns, or

[4]The CHILDES database includes transcripts and recordings of natural conversation by various child-language researchers. The researchers contributing to the data of the Gelman et al. (2008) study were Bloom (1970), Brown (1973), Kuczaj (1976), MacWhinney (1991), Sachs and Nelson (1983); and Snow (see MacWhinney & Snow, 1990).
[5]This article follows the established convention of representing children's ages as two numbers separated by a semicolon, *m*;*n*, where *m* is the year and *n* is the month.

nouns proceeded by "a/an", which were in turn coded as generic or nongeneric by two coders. NPs proceeded by the word "the" were taken as indications that the NP was not generic on the basis of prior research showing that such forms were almost never used generically in child-directed speech (Gelman et al., 1998). The study found that all children for whom there were data at age 2 years produced generics, with children of age 4 years producing generics as frequently as adults. The study also found that the children actively initiated generic conversations, rather than merely imitating their parents' generic talk.

These findings clearly suggest that children produce utterances that adults interpret as generic, but do they comprehend them as such? After all, children may be producing sentences that sound like generics without necessarily assigning the same meaning to them. Comprehension studies indicate that young children comprehend generics as such, whereas it is only by the age of four that children distinguish generics from *all* and *some*. For example, Gelman and Raman (2003) report results of experiments in which children aged 2;0 to 4;0 were presented with atypical category instances (e.g., two birds that cannot fly) and asked questions that varied in linguistic form class (e.g., "Do *birds* fly?" [generic] versus "Do *the birds* fly?" [non-generic]). They found that, even at age 2;6, the children who were asked the generic question answered affirmatively despite the presence of counter-instances, while the children who were asked the non-generic question answered negatively. This suggests that children make use of these form-class cues to identity generics by age 2;6. Furthermore, Hollander et al. (2002) conducted two studies examining whether children aged 3;0 and 4;0 distinguish between generics, "all", and "some". They found that while 4-year-olds treat generics as distinct from indefinites and universal quantifiers, 3-years-olds do not distinguish between "all", "some", and the generic form. These findings are evidence that young children also comprehend generics as such.[6]

To summarise the evidence from production data (of spontaneous child speech), generics are frequent in children's speech and they produce them from at least 2 years old. Moreover, children do not simply take the parents' lead by copying, because they initiate generics at a high rate. To summarise the evidence from comprehension studies (involving solicited speech in experimental settings), children as young as 2;6 identify and understand generics as such.

There are some limitations in the empirical literature reported by Leslie in support of an asymmetry between children's performance with generics and overly quantified sentences. First, there is some imbalance between the data used to argue that children master generics from a young age (production studies from 2 years old) and data used to argue that children do not master *all* and *some* (comprehension studies only from 3 years old). As observed by Lazaridou-Chatzigoga et al. (2015), the studies cited by Leslie do not directly compare the acquisition of generics with the acquisition of quantificational determiners; neither the Gelman et al. (2008) study nor any of the other studies reporting generic utterances in early child speech contrast the rates of generic production with the rates of quantified utterances in the children at the same ages. While the presence of generic utterances in early child speech is consistent with the generics-as-default-generalisations hypothesis, direct comparison is needed to fully support the generics-as-default-generalisations hypothesis. As summarised by Lazaridou-Chatzigoga et al. (2015), only two studies that investigate the production and comprehension of generics in early child speech report robust evidence that young children show an early advantage for generic versus quantified generalisation, namely, Hollander et al. (2002) and Leslie and Gelman (2012).

[6]See also Cimpian and Markman (2008) for evidence that children as young as 3 years old can use contextual and semantic information to construe sentences as generic.

Conflicting evidence is also presented by Gelman et al. (2015), who find that children as young as 3-year-olds can distinguish between generics and quantifiers.[7]

Second, it is not clear that the difficulties that children have with overtly quantified sentences indicate a lack of semantic grasp. While children acquire *some* and *all* at around age two in both comprehension (roughly 16 months) and production (roughly 26 months) (Fenson et al., 1994), in experimental settings, children, unlike adults, interpret *some* as compatible with *all*, rather than as the pragmatic *some, but not all*, and their performance does not match that of adults until age seven (Guasti et al., 2005; Huang & Snedeker, 2009; Noveck, 2001; Papafragou & Musolino, 2003). This is despite the control conditions in most of these experiments indicating that children have a good semantic grasp of the two quantifiers. Consequently, the gap in performance may be due to the metalinguistic nature of the sentence verification task used in these experiments, rather than any deficit in children's semantic grasp. Indeed, the age at which children interpret *some* as incompatible with *all* can be pushed down to 4 years old in some paradigms (Katsos & Bishop, 2011; Pouscoulous et al., 2007) and a corpus study on early production and perception of *some* suggests that, as soon as they are acquiring *some*, children are fully competent in its production and mirror adult perception (Eiteljoerge et al., 2018). It cannot be ruled out that the asymmetry between children's performance with generics and overtly quantified sentences as reported by Leslie is not simply a function of children's limited performance with overt quantifiers in experimental contexts more generally.

Third, while the above evidence suggests that children comprehend certain aspects of the meaning of generics by the age of four, it does not mean that their performance matches adults with respect to all aspects of generics. For example, children's performance does not match adults' performance with so-called "striking property" generics. While prototypical generic generalisations express claims about characteristic properties (e.g., *ravens are black*, *tigers have stripes*), we often use generics to communicate information about striking properties, which seem sufficiently noteworthy to warrant generalisation, despite being instantiated by only a minority of the kind (e.g., *sharks attack people*, *mosquitos carry malaria*) (Leslie, 2007, 2008; Leslie et al., 2011; Prasada et al., 2013). Lazaridou-Chatzigoga, Katsos, and Stockall (2019) report the results of an experiment in which English-speaking 4-year-olds and 5-year-olds ($N = 32$, $M = 60.53$, SD = 5.1) and 140 English-speaking adults ($M = 35.35$, SD = 11.95) were introduced to two instances of a novel kind and either a striking property or a neutral property was attributed using a generic nominal ("These are ackles. Ackles love to place with toys (neutral)/fire (striking)"). They were then introduced to a third instance of the same kind and asked a question to measure the extension of the property ("Does this ackle love to play with toys (neutral)/fire (striking)?"). It was found that, while both adults and 4-year-olds and 5-year-olds show a sensitivity to strikingness by extending striking properties less than neutral ones, the children had not reached adult-like willingness to extend striking properties.

Fourth, the studies surveyed by Leslie focus mainly on English, but since the expression of genericity widely varies across languages, the study of children's understanding of generics and quantifiers in languages other than English is highly motivated. For example, in Spanish, genericity is expressed predominately with the definite determiner, which is also used in other contexts, and so we might expect generics to be harder to learn as children have to figure out the ambiguity between generic and specific readings (Pease-Gorrissen, 1980). The empirical literature comparing children's performance with generics and quantified sentences in languages other than English is scarce and the results vary. In Gelman et al. (2016), 48 Spanish-speaking

[7]For further critical discussion, see Lazaridou-Chatzigoga et al. (2019, 2023) and Castroviejo et al. (2023).

children (mean age 5;0) and 48 Spanish-speaking adults were instructed to recall sentences in two conditions: DET.PL (generic) or the quantified NPs *muchos* ("many") or *todos* DET.PL ("all the"). Participants were presented with a serious of photographs of animals and learned a novel fact about them, half realised in the form of a generic and half realised as a quantified statement. After a 4-min distraction task, they were then shown the photos again and asked to recall what they had been told about each picture. Both adults and children recalled the generics more accurately than the quantified NPs.

One limitation of this experimental set-up is that it tests for comparisons between generic and quantified NPs only indirectly. To test the comparison between the interpretation of generics and quantified NPs more directly, Castroviejo et al. (2023) looked at 55 Spanish-speaking children divided into two age groups, a 4/5 year old group ($N = 31$, $M = 68.16$ months, SD = 6.8) and a 8/9 year old group ($N = 24$, $M = 108.73$ months, SD = 6.8), and a group of 28 adults. Participants were presented with a series of images of an individual that either contradicted or supported a generalisation to be judged, such as a cat without whiskers. They were then asked whether they agreed with the generalisation, presented in either a generic condition (DET.PL) or a universal condition (*todos*/*as* DET.PL) (e.g., *¿Dirías que todos los/los gatos tienen bigotes?*), answering either "Yes" or "No". Interestingly, in all three age ranges, the accuracy of generic statements is greater than the accuracy of universally quantified statements, and there is an observed decline in the accuracy of generic statements in both the older group of children and the adults. At present, it is not clear how to interpret these studies, which makes the case for further experimental work on genericity in languages other than English more pressing.

Fifth, one might question how developmental arguments should bear on adult lexical competence and semantics. It is generally accepted that the child's mastery of their lexicon falls short of the adult's. For example, it is a common cognitive-developmental trajectory in language acquisition to have a U-shaped curve that involves a fluctuation between good and bad performance.[8] Furthermore, there is also a tendency among children to overextend and/or underextend newly uttered, but previously understood words in both production and comprehension. Given these facts, the development of specific aspects of the child's lexicon are normally traced to what we know about the linguistic capacities of adults, rather than the other way around. Indeed, it seems peculiar to use children's competences as indications of features of the adult's competence, rather than the other way around.

2.3 | Leslie's challenge

We are now in a position to state Leslie's puzzle. Leslie interprets these studies as evidence that children acquire generics before quantificational determiners and argues that these findings pose a problem to the standard approach to generic sentences according to which they have quantificational tripartite logical forms. Given the sophisticated attempts to reduce the semantics of generics to quantification, it is unclear how and why children acquire generics before they acquire explicit quantifiers: Children learn with ease what generations of talented linguists and philosophers have struggled to theorise. Moreover, the fact that children acquire generics so easily is even more surprising considering the lack of any corresponding phonologically

[8]Thanks to an anonymous reviewer for suggesting this original idea to me. For some potential empirical evidence in support of this hypothesis, see Castroviejo et al. (2023).

realised operator associated with generics.[9] Given that *Gen* is not articulated in any known language, there is no direct or explicit object of study on which children can form hypotheses and from which they can learn. Leslie claims that it is puzzling that they master generics from a young age, since associations with absence are notoriously difficult for children to master. Contrastingly, one would expect that children would acquire explicit quantifiers more quickly, since they are phonologically realised, thereby giving children an object of study.

Call the task of accounting for the primary acquisition of generics *the problem of generic acquisition*. Any empirically adequate account of generics must explain these facts and, in particular, how children acquire generics before explicit quantifiers, even though the former are truth-conditionally more complex than the latter and do not offer an explicit object of study.

3 | GENERICS AS DEFAULT GENERALISATIONS

Leslie (2007, 2008) argues that the appearance of genericity in early child speech is predicted by a certain view of the mind according to which the cognitive system is endowed with a primitive, default mechanism of generalisation and it is to these generalisations that generics give voice. Empirical studies indicate the ability to generalise in this manner pre-dates the acquisition of language. For example, infants of age 0;9 to 1;2 can form category wide generalisations on the basis of experience with a few instances of the category (Baldwin et al., 1993; Graham et al., 2001). Leslie takes the capacity of pre-verbal infants to form generalisations as evidence for the existence of an innate cognitive mechanism for generalising from a few instances to the class of perceptually similar items that, though aided by language, does not depend on language per se. It is the generalisations of this primitive mechanism to which generics give voice. Call this the *generics-as-default-generalisations hypothesis*.

Leslie characterises the default mode of generalising as a basic information-gathering mechanism that increases the speed and efficiency with which infants gather information about the world. Under certain conditions, the default mode of generalising is activated and, by taking advantages of certain worldly regularities, the mind draws inferences from particular instances of a category to novel and unobserved ones, forming the corresponding generic belief. Contrastingly, the comprehension of explicit quantifiers involves a more complex process than the comprehension of generics. For if generics give voice to the only default mode of generalising, then this mechanism for forming generalisations must be inhibited or overridden to make the kinds of generalisations expressed by existential and universal quantification. Given that these kinds of inhibitory processes are more taxing for the conceptual system to implement than non-inhibitory process, the conceptual system will likely be overwhelmed when trying to implement the inhibitory process and consequently revert to the default. Given this hypothesis, it is unsurprising that we see a correlation between the appearance of

[9]Of course, phonologically null expressions are not *in principle* necessarily more difficult to learn. For example, children produce and comprehend *wh*-questions from an early age, even though contemporary syntactic analyses of *wh*-questions posit phonologically null traces resulting from movement.

(i) What did John see?

a. $[_{CP}\ what_j\ [_{C'}\ did_i\ [_{TP}\ John\ t_i\ [_{VP}\ see\ t_{j\_}j]]]]$

No specialised default module needs to be postulated to explain the acquisition of wh-movement; the standard explanation for the acquisition of wh-movement is that it is mandated by universal grammar, and so children simply acquire it as part-and-parcel of acquiring the language (cf. Guasti, 2002, Chap. 6).

quantificational determiners in early child speech and an increase in our ability to implement inhibitory processes between ages three and four.

Leslie links her claim that generics express the conceptual system's default generalisations with the dual-process theory of cognition, according to which there are two systems of cognition, a fast, automatic, effortless lower-level system, which is called "System 1", and a slower, more effortful higher-level system, called "System 2" (Kahneman, 2011; Kahneman & Frederick, 2002). According to dual-process theory, when faced with reasoning tasks, System 1 issues initial judgments that involve fast, automatic, and opaque reasoning, while System 2 issues the more accurate responses that involve effortful, conscious, and rule-governed reasoning. Leslie suggests that generics are judgments issued by System 1, whereas quantifiers express judgments issued by System 2:

> [Generics] are thus non-quantificational; they do not depend on considerations of quantity, or any such information easily captured by set-theory. They are, however, automatic, effortless, and cognitively basic. Quantifiers, in contrast, express judgments issued by System 2, the rule-governed, extension-sensitive, higher-level system. Quantifiers *do* depend on considerations such as *how much* and *how many*. (Leslie, 2007, pp. 396–397)

If the generics-as-default-generalisations hypothesis is correct, then there should be no puzzle about how children acquire generics. For on this view, generics are the manifestation of our default mode of generalising and children will have already formed the System 1 generalisations to which generics give voice before acquiring any language at all. Consequently, the task of learning generics consists only of generating *logical forms* for generics by partitioning the sentence material into the restrictor and matrix clauses and binding any free variables therein, in addition to associating the generic interpretation with particular forms, such as the bare plural. It is natural to suppose that the language faculty's innate endowment—say, innate knowledge of universal grammar—is responsible for children's ability to partition sentence material into the restrictor and matrix clauses, and subsequently bind any free variables. Furthermore, we can explain why children handle generics with greater ease than explicit quantifiers and why they tend to interpret quantified sentences as though they were generics. For processing explicit quantifiers is a sufficiently complex System 2 task, and so we would expect it to manifest at a later developmental stage and for children to default back to generics under pressure. If correct, the generics-as-default-generalisations hypothesis explains why children acquire generics before explicit quantifiers and the problem of generic acquisition dissolves.

4 | THE PROBLEM OF THE EARLY ACQUISITION OF A-QUANTIFIERS

The generics-as-default-generalisations hypothesis marks a dramatic shift in more than 40 years of research on generics, setting aside the tools of formal semantics and developing an account of generics couched in the framework of cognitive science. It is undeniable that the generics-as-default-generalisations hypothesis provides a compelling explanation of the acquisition of genericity, whereas the standard view seems to have no explanation. As we saw in Section 2, a closer look at the empirical evidence makes it far from clear that Leslie's theory is

well-supported by the data. While these observations go some way to undermining the empirical evidence for an asymmetry between the acquisition of generics and the acquisition of quantificational determiners, I wish to present a different problem.

The primary problem I want to raise is that neither Leslie nor the studies she cites directly compare the age at which children acquire generics with the age at which they acquire other kinds of quantificational expressions, such as adverbial quantifiers like *always*, *usually*, and *sometimes*, or modal auxiliaries like *must* and *might*. Instead, Leslie only compares the acquisition of generics with the acquisition of quantificational determiners, like *every*, *some*, and *all*. But while standard logico-philosophical approaches to quantification primarily concern quantificational determiners, the manifestation of quantification is by no means restricted to these expressions.

In addition to determiner phrases, natural language incorporates the expression of quantification in verbal morphology, either in the whole verb stem or in auxiliary verbs, preverbs and verbal affixes. Building on the work of Lewis (1975), and Heim (1982), Partee (1991a) distinguishes between D-quantifiers and A-quantifiers, where "D" is a mnemonic for determiner and "A" for the cluster of adverbs, auxiliaries, affixes, and argument-structure adjusters, such as *usually*, *always*, *sometimes*, *must*, and *may*. Syntactically speaking, D-quantifiers, like *every* and *some*, form a constituent with a projection of the lexical category of nouns, as in (4), whereas A-quantifiers form a constituent with some projection of the category of verbs or sentences, as in (5):

(4) $[_{IP}\ [_{DP}$ Det NP] VP]
(5) a. $[_{IP}$ DP [always VP]]
b. $[_{IP}$ always [IP *subject* $[_{I'}$ I $[_{VP}$ NP VP]]]]

Given the widespread treatment of the generic operator *Gen* as an adverbial quantifier, it is puzzling why Leslie directly compares the acquisition of generics with the acquisition of explicit quantificational determiners, rather than the acquisition of adverbial quantifiers. Indeed, it would be more natural to compare the acquisition of generics with the acquisition of other A-quantifiers, such as explicit adverbial quantifiers and modals. After all, A-quantifiers and D-quantifiers constitute separate grammatical categories with different syntactic and semantic features, and so may have differing acquisition paths. Furthermore, adverbial quantification is a linguistic universal in all known languages, whereas determiner quantification is rare (Bach et al., 1995). Given that genericity is also a universal in all known languages, it is more likely that *Gen* is one of the ubiquitous quantificational adverbs, rather the less-common quantificational determiner, and so we should compare the acquisition of generics to the acquisition of explicit quantifiers.

We should also examine other grammatical categories, such as tense and aspect, that have long been semantically analysed in terms of quantification over times, events, and intervals (Bennett & Partee, 1972; Montague, 1973; Prior, 1967; Reichenbach, 1947). If the acquisition gap between generics and quantificational determiners is meant to be explained by the cognitive challenges posed by quantification, then we should also predict an acquisition gap between generics and A-quantifiers.

In this section, I present evidence that adverbs of quantification, modals, tense, and aspect also emerge at around the same time as generics in early child speech. This observation goes some way to undermining the argument from acquisition for a fully cognitive account of generic sentences, at least insofar as it is couched in the terms of dual-process theory. For if generics express the judgments of a default mode of generalising like System 1, while explicit quantifiers express the judgments of the more cognitively taxing System 2, then we would

expect these other A-quantifiers to emerge at a later point as well, since they would presumably require inhibitory processing or enough cognitive sophistication to access the relevant System 2 judgments. The fact that they appear at around the same time is problematic for the generics-as-default-generalisations hypothesis.

4.1 | Adverbial quantifiers

4.1.1 | The characteristics of adverbial quantifiers

Let us begin with adverbial quantifiers. Adverbial quantifiers, such as *always*, *sometimes*, and *usually*, are used to express generalisations over times, events, or situations. Since *Gen* is widely held to be an adverbial quantifier, such expressions play a central role in theorising about generics. As we saw in Section 2.1, sentences containing adverbial quantifiers have a tripartite logical form involving an operator that unselectively binds any free variables in its restrictor and matrix (Lewis, 1975). For example, (6a) may be given the simplified logical form in (6b)[10]:

(6) a. When Mary goes to the cinema, Mary usually takes John.
b. usually *e* [Mary goes to the cinema in *e*][Mary takes John to the cinema in *e*]

where the variable *e* ranges over events.

The semantic contribution of adverbial quantifiers is widely held to be functions from cardinalities of sets to truth-values, with different adverbial quantifiers varying in quantificational strength or domain. For example, (6a) is true, roughly speaking, iff the cardinality of the set of events where Mary goes to the cinema and takes John is greater than the cardinality of the set of events where Mary goes to the cinema and does not take John. More formally[11]:

(7) $[\![\text{usually}[\varphi][\psi]]\!]^{c,i} = 1$ iff $|[\![\varphi]\!]^{c,i} \cap [\![\psi]\!]^{c,i}| > |[\![\varphi]\!]^{c,i} \setminus [\![\psi]\!]^{c,i}|$

where φ, ψ denote the restrictor and matrix material, respectively. Similar remarks apply for other adverbial quantifiers.

4.1.2 | Acquisition data

The generics-as-default-generalisations hypothesis makes a clear prediction that adverbial quantifiers should be acquired later than generics. For given that they involve quantification, and their truth-conditions involve set-cardinalities, adverbial quantifiers should express generalisations issued from System 2. Consequently, we should expect them to be produced and comprehended only when children have reached a sufficiently sophisticated stage in cognitive development to handle set cardinalities and inhibitory processing.

[10]When the restriction of the adverbial quantifier is not explicitly represented, such as in "Usually, Mary takes John to the cinema", the restriction is derived from some context-sensitive process, such as "semantic partition" or pragmatic anaphora resolution (cf. Partee, 1991b; Rooth, 1985; von Fintel, 2004).

[11]The semantic interpretation function $[\![.]\!]^{c,i}$ is a function from expressions to suitable denotations relative a context *c* at an index *i*. Here, we assume that indices are world–time pairs.

There is some limited evidence that children start producing adverbs of quantification and understanding them as such from a young age as well. For example, Antinucci and Miller (1976) report data from a study in the developmental acquisition of past tense expressions by examining longitudinal transcripts of parent–child conversations. The data involved eight Italian-speaking children from 1;6 to 2;6, supplemented with data from the longitudinal records of the speech of another Italian child and from the records of spontaneous speech of the Italian children tested in the Berkeley Cross Cultural Study of Language Acquisition.[12] In this study, we find a case of children as young as 1;8 producing and comprehending adverbs as such, as witnessed in the following dialogue[13]:

(8) (1;8) (The child sees a cat moving along the eaves of a house)
Adult: *Che bel gattone; ti piace i gatti*? "What a pretty cat; do you like cats?"
Child: *Graffiano* "They scratch".
Adult: *Graffiano solo se vengono disturbati* "They scratch only if they are disturbed".
Child: *No, graffiano* ***sempre****... cattivi gatti* "No, they **always** scratch ... bad cats" (Antinucci & Miller, 1976: 174, emphasis added)

It is remarkable that we see here a child voluntarily producing the adverbial quantifier *sempre* as a correction to the adult's claim. If the Antinucci and Miller (1976) study is representative, this would go some way to weakening the dialectical force of the problem of generic acquisition, since we would have interesting evidence that children begin to produce generics and adverbial quantifiers at around the same time as surveyed in Section 2. But given the objective scarcity of studies on the acquisition of adverbial quantifiers, we are not in a strong enough position to make this claim and it is not clear how much we can build on data like the one exemplified in (8). Fortunately, there is a much larger body of literature on the acquisition of modals and tense and a similar argument can be marshalled from these grounds. It is to these expressions that we now turn.

4.2 | Modals

4.2.1 | The characteristics of modals

It is widely acknowledged in the linguistics literature that modal expressions, such as *may*, *must*, and *have to*, are essentially context-dependent quantifiers over a domain of possibilities (Kratzer, 1977, 1981, 1991). Different strengths of modality correspond to different strengths of quantification: Possibility modals like *may* involve existential quantification, whereas strong necessity modals like *must* involve universal quantification. Different flavours of modality correspond to quantification over different domains of possibilities, which cluster in two broad categories: epistemic modals, which deal with knowledge-based inferences about the degree of agent commitment to the truth of the proposition that forms the complement of the modal, and root modalities, which concern the necessity or possibility of acts performed by morally

[12]An anonymous reviewer observes that, while discussions of acquisition studies concerning many different languages is advantageous for testing whether the acquisition data provides the cross-linguistically robust evidence for the generics-as-default-generalisations hypothesis, it also raises questions about the relative age of acquisition of generics and other constructions in those languages. For considerations of space, I focus mainly on the acquisition of English, leaving discussion of these interesting and complex cross-linguistic issues to future work.

[13]Also, see Cromer (1968), who reports that, in Polish, adverbs such as *zawsze* "always" and *nigdy* "never" merge before the age of 3.

responsible agents, such as obligation, permission, abilities, and disposition, amongst others. The utterances in (9) are examples of root and epistemic modality, respectively:

(9) Kermit must smoke lots of cigarettes...
  a. ... because Miss Piggy said they'll make him more attractive. (Root)
  b. ... because there are lots of empty cigarette ends around his home. (Epistemic)

A prominent way of implementing these ideas is to assign a unitary semantics to modal verbs, which is pragmatically developed into epistemic or root interpretations in the process of utterance comprehension (Kratzer, 1977; Papafragou, 2000). According to this view, modals have the following general logical form:

(10) MODAL(B)(φ),

where MODAL is some quantifier Q, which supplies the relevant force of the modal; the first argument B is the *modal base*, which determines the restriction on the domain of worlds over which the modal quantifies relative to a context c and index i; and the second argument φ is the *prejacent*, the sentence that the modal claim says is true in Q of the possibilities of B. By varying the domain of possibilities determined by B relative to a context, we get different flavours of modality. More formally, the general truth-conditions for a sentence of the form ⌜might(B)(φ)⌝ is as follows[14]:

(11) $[\![\text{might}(\text{B})(\varphi)]\!]^{c,i} = 1$ iff $\exists w' \in [\![\text{B}]\!]^{c,i}$: $[\![\varphi]\!]^{c,<w',t_i>} = 1$,

where $[\![\text{B}]\!]^{c,i} = \{w$: w is compatible with the c-relevant information at $i\}$. In English, a sentence ⌜might(B)(φ)⌝ is true at a context–index pair c, i iff φ is true at some world in the modal base determined by c and i. The resulting view is an empirically powerful theory of modality.

4.2.2 | Acquisition data

There is substantial evidence that children begin using modal expressions from a young age, even though modals bear the hallmarks of quantification. Major findings on the development of modality come from naturalistic longitudinal studies of children's spontaneous speech, which I focus on here, since extant experimental studies looking at modal use tend to focus on an older age range of children than the analogous studies concerning generics. Most longitudinal studies on the acquisition of modal auxiliary verbs find that children begin to use English modals between 1;10 and 2;6, beginning gradually from a single negative modal form, such as *cannot*, before rapid growth in modal vocabulary from root modality to epistemic modalities (Brown, 1973; Kuczaj & Maratsos, 1983; for a review of English learners, see Stephany, 1986; Wells, 1985; Shatz & Wilcox, 1991; Papafragou, 1998).[15]

Bloom et al. (1975) reported the data from a developmental study of the speech of four English-speaking children from 1;7 to 2;2, progressing from single-word utterances to an MLU

[14]Alternatively, modals might be treated as explicit quantifiers in the object language, since natural language not only has the expressive power of a language with explicit quantification over worlds, syntactic structures also contain items that function as variables over worlds or situations and that are bound by modals (Cresswell, 1990; Percus, 2000; Schlenker, 2006; Stone, 1997).

[15]For a cross-linguistic perspective on the development of modality in first language acquisition, see Stephany and Aksu-Koç (2021).

of 2.5. In the study, a set of verbs (*want to*, *wanna*, *gonna*, *have to*, *hafta*, *cannot*) were characterised as having the meaning *desire to act*. The study found that, for two of the children, these verbs were productive at 2;1, for one, they were productive at 1;10, and for the last, there were no example of such verbs by 2;1.[16] Fletcher (1979) uses the diary data for a child named Hildegard and finds that her first auxiliaries were *will not* and *cannot* at the age of 2;0–2;2 years. About a month later, she acquired *will* in yes–no questions and answers to them. Hildegard also started using *will* in sentences not dependent on a question at 2;4 and *I may* at around the same time. By 2;5, she was using the progressive form *be* + *ing*. The modal use of these auxiliaries suggest that children as young as 2 years have a rudimentary comprehension of modality.

Similar results hold for larger samples of children. For example, as part of the Bristol Language Development Study, Wells (1979) time-sampled 60 children with their mothers every 3 months from 1;3 to 3;6. He found that by 2;6 more than 50% of the children used *can* to convey both ability and permission, as well as using *will* to communicate intention. Wells (1985) reports on another sample of 65 children from age 3;3 to 5;0. This study found that, by 3;3, at least half of the children were using all categories of root modality, although the same proportion of children only used *may* and *might* to express epistemic possibility by the same age, and only 25% of the sample gave evidence of using modals to convey epistemic certainty by 5;0. The progression of meaning development from root modalities to epistemic modalities have also been noted in other studies. For example, Pea et al. (1982) examined 1766 utterances containing a modal in the speech of a child between 1;11 and 3;4 and found that only seven express epistemic modality, five of which occur after 2;8. These findings support the claim that children productively use modals verbs to express root modalities at around the same time that they productively use generics.

However, there is an acquisition gap in early child speech between their production and comprehension of root modals and epistemic modals. While children produce and comprehend modal verbs with ostensibly root meanings from an early age, they produce epistemic modals only at around age three (Papafragou, 1998; Shatz & Wilcox, 1991; van Dooren et al., 2022). Furthermore, empirical studies find that preschool and early school age children both overaccept possibility modals in necessity contexts, and necessity modals in possibility contexts (Dieuleveut et al., 2019, 2021; Moscati et al., 2017; Noveck, 2001; Ozturk & Papafragou, 2015). This is evidence that, while children are adult-like in their performance with some aspects of modality from early on, they do not acquire full mastery until later. One potential explanation for this acquisition gap is that root meanings are conceptually prior in some way to epistemic meanings, and, as such, epistemic meanings come online only after children make certain conceptual metarepresentational milestones (Dack & Astington, 2011; Papafragou, 1998; Shatz & Wilcox, 1991).

4.3 | Tense and aspect

4.3.1 | The characteristics of tense and aspect

Temporality is determined by three grammatical notions: lexical aspect (also called *Aktionsart*), grammatical aspect, and tense. Lexical aspect characterises the temporal profile or contours of a situation; a situation could be described as an activity (*She slept for eight hours*), an accomplishment (*I read the article in thirty minutes*), an achievement (*He baked a cake*), or a state of affairs (*She is*

[16]Bloom et al. (1975) judged a semantic-syntactic category to be productive if "five or more utterance types were observed in the category in the data from a particular child in a particular sample" (Bloom et al., 1975, p. 9).

asleep) (Vendler, 1957). Grammatical aspect characterises "different ways of viewing the internal temporal constituency of a situation" (Comrie, 1976, p. 3) by imposing layers of temporal structure on the event time, whereas tense locates a situation in relation to a reference time, such as the speech time or some other time. For example, the difference between *John is sleeping* and *John was sleeping* is a matter of tense, since the *is/was* contrast signifies a difference in the temporal location of the described situations relative to speech time. The difference between *John drank coffee* and *John was drinking coffee* is a matter of grammatical aspect, since the contrast is about how the action of drinking coffee is viewed by the speaker; the former describes the situation in its entirety, as a completed action, whereas the latter describes the situation as being of an event in progress or continuing.

Linguists and philosophers standardly treat tense and aspect as involving quantification over times, intervals, or events. For example, on a simple analysis of past tense, a sentence of the form ⌜PAST(φ)⌝ involves existential quantification over times occurring prior to the time of speech (Montague, 1973; Prior, 1967)[17]:

(12) $[\![\text{PAST}(\varphi)]\!]^{c,\,<w,\,t>} = 1$ iff $\exists t'$ such that $t' < t$ and $[\![\varphi]\!]^{c,\,<w,\,t'>} = 1$.

In English, a sentence of the form ⌜PAST(φ)⌝ is true at a context c and index $<w, t>$ iff there is some time t' prior to t such that φ is true at c and $<w, t'>$.[18]

Such analyses can be extended for grammatical aspect as well. For example, on a simple analyse of the progressive, a sentence of the form ⌜PROG(φ)⌝ involves cardinality measures over intervals (Bennett & Partee, 1972), as in (13)[19]:

(13) $[\![\text{PROG}(\varphi)]\!]^{c,<w,I>} = 1$ iff $\exists I'$ such that $I \subseteq I'$ and $[\![\varphi]\!]^{c,\,<w,\,I'>} = 1$.

In English, a sentence of the form ⌜PROG (φ)⌝ is true at a context c and index $<w, I>$ iff I is a subset of some interval I' such that φ is true at c and $<w, I'>$. While the problems with these proposals are well-known, they illustrate the promise of quantificational treatments of tense and aspect.

4.3.2 | Acquisition data

Since the mid-1970s, there have been many studies of the acquisition of tense and aspect markers in spontaneous and elicited production of early child speech in many different languages. Without exception, the studies find that children begin to acquire tense and aspect markers from a young age (that is, before 2;6), although they do not voice all available tense–aspect combinations in their language immediately. More specifically, children typically restrict their past tense and perfective markers to telic verbs (verbs which describe actions tending

[17]Here our model contains a set $T = \mathbb{R}$ (intuitively, the set of times) and a linear order $\leq$ over T (intuitively, the *before-or-at-the-same-time-as* relation). Then $t_1 < t_2 =_{\text{df.}} t_1 \leq t_2$ and $t_1 \neq t_2$.

[18]As with modality, some theorists argue that natural language employs a temporal system involving *explicit* quantification over times in the object language, analogous to the extensional machinery analysis of objectual quantifiers in terms of explicit syntactic variables, which are evaluated relative to variable assignments functions and bound by quantifiers (Cresswell, 1990; Kusumoto, 2005; Partee, 1973; Schlenker, 2006).

[19]Here, we take indices to be pairs of worlds and intervals, where I is an *interval of* T iff $I \subseteq T$ and for any $t_1, t_3 \in I$ such that $t_1 \leq t_3$, if t_2 is such that $t_1 \leq t_2 \leq t_3$, then $t_2 \in I$. Truth at a singular instant t_i is just truth at the interval $[t_i, t_i]$.

towards a goal or which have an endpoint), while also restricting their language's present tense and imperfective aspect to atelic verbs (verbs which describe situations that are realised as they begin), even though there is nothing ungrammatical about other tense–aspect combinations. For example, children will often say things like *broke* (telic + past + perfective), but rarely say things like *breaking* (telic + imperfective) or *rode* (atelic + past + perfective). This phenomenon is widely observed across languages, although the specific instantiation of this pattern does vary from language to language.

Production studies of the acquisition of English suggest that morphological forms of grammatical aspect and tense tend to be acquired early. For example, in a naturalistic longitudinal study of spontaneous and elicited speech of three children, Adam, Eve, and Sarah, Brown (1973) found that the progressive *-ing* and the past tense *-ed* are among children's earliest morphemes. More specifically, Brown found that each child had acquired present progressive by the time that they had an MLU of 2.25 (Eve: 1;9, Adam 2;6, Sarah: 2;10) and had acquired past tense (*−ed* and irregular forms) by the time they had an MLU of 4.0 (Eve: 2;3, Adam 3;6, Sarah 4;0). Similarly, Bloom et al. (1980) observed similar results in the spontaneous speech of four American English-speaking children; progressive *-ing* typically appears on activity verbs like *playing*, and not on telic verbs, while past tense is mostly produced on telic verbs such as *found* and *fell*. Similar such asymmetrical patterns have been observed in other languages, such as French (Bronckart & Sinclair, 1973), Italian (Antinucci & Miller, 1976), German (Mills, 1985), Greek (Stephany, 1981), Japanese (Shirai & Andersen, 1995), Mandarin Chinese (Li & Bowerman, 1998), Polish (Weist et al., 1991, 1997, 1999), and Russian (Bar-Shalom, 2002); see, also, the references in Slobin (1985).

Comprehension tests also suggest that even 2-year-old children understand tense marking. For example, Valian (2006) conducted a simple experiment on 2-, 3-, and 4-year-old monolingual English-speaking children to test their understanding of present and past tense auxiliaries. Children were shown two items in the same state (e.g., two baby shoes, both untied) and then one of the items changed state (e.g., the experimenter tied one of the shoes). After tying a shoe, children were asked "Show me the one I *did* tie" or "Show me the one I *will* tie". Even the 2-year-olds reliably distinguished the tense very well with *will*/*did*. The children were also tested with progressive *is*/*was* for atelic verbs, such as *cry*. For example, children were shown two crayons rolling back and forth. After stopping rolling one crayon, the child was asked "Show me the one that *is* rolling" or "Show me the one that *was* rolling". It was found that 2-year-olds were unsuccessful at distinguishing these forms, although 3-year-olds performed better on this task. These findings support the claim that children produce and comprehend some tense–aspect combinations from as young as 2 years of age (that is, at around the same time as they productively use generics), although they fail to use all tense–aspect combinations available to them until later in development.

4.4 | Discussion

I began this section by observing that the evidence that generics are acquired before quantificational determiners does not straightforwardly support the hypothesis that generics express a primitive, non-quantificational form of generalisation. This is because the generic operator is standardly analysed as an adverbial quantifier, not a quantificational determiner, and the acquisition pathways of these different kinds of quantifiers may differ in important regards. Consequently, to rule out the possibility that generics express quantificational generalisations, we

should compare the acquisition pathway of generics with that of A-quantifiers, the grammatical category to which the generic operator belongs, and only if we find that generics are acquired before A-quantifiers would we have support for the generics-as-default-generalisations hypothesis.

However, looking outside the study of generics, one finds evidence that children begin to produce adverbs, modals, tense, and aspect from around the same time that they acquire generics. Furthermore, there is evidence that children lack complete adult-like mastery of all aspects of modals, tense and aspect until later on in development. These facts are surprising if the dual-process explanation for an acquisition gap between generics and quantificational determiners is correct. For this explanation trades on the idea that generics express cognitively primitive, *non-quantificational* System 1 generalisations, whereas quantificational generalisations are expressions of System 2 judgments. That is, quantificational generalisations appear later in development than non-quantificational generics because they depend on considerations of quantity, whereas generics do not, and they require inhibitive processing to override System 1 judgments. But if this explanation is correct, then it is puzzling why children acquire these A-quantifiers at the same time as generics. After all, our best semantic theories invariably understand modals, tense, and aspect as involving quantification. Consequently, the dual-process explanation makes a specific prediction about when we should expect them to appear in early child speech: Such expressions should come latter in language development, presumably at the same time as explicit D-quantifiers, rather than alongside generics. This prediction is not borne out in the empirical literature, casting doubt on the viability of the explanation.

One might wonder whether Leslie's scepticism towards formal semantic approaches to generics could be extended further. If the acquisition data suggests that children begin to acquire modals, tense, and aspect from a young age, could the formal semantic approaches to those domains be incorrect as well? Not obviously. For while non-quantificational theories of modality and tense have been proposed, it is far from clear how to extend a dual-process explanation for acquisition gaps to those domains. Furthermore, it is unclear how any such proposal would account for the acquisition gaps *within* those domains, that is, for the "epistemic gap" between root and epistemic modalities and the failure of children to productively use all tense-aspect combinations available to them. Lastly, even if such explanations are forthcoming, given the empirical and predictive power of quantificational formal semantic approaches to modality, tense, and aspect, we should not jettison such theories without properly investigating whether they can be reconciled with the acquisition data. In the following section, I propose an alternative approach to these acquisition puzzles that reconciles the genuine insights of the cognition-based approach with formal semantics.

5 | DEFAULTS IN THE VERBAL DOMAIN

The early acquisition of A-quantifiers undermines any account of generics that attempts to drive a wedge between them and other quantificational expressions, such as Leslie's dual-process theory. But proponents of the generics-as-default-generalisations hypothesis need not commit themselves to this specific implementation of their core idea. Once we decouple the claim that generics involve cognitive defaults from the claim that they express non-quantificational System 1 judgments, we are free to use cognitive defaults to explain the acquisition of various other quantificational expressions. In this section, I sketch such an explanation, with the aim of reconciling the genuine insight that generics involve cognitive defaults with the progress that formal semantics has made to our understanding of A-quantifiers more generally.

Some theorists explain the development of modal language in early children speech in terms of the forms of mental representation available to children at different stages in cognitive development. For example, Anna Papafragou (1998, 2000) explains the acquisition gap between root and epistemic modals in terms of the development of a "theory of mind" in young children.[20] Human cognition involves the ability to reflect upon one's own mental contents and processes to construct a coherent, common-sense theory about the world, and, as a child's theory of mind develops over time, they are capable of entertaining increasingly complex forms of mental representation (Carruthers & Smith, 1996; Gopnik, 1993; Gopnik & Wellman, 1994; Wellman, 1990). Initially, 2-year-old children have a non-representational grasp of desire and perception, which takes desires as drives towards objects and perceptions as awareness of objects. This basic desire–intention psychology predicts that desire- or goal-based modalities would be the child's first modalities, since their theory of mind is constrained to only non-representational desires or perceptions. And this is exactly what we see: The first uses of English modals appear before the third year and typically communicate ability (*can*) or (quasi-) intention (*will*).

But as the child's theory of mind develops, they gain the ability to form and entertain representations that differ from reality, such as representations of other people's states of mind. 3-year-olds develop a non-representation conception of belief according to which belief contents reflect or "copy" the world directly, with children being incapable of acknowledging beliefs from different sources. By 4 or 5 years of age, children develop a representational model of mind capable of representing multiple perspectives in explanations of human thought and action. Consonantly, we see the emergence of epistemic modals and mental terms like *may* and *might*, which is unsurprising given that these developments are needed to understand epistemic modals and mental terms that communicate different representations of possibility. The development of the child's theory of mind tracks the temporal pattern of their acquisition of modals with surprising accuracy.

Such explanations are compatible with the standard quantificational semantic analysis of modals according to which whether a modal has an epistemic or a root interpretation is encoded by its modal base, the set of propositions that provides the domain of possibilities over which the modal quantifies. Epistemic modals require an epistemic modal base (e.g., *In view of what is known* ...), while root modalities require other kinds of modal bases, such as a deontic (e.g., *In view of what is commanded* ...) or a teleological (e.g., *In view of your aims* ...) modal base. If a child's theory of mind constrains the kinds of representations available to her, then it may also constrain the kinds of modal bases she can construct in systematic ways. On this view, children initially give voice to desire-based or goal-based modalities because their theory of mind only allows them to construct modal bases grounded in non-representational desires or perceptions. As the child's theory of mind develops, she develops a representational model of belief and thus the ability to construct modal bases grounded in mental representations of beliefs and knowledge. Consequently, the child begins to produce and comprehend epistemic modals.

Similar remarks apply to the temporal domain. Theorists have argued that children's underextension of temporal and aspectual morphology reflects a link between certain tense–aspect combinations and the underdevelopment of certain forms of representation. More specifically, children initially form mismappings between tense and grammatical aspect morphology and meanings because they are employed to mark (a)telicity (or lexical aspect), rather than

[20]For other arguments that humans possess a primitive ability to construct default representations of modality, see Phillips and Cushman (2017) and Phillips and Knobe (2018).

temporality or grammatical aspect meanings (Antinucci & Miller, 1976; Bloom et al., 1980; Shirai & Andersen, 1995; Wagner, 2001; Weist et al., 1984). Different explanations have been proposed for why children initially misanalyse tense and aspect morphology, but they all assume that there is something more natural about certain tense–aspect combinations, in particular, telic + perfective + past and atelic + imperfective + present. According to one prominent account, early uses of tense and aspect reflects a limited capacity to temporally decentre, that is, to adopt a temporal perspective that may differ from the event time itself or the present time (Weist, 1989). At around 2–3 years of age, children become capable of considering past and future events from the perspective of the time at which those events happen, and not just from their own perspective. Concurrently, we see the emergence of past tense. But since those representations are still tied to the present, tense and grammatical aspect is taken to encode the (a)telicity of the verb: Telic verbs are paired with past tense and perfective aspect because events with a natural point of completion are more naturally described as having taken place in the past, while atelic verbs are paired with present tense and imperfective aspect because unbounded events are more naturally described as currently taking place. As children develop the ability to consider past and future events from different perspectives, such as from reference times that differ from the speech or event time, other tense–aspect combinations emerge.

These explanations are compatible with the standard quantificational semantics for tense and aspect. Formal semantics does not require that the meaning of every tense–aspect combination is immediately graspable in cognition. Certain tense–aspect combinations may describe events and situations that are more cognitively natural than others, and so we would expect them to appear earlier in child speech. As the child gains the ability to entertain more complex representations, we see this reflected in their language. Rather than presenting cognitive defaults as in tension with a formal semantics, we have a view where aspects of the formal semantic analysis are gradually revealed to the child. While we do not have complete and immediate access to all linguistic components, as we gain cognitive sophistication, we gain mastery of our language. Again, we see how a developmental explanation of the acquisition of tense and aspect is compatible with its standard quantificational semantic analysis.

So far, I have focused on how cognitive-default-based explanations of the acquisition of modals, tense, and aspect are compatible with their standard quantificational semantic analyses. I now want to propose something similar for generics: The crucial insight that generics give voice to an innate, default mode of generalising can be implemented within the standard quantificational analysis of generics.

As proof of concept, assume generics involve quantification over the most normal worlds or the most normal individuals under a particular restriction (e.g., Asher & Morreau, 1995; Asher & Pelletier, 2013; Eckardt, 2000; Greenberg, 2003; Krifka et al., 1995; Pelletier & Asher, 1997). More formally:

(14) $[\![\text{Gen } x_1,\ldots, x_n\ [\text{Restrictor}(x_1,\ldots, x_n)][\text{Matrix}(x_1,\ldots, x_n)]]\!]^{w,\,f,\,\leq} = 1$ iff for every $x_1,\ldots, x_n$ and every $w' \in \cap f(w)$ such that $[\![\text{Restrictor}(x_1,\ldots, x_n)]\!]^{w',\,f,\,\leq} = 1$, there is a world $w'' \in \cap f(w)$ such that $w'' \leq_w w'$, and for every world $w''' \leq_w w''$, $[\![\text{Matrix}(\{x_1\},\ldots,\{x_n\})]\!]^{w''',\,f,\,\leq} = 1$,

where $\cap f(w)$ is the modal base relative to w, and $\leq_w$ is an ordering source. We have seen that children can produce and comprehend root modalities from a young age, in part because their basic desire–intention psychology permits them to construct the relevant modal bases. Furthermore, any inability to temporally decentre does not prevent the use of atelic verb forms with present tense and imperfective aspect morphology. Consequently, given that early generics

typically involve root modalities with verb forms least marked for tense and aspect, there is no reason that children would be incapable of handling truth-conditions like (14). Indeed, we can understand the default mechanism for generalisations proposed by Leslie and her collaborators as a mechanism that supplies the modal base of the generic operator.

Contrastingly, to interpret quantificational determiners in context, one requires the ability to determine an appropriate domain restriction, which is only acquired later in development. Determining exactly which bottles are relevant for evaluating the sentence "Every bottle is in the fridge" involves the ability to represent reality in a certain way and to entertain the states of mind of other people. If this is correct, then one would naturally expect quantificational determiners to appear later in development than other quantificational expressions whose domains are specified by a cognitive default. The result view is a powerful explanation for the early acquisition of generics, one which combines the insights of Leslie and her collaborators with the resources of formal semantics.

The emerging idea is that cognitive defaults can inform the development of our lexical competence across a broad range of domains and subject matters, including genericity, modality, and temporality. Initially, children's use of modals and tense–aspect morphology give voice to certain default ways of representing possibilities and temporality with their interpretations limited by the kinds of representations they can make. As they become capable of more complex representations, this is reflected in their modal and temporal language. This explains the acquisition gap between root and epistemic modalities and the initial under-extension of children's tense–aspect morphology. I have suggested that similar explanations may hold about the acquisition of genericity. Consequently, rather than jettisoning the standard quantificational semantic analyses of these expressions, these explanations augment and complement formal semantics by demonstrating how different aspects of cognition play a role in lexical competence.

6 | CONCLUSION

This article has reconsidered the generics-as-default-generalisations hypothesis by drawing connections between the acquisition of generics and other A-quantifiers. An analogue of Leslie's problem of generic acquisition involving the acquisition of other A-quantifiers calls into question the empirical support for a purely cognition-based approach to generics as implemented within a dual-process theory of cognition. This puzzle requires us to decouple the core hypothesis that generics involve cognitive defaults from its specific implementation within a dual-process theory, and generalises the idea that semantic processing involves cognitive defaults to the modal and temporal domains. There is empirical evidence for default modes of representation in such domains, as well as evidence that cognitive development constrains the order in which we seem to acquire certain concepts. These facts do not require us to jettison formal semantics. Instead, formal semantics and cognitive defaults work in tandem, whereby the cognitive system provides default values for contextual parameters and general constraints on orders of acquisition. In the case of generics, their early acquisition may be explained by a combination of their cognitive primitiveness together with more general psychological tendencies to favour root modalities and an inability to temporally decentre at an early age. This suggests a more ecumenical explanation for the general acquisition problem: Cognitive defaults inform our formal semantics in ways that are responsible for the acquisition of A-quantifiers more generally.

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There are no data available.

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