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GENERICITY IS EASY? FORMAL AND EXPERIMENTAL PERSPECTIVES

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Abstract

In this paper, we compare the formal semantics approach to genericity, within which genericity is viewed as a species of quantification, and a growing body of experimental and developmental work on the topic, mainly by psychologists rather than linguists, proposing that genericity is categorically different from (and significantly simpler than) quantification. We argue that this *generics-as-default* hypothesis is much less well supported by evidence than its supporters contend, and that a research program combining theoretical and experimental research methods and considerations in the same studies is required to make progress.[1]

1. Introduction

Generalisations can be expressed in natural language in two distinct ways: quantificational and generic. Quantificational generalisations are expressed in quantitative, statistical terms. Statements like *some lions live in cages*, *most tigers have yellow eyes* or *all cats eat mice* refer to the quantity that satisfies the relevant property. In a semantic theory, these generalisations can be relatively easily modelled in terms of set-inclusion relations (Barwise and Cooper, 1981). Thus, for the sentence *some lions live in cages* to be true, the intersection of the set of lions with the set of things that live in cages must be non null and for the sentence *all cats eat mice* to be true the set of cats must be a subset of the set of things that eat mice.

On the other hand, generic generalisations do not seem easily reducible to these terms, but seem to reflect richer and more complex relations between the kind and the property. Generic statements like *tigers have stripes*, *the lion is a proud animal* and *a cat is a mammal* make general claims about kinds of entities and refer to a property that is characteristic of the kind in question. They

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express properties that have been characterised as 'non-accidental' (Dahl, 1975), 'essential' (Gelman, 2003), or that bear a 'principled connection' to the kind (Prasada and Dillingham, 2006).

Generic statements have been studied in the formal semantics literature since the '70s (Lawler 1972, 1973, Dahl, 1975, Nunberg and Pan, 1975, Carlson, 1977). Questions about genericity have also been recently addressed in experimental and developmental psychology, where researchers have proposed the *generics-as-default* view (see Hollander, Gelman and Star, 2002, Leslie, 2008, Leslie, Khemlani, and Glucksberg 2011, Gelman 2010). This experimental perspective is welcome, as it can provide robust and replicable evidence about the interpretation of generics in different contexts, which may contribute towards resolving debates about different semantic analyses of the source of generic interpretations and modelling of their truth conditions (see Krifka, Pelletier, Carlson, ter Meulen, Chierchia, and Link 1995 and Mari, Beyssade, and del Prete 2013 for overviews of the topic).

However, the literature on the processing and acquisition of genericity has often ignored or misrepresented the relevant linguistic analyses and stands to benefit from the wealth of insights and the systematicity found in the theoretical linguistics literature.

Traditionally, there have been two types of phenomena classified as *generic* (Krifka et al., 1995). The first one involves *kind-referring* noun phrases (NPs henceforth), as in (1), where the subject NP *the potato* does not refer to a particular potato, but rather to the kind *potato* itself. The second one involves propositions, called 'characterising sentences', which describe a general property or regularity that summarises groups of particular episodes or facts, as in (2), rather than specific or isolated facts. These two phenomena can also co-occur, as in (3). In this paper, we focus mainly on sentences of the third type.

(1) The potato was first cultivated in South America.
(2) John goes for a walk after dinner.
(3) The potato is highly digestible.

The main characteristics of generics include the following: a) temporal unboundedness, or atelicity (usually not linked to a specific time), b) law-likeness, or regularity (expressing patterns, not singular events or situations), c) association with dispositions and abilities (independent of particular circumstances),

d) resistance to contextual restriction, and e) tolerance of exceptions. We do not discuss the first three characteristics here in detail, given that the research we discuss has not focused on these features of generics, but see Mari et al. (2013: 43–53) for an insightful discussion. In the next section we turn to the remaining two main characteristics of generics.

1.1 Resistance to contextual restriction

Standardly (Krifka, 1987:7), generics differ from universals in that they cannot be contextually restricted. Thus, while the nominal argument of *every* (*lion* in (4a)), is subject to *quantifier domain restriction* (QDR) in the sense of Stanley and Szabó (2000) and can be contextually restricted to the set of lions in this cage by covert domain variables at LF or some other appropriate level of representation, this is not a possible interpretation for the NP *lions* in (4b), which expresses a property of lions in general, rather than of the specific set of lions in the cage under discussion:[2]

(4) Context: There are lions and tigers in this cage.
   a. Every lion is dangerous. (Can mean 'Every lion in this cage is dangerous')
   b. Lions are dangerous. (Cannot mean 'Lions in this cage are dangerous')

1.2 Tolerance to exceptions

Generic statements tolerate exceptions (Krifka et al. 1995), in contrast to universally quantified statements. Take for example (5):

(5) Tigers have stripes.

(5) can be truthfully uttered even in the face of exceptions, such as the existence of stripeless tigers. By comparison, the universally quantified statement (6) is false if there is even one tiger that does not have stripes (unless its domain is appropriately restricted, as above).

[2] This is only one possible way to derive domain restriction, but it suffices for the purposes of this discussion. We return to QDR in section 3.

(6) Every tiger has stripes.

Clearly, generics do not have the straightforward truth and licensing conditions of quantified generalisations. Even though generics have been studied for more than four decades, the question Pelletier (2010:9) poses remains unanswered: "How many exceptions can a generic statement tolerate and still be true?" He provides the following examples to illustrate the differences in the number of exceptions allowed:

(7) Snakes are reptiles.
(8) Telephone books are thick.
(9) Guppies give live birth.
(10) Lions have manes.
(11) Italians are good skiers.
(12) Frenchmen eat horsemeat.

In (7–12), we see that the percentage of exceptions ranges from 0, to a few abnormal cases, to around 50% and even higher. (13) (due to Leslie, 2007) seems to be true even though fewer than 1% of mosquitoes actually carry the virus (Hayes, Komar, Nasci, Montgomery, O'Leary and Campbell 2005), while (14) is not, even though considerably more than half of all books published are indeed paperback (Shaffer, 2012). Thus statistical prevalence is neither a necessary, nor a sufficient requirement for genericity.

(13) Mosquitoes carry the West Nile virus.
(14) Books are paperbacks.

Greenberg (2007) argues that, contra Krifka (1987), generics may be subject to contextual restriction after all. She draws an important distinction between two types of exceptions: exceptional individuals/situations and contextually irrelevant individuals/situations. Exceptional individuals/situations are non-standard or abnormal with respect to some relevant aspect, i.e. legitimate exceptions to 'dogs have four legs' are dogs that have mutations, have had an accident, etc. An implicit contextual restriction to 'normal' or 'typical' individuals can account for how generics tolerate these exceptions, and such an implicit restriction may also block the availability of more specific contextual restriction in (4b). By contrast, the tolerance to contextually irrelevant individuals/situations is dependent on utterance context or is

contributed by presuppositions, implicatures or real world knowledge triggered by the predicate (drawing on Carlson 1999). For instance, in considering *snakes lay eggs*, male and juvenile snakes are excluded from the context because the predicate *lay eggs* is only felicitously applied to the subset of animals that can give birth (adult females). We return to a fuller discussion of exceptions and QDR in our review of the experimental literature.

1.3 Classification of generics

The variability in the tolerance of exceptions discussed in the previous section and the fact that generic statements as a group have a wide variety of interpretations has lead some people to suggest that they do not form a uniform class (Lawler, 1973). Even if we want to treat generics as a single phenomenon though, it seems essential to acknowledge different types of generic generalisation. Leslie et al. (2011: 19, table 1) define (5) distinct subtypes:

a) **quasi-definitional**: property must be universally true of all the members of the kind; no exceptions, e.g. *triangles have three sides*
b) **majority characteristic**: property must be central, principled or essential (Gelman 2003; Medin and Ortony 1989) and directly related to the nature of the kind. It must be highly prevalent – while allowing some exceptions (e.g. albino tigers), e.g. *tigers have stripes*
c) **minority characteristic**: property must be central, principled or essential, but only be held by a minority of the kind. Restricted to methods of gestation, methods of nourishing the very young, and characteristic physical traits exhibited only by one gender, e.g. *lions have manes*
d) **majority**: property must be prevalent among members of the kind, but must not be a principled connection (Prasada and Dillingham 2006, 2009), e.g. *cars have radios*
e) **striking**: property must only be exhibited by a small minority of the kind, and must signify something dangerous which is to be avoided, e.g. *sharks attack people*

Leslie et al. (2011) distinguish these types of generic generalisations from false generalisations that share the form of generics, but are not true:

a) **false generalisation**: property must be prevalent among members of the kind and there must be a sufficiently salient alternative property (e.g. being left-handed), so that the generic form of the predication sounds false or mistaken, e.g. *Canadians are right-handed*

The degree of exceptionality is one of the defining parameters of the above-described categories. Quasi-definitionals do not allow any exceptions, majority characteristics allow for some exceptions, minority characteristics allow for over 50% of exceptions and striking generics allow for a vast number of exceptions. The other defining parameter seems to be whether the property is a characteristic or striking one or just a statistical generalisation (see Prasada, Khemlani, Leslie and Glucksberg, 2013 for further discussion).

Striking and minority characteristic generics pose a particular problem for quantificational accounts, since the relevant property holds of only a minority of members of the kind in question.

1.4 The expression of genericity

Even though most of the examples above involve bare plurals (BPs), generics can be expressed by a range of NP types (Krifka et al. 1995:8):

(15) a. John drinks coffee.
b. My brother drinks coffee.
c. A teacher drinks coffee.
d. Every teacher drinks coffee.
e. Coffee is tasty.

The important observation here is that genericity is not encoded in a unique and unambiguous way by the use of exclusively generic forms (e.g. by a generic determiner or quantifier). This is not a particular characteristic of English. Generic meaning is not known to be encoded by a dedicated overt GEN marker in any language. Although genericity is common in all languages, languages make use of various grammatical, semantic and pragmatic cues, which contribute to the interpretation of a certain sentence as generic. These include the lexical semantics of the constituting elements, pragmatic knowledge, discourse situation, grammatical marking of definiteness and quantification, syntactic position of

the NPs and grammatical marking of tense, aspect, and mood on the predicates (see Chierchia, 1998, Longobardi, 2001, Farkas and deSwart, 2007).

In Greek, for instance, a definite plural NP is by far the most frequent in generic statements (Marmaridou-Protopapa, 1984):[3]

(16) I tighris ehun righes.
the tigers have stripes
'Tigers have stripes.'

While variety of means of expression of a phenomenon cross-linguistically is not rare, what *is* remarkable is that genericity is not encoded in a unique and unambiguous way by the use of exclusively generic forms in any known language.[4] Thus, an interesting question is how interlocutors recognize that a generic statement has been made and whether the absence of a dedicated, unique marker of genericity is a theory-critical observation. We return to this issue in section 4, which discusses the *generics-as-default* view. In the next section, we discuss the formal semantics view that relies on a quantificational analysis of genericity, the backdrop against which the *generics-as-default* view was proposed.

2. The formal semantics analysis of genericity

Mari et al. (2013) surveys the full range of analyses of genericity, which variously assume modal operators in possible-world semantics (Krifka et al., 1995 among others), non-monotonic inferences (Asher and Morreau, 1995), prototypicality (Nunberg and Pan, 1975), stereotypicality (Geurts, 1985) and/or probability of the information conveyed (Cohen 1999, 2004) as licensors of generic interpretations. We focus on just the modal approach laid out in Krifka et al. (1995).

[3] These sentences are ambiguous between a definite (specific) and a generic interpretation; the context disambiguates which one is the intended meaning. See Ionin, Montrul, and Santos (2011) and Ionin, Montrul, and Crivos (2013) for the same ambiguity in Spanish.

[4] In languages without articles, such as Finnish, which morphologically conflates referential marking and role marking, the morphological case of a phrase might be a relevant feature in generic marking. Korean and Tagalog employ topic-marking elements, while in Vietnamese some types of generics contain classifiers. For a discussion of the typological parameters of genericity see Behrens (2000).

The common feature of all these accounts is the fact that they treat generics as quantificational, akin to quantificational adverbs. Thus the formal semantics accounts of generics do not assume a categorical distinction between the two kinds of generalisation, generic and quantificational.

2.1 The modal approach

Krifka et al.'s (1995) version of the modal approach has become the received view of generics. This view treats generic sentences as modalised conditional statements that involve a universal quantifier. This proposal was an answer to the following puzzle: though generics seem similar to statements involving the universal quantifier, they are both more restrictive and less restrictive. Generics are more restrictive, because they are law-like: mere accidental generalisations like *books are paperbacks*, although statistically true, do not qualify as true generics. But generics are also less restrictive than universals, given that they allow for exceptions.

Modal accounts assume a phonologically null quantifier 'GEN' that is an unselective variable binding operator similar to a quantificational adverb like *usually* as analysed in Lewis (1975). This operator is sentential and is represented by a tripartite structure as in (17) (Krifka et al. 1995:26) showing the general form of adverbial quantification:[5]

(17) GEN [restrictor] [matrix]
Q [x_1, . . . , x_j; y_1, . . . , y_j] (Restrictor [x_1, . . . , x_i]; Matrix [{x_1} . . . , {x_i}, y_1, . . . , y_j])

Krifka et al.'s (1995) intensional analysis of GEN proposes that a sentence with an indefinite singular is interpreted as a conditional sentence with the *if*-clause providing the restriction for GEN. GEN is interpreted as an intensional unselective universal quantifier meaning 'must'. On the assumption that indefinites contribute a free variable ranging over individuals (Heim, 1982), this variable can also be bound by the universal quantifier. As Mari et al.

[5] The tripartite structure (Heim, 1982, Farkas and Sugioka, 1983), an alternative to Carlson's unitary operator *Gn*, was proposed to accommodate sentences like "typhoons arise in this part of the Pacific", which can be interpreted as either "typhoons in general have a common origin in this part of the Pacific", or as "there arise typhoons in this part of the Pacific" (see Krifka et al. 1995).

(2013:67) illustrate, Krifka et al. follow a classical modal framework, in which *W* is a set of worlds, *D* is a domain of entities, and ≤ an ordering source on worlds according to normality. Thus, a generic sentence like (18) is represented as follows:

(18) a. A dog barks.
b. If something is a dog, it barks.
c. $\forall w' \leq_w$, x [dog(x,w′)][barks(x,w′)]
Paraphrase: in all worlds, which are 'normal', if something is a dog in those worlds, then it barks in those worlds.

Quantificational approaches to genericity suffer from two basic problems. First, as discussed above, striking and minority characteristic generics are not obviously accounted for. And second, these analyses do not address the issue of how listeners know that there is a generic operator in a sentence, or, especially, how children learning a language would come to posit such an operator.

Since the early 2000s, generics have drawn the attention of psychologists (see Hollander et al. 2002, Leslie 2008, Gelman 2010, Leslie et al. 2011), who offer an alternative view of generics.

3. The psychology literature: the *generics-as-default* view

Much of the psychology literature focuses on the following two fundamental questions:

a. How do children acquire generics in the absence of dedicated words or morphemes that encode genericity cross-linguistically (Dahl 1985)? Relatedly, when are generics acquired?
b. What is the status of generics in the language/cognition interface?

One possible answer to these questions is given by the *generics-as-default* (GaD henceforth) view. The main tenet of this approach is that children do not need to learn anything in order to acquire generics, as generics are a default and innate mode of thinking. Thus, generics come essentially for free. This approach treats generics as categorically different from quantifiers in some

respects, and postulates that generics come first in acquisition. In this view, it is universal (e.g. *all*) and existential (e.g. *a*, *some*) quantification that must be learned as children develop.

In the remainder of this section we will review the main evidence used by defenders of this view in order to gain a better understanding of it. Leslie (2007:381) proposes:

> Children do not ever learn truth conditions for generic claims. Rather, the generalizations that generic sentences express correspond to the cognitive system's most primitive, default generalizations. The ability to generalize pre-dates the acquisition of language; infants as young as 12 months readily form category-wide generalizations on the basis of experience with a few instances of the category [. . .]. There must, then, be an early-developing cognitive mechanism responsible for these most basic generalizations.

Thus the learnability question is not the main puzzle and the lack of a unique cue to identify generics is not a challenge for children. Generics are just the kind of generalisation children first make. When these generalisations are expressed in language, they take the form of generic statements.

This view has consequences for a model of the language/cognition interface. The GaD view posits a 'generic bias', according to which generics come earlier than quantified statements. This idea is linked to the view of cognition that assumes two different systems, made popular by Kahneman and Frederick (2002), which includes a distinction between System 1, a fast, automatic, effortless lower-level system and System 2, a slower, more effortful higher-level rule-governed system.[6]

Leslie (2007) argues for a categorical distinction between generics and quantifiers parallel to the dual systems view. Generic statements are argued to be cognitively primitive generalisations, which are not concerned with quantity, in contrast to quantificational generalisations that are expressed with universal or existential quantifiers. Leslie argues that generics are part of System 1, while quantificational statements are part of System 2.

[6] The dual systems view of cognition, one intuitive in nature and one reflective, is common across scientists who study human reasoning, including conditional and probabilistic reasoning (Sloman, 2002).

One piece of evidence for the existence of two systems is the fact that they can lead to conflicting judgments.[7] Conflicts can arise between what people judge on an intuitive basis and what people judge on a reflective basis and result in fast, automatic System 1 responses, when slower, more effortful System 2 responses are required. In these cases, we might say that System 1 is 'erroneously' employed, and thus, overused. Inspired by this rationale, Leslie speculates that it might be possible to find an error of this sort when one tests the interpretation of generic (System 1) and quantificational (System 2) statements. Errors then would arise when "people interpret quantified statements as though they were generics" (Leslie 2007:398).

3.1 Initial motivation for the GaD view

The following evidence has been used to support the GaD:

Marked/unmarked forms: No known language has a dedicated marker for genericity. Rather, genericity seems to be the result of different cues. On this basis, Leslie (2008:24) argues that generics are the unmarked surface form, whereas quantified statements are marked. Leslie cites Chomsky's (2000) discussion of cases like *John climbed the mountain*: the default interpretation is 'John climbed up the mountain', and the marked interpretation 'John climbed down the mountain', is expressed by explicitly adding the preposition *down*.[8]

Deaf children: Goldin-Meadow, Gelman, and Mylander (2005) report that congenitally deaf children who were never exposed to either spoken language or sign language, and instead developed their own communicative gesture system (home sign) routinely

[7] Leslie (2007:395) cites Frederick's (2005) "cognitive reflection test", to illustrate the two systems: "A bat and a ball cost $1.10 in total. The bat costs $1 more than the ball. How much does the ball cost?" Most people report an initial inclination to answer "10 cents". System 1 supplies this first fast, but erroneous response. The correct response of "5 cents" requires algebraic reasoning, part of the slower System 2.

[8] In semantic/pragmatic theory there is a well-established association of marked forms with the complement of the interpretation that is stereotypically assigned to the unmarked counterparts (in the case of 'climbing the mountain', given that its semantics encompass both climbing up and climbing down, the complement of the stereotypical interpretation, climbing *up* the mountain, is climbing down). Lehrer (1985) offers an analysis of this phenomenon that relies on non-equi-biased antonyms, and Levinson (2000) proposes a more general theory of markedness and stereotypical interpretation: the interpretation of the marked pair of some form of expression is given with contrast to the preferred interpretation of the unmarked. However, it is unclear to us what the complement of the stereotypical interpretation of generics would be, or that quantified statements are interpreted with contrast to the interpretation assigned to generics.

employed gestures most naturally understood as generics (Leslie 2007:383) and, furthermore, that the amount of generics used by these children was very close to the amount used by hearing children.[9]

Pirahã: Everett (2005) argues that Pirahã lacks universal quantifiers like *all*, yet features generics. Everett discusses examples like *kaoáíbogi hi sabí 'áagahá* (evil spirits are mean) and argues that their truth conditions correspond to the truth conditions of generics (tolerance of exceptions).[10]

Reasoning: Jönsson and Hampton (2006) found that adults judged that *all ravens are black* was more likely than *all young jungle ravens are black*. Logically, such judgments are erroneous, because the first sentence entails the second. Leslie et al. (2011) propose that participants interpreted the universal statements as generics, that is, they relied on the generic *ravens are black* that could be true even if jungle ravens were of a different colour when young.

The GaD view makes the following predictions:

A. **Age/Ease of Acquisition***:* children are expected to produce and comprehend generics with greater ease than quantifiers, and at earlier ages
B. **Generic Overgeneralisation***:* "nongeneric generalizations would, from time to time, inappropriately exhibit some characteristics of generics, especially if the information-processing demands were made great enough" (Leslie, 2008:25). This has been coined the Generic Overgeneralisation (GOG) effect.
C. **Processing costs***:* Quantified generalisations require the "conceptual system to override or inhibit its default operation" (Leslie, 2008:23)

The first two predictions have been tested in a growing literature, as follows.

3.2 The acquisition of generics

As predicted by the GaD view, which argues that generics should be easy for young children to produce and understand, generics

[9] For these observations to be strong evidence in favour of the GaD view, one must also document the distribution of quantified statements in home sign systems.

[10] Everett's data are contested (cf. Nevins, Pesetsky and Rodrigues 2009, Sorensen 2012).

can be found in the speech of children at the earliest multi-word stages. Gelman, Goetz, Sarnecka and Flukes (2008) report data from a study of the developmental emergence of generics by examining longitudinal transcripts of parent-child conversations taken from the CHILDES project (MacWhinney and Snow 1985). The study included eight children aged 2;0–3;7 at first recording, who were followed to ages 3;1–4;11. They find, first, that generics are frequent in children's natural speech: all children, for whom there were data at age two, produced generics, and by age four children produced generics as frequently as adults. Secondly, they claim that children do not simply imitate their parents' generic talk, but actively initiate generic conversations.

Finding generic utterances in early child speech is certainly consistent with the GaD hypothesis, and not obviously predicted by the standard approaches in formal semantics, which postulate a null GEN operator and complex licensing conditions for generic interpretations. However, neither the Gelman et al. (2008) study nor the other studies reporting generic utterances in early child speech contrast the rates of generic production with the rates of production of quantified or specific utterances in the same children at the same ages. Without that direct comparison, these studies only provide partial support for the GaD hypothesis.

In fact, although there are now nearly 20 studies investigating when and how children produce and understand generics (see the Appendix available as supplementary material), clear, strong evidence for the GaD hypothesis, in line with the above predictions, is quite rare. Only two studies report robust evidence that young children show an early advantage for generic vs. quantified generalisation, as predicted by the GaD view. Hollander et al. (2002) asked 3- and 4-year-old children and adults to answer questions like *Are {fires/all fires/some fires} hot?* They found that while both 3- and 4-year-olds were adult-like in their responses to generic questions, only the 4-year-olds were adult-like with *all* and *some* questions. The 3-year-olds answered all three question types as if they were generic, exactly as predicted by the GaD hypothesis. Leslie and Gelman (2012) asked 3- and 4-year-olds and adults to recall novel facts about familiar animal kinds, where the facts were introduced in either a generic or quantified statement. They found that both children and adults reliably recalled generic facts as generic, but recalled many quantified facts as generic (a GOG effect). The children in this study also differed from adults in their responses to the two quantified statement types used in this

study (*all* vs. *all of these*), suggesting they had not yet mastered the semantics of quantification and specificity.

By contrast, in almost all the other studies published to date, even children as young as two perform well, and adult-like, in their comprehension of both generic and quantified or specific statements. For instance, Gelman and Raman (2003) showed 2-, 3- and 4-year-old children and adults pictures of atypical category instances (e.g. penguins) and asked them questions like *Do birds fly?* or *Do the birds fly?* Both adults and children interpreted non-generic questions as referring to the items in the present context (by answering 'no') and generic questions as referring to the kinds generically (by answering 'yes'). Thus, the authors conclude that even 2-year-olds are already sensitive to subtle morpho-syntactic cues (e.g. *the Xs* versus *Xs*) to distinguish generic from specific reference. This is not the pattern predicted by the GaD view.

An extension of the GaD hypothesis is offered by Gelman (2010: 114), who speculates:

> If I am correct, the task for children is not to acquire a list of all the ways that generics can be marked, but rather to learn to recognize when an utterance is specific. If children assume a conceptual distinction between generic and specific reference, then they can identify as generic those utterances that are not somehow marked specifically. It is in this sense that I propose generics as a default.

Note, however, that even this modified GaD hypothesis, which proposes that not only are generics themselves easy and freely available to the youngest children, but also that children know that generics contrast with specific interpretations, and can thus use morpho-syntactic cues to acquire the grammar of specificity, still predicts an asymmetry. The youngest children should not yet have learned which morphemes mark specific and quantified interpretations, and should make more errors with these utterances. Hollander et al. (2002) and Leslie and Gelman (2012) are the only studies to offer evidence consistent with this prediction, while Gelman and Raman (2003) contradicts it. The developmental studies, then, offer mixed support for the GaD proposal.

Adult processing studies have also been argued to support the GaD view.

3.3 Adult processing of generics

3.3.1 The GOG effect

Prediction 1 above has been argued to be instantiated in the Generic Overgeneralisation Effect (GOG). Leslie et al. (2011) use GOG to refer to "the tendency to overgeneralise the truth of a generic to the truth of the corresponding universal statement" (Leslie et al. 2011:17).

The first detailed investigation of the GOG effect is found in Leslie et al. (2011). Similar results have been reported in other experiments that used truth value judgment (TVJ) tasks (Khemlani, Leslie, Glucksberg, and Rubio-Fernández 2007, Khemlani, Leslie, and Glucksberg 2009, 2012 and Meyer, Gelman and Stilwell, 2011) or recall tasks (Leslie and Gelman, 2012). Other studies have focused on prevalence estimation (Prasada and Dillingham 2006, 2009, Cimpian, Gelman, and Brandone 2010a, 2010b) and the role of prevalence, cue validity and normalcy in the licensing of generics (Prasada et al., 2013).[11]

In Leslie et al.'s (2011) experiment 1, participants had to perform a TVJ task on sentences that were presented in one of three forms: generic, universal (*all*), or existential (*some*). The statements involved different kinds of properties (see §1.3): quasi-definitional, majority characteristic, minority characteristic, majority non-characteristic, striking, and false generalisations. The adult participants sometimes judged universally quantified statements like *all ducks lay eggs* as true, despite knowing that they are truth-conditionally false. The authors claim that the participants made this 'error' because they relied on the corresponding generic statement (*ducks lay eggs*), which is true. They find that the GOG effect occurs in more than half the trials when the statement involves characteristic properties: 78% for majority characteristic and 51% for minority characteristic statements.

Leslie et al. consider some alternative explanations before concluding that the GOG effect is the most suitable interpretation of their results: a) subkind interpretation, according to which people interpret *all ducks lay eggs* as 'all kinds of ducks lay eggs' and thus true, b) ignorance of the facts, according to which people actually think that all ducks (both male and female) lay

[11] There is other experimental work on generics, not motivated by the GaD view, see Ionin et al. (2011, 2013) for a cross-linguistic and second language acquisition perspective, and Prasada, Salajegheh, Bowles and Poeppel (2008), who measure ERP responses to (non)generic utterances.

eggs, and c) domain restriction, according to which people interpret *all ducks lay eggs* as a claim only about the relevant restricted set of female fertile ducks (as per Carlson 1999, Greenberg 2007, discussed above).

The authors discarded the first explanation by asking participants to provide paraphrases of the statements they had just read (their experiment 2b). Subtypes were almost never referred to in the paraphrases, which the authors take to mean this kind of interpretation is not readily available to participants, and thus cannot explain the GOG effect. The second explanation was ruled out on the basis of a knowledge test that showed that people knew the relevant facts (their experiment 3).

They addressed the third possible explanation in experiment 2a. In order to check for the possibility of domain restriction in the sense of Stanley and Szabó (2000), as discussed above, they provided the participants with population estimates of the following form:

(19) 'Suppose the following is true: there are 431 million ducks in the world. Do you agree with the following: all ducks lay eggs.'

This information was supposed to prime quantification over every individual duck in the world, and thereby make it difficult/impossible to interpret *all* as restricted to only the ducks that are presupposed by *lay eggs*. If acceptance of *all ducks lay eggs* in the first experiment was driven by contextual quantifier domain restriction, the authors predicted that it would disappear in the context of population information.

Nevertheless, the GOG effect still occurred on a substantial portion of trials, with a 60% acceptance rate for *all* statements for majority characteristic statements and 30% for minority characteristic statements – less than when the statements appeared with no preceding context, but still a high percentage. The authors thus conclude that domain restriction cannot be the sole explanation for the GOG effect.

4. Taking stock: on how to investigate generics

We now raise some problems with both the experimental evidence for the GaD view, and with current formal semantic

analyses, and sketch out the ways our own recent and ongoing research seeks to address these issues.

4.1 Critical review of the GaD view

Leslie et al.'s (2011) experiment 2a and their interpretation of the results are challenged by the following observations. First, the contexts they use to induce specific/individual interpretations do not make salient the exceptions that would make the universal quantification over individuals interpretation false. An effective context would make reference to, for instance, male ducks, which are exceptions to the generalisation. Merely providing participants with population estimates may not be enough to make domain restriction to only the relevant (adult female) ducks impossible.[12]

Second, claims about universal quantifiers in general ought to be further refined. Languages have different types of universal quantifiers, so even if we accept that *all* is associated with a GOG effect, it is not obvious that other universal quantifiers should also trigger it. It might be that the GOG effect is restricted to *all* quantified statements due to unique features of *all*, such as the possibility for floating and the fact that *all* may or may not be interpreted with respect to the context given. For instance *all cats eat mice* might be interpreted as referring to cats in general or to some contextually salient cats, whereas *all the cats eat mice* is necessarily linked to a salient set. Brisson (2003) proposes that *all* is not a quantifier at all, while Lasersohn (1999) proposes that it has a maximising effect acting as a pragmatic slack regulator. Both accounts would predict that *all ducks lay eggs* would be judged as true, without *all* being misinterpreted as a generic. However, other universal quantifiers, such as *every*, which do not share the special properties of *all* would not be, e.g. compare *all ducks lay eggs* to *every duck lays eggs*. Previous experimental work has not paid close attention to the fine-grained distinctions between different varieties of universal quantifiers, as for instance exemplified in the observation that *all*, *every* and *each* are all universal quantifiers, but differ in terms of distributivity: a collective interpretation is more readily available for *all*, while it is less possible for *every* and impossible for *each* (cf. Beghelli and Stowell 1997).

[12] Leslie et al. do not provide a complete set of materials, so we can only speculate about the extent to which this example is representative.

Another issue that previous experimental work has overlooked is variation in the realization of generics and universally quantified statements both within a language and across languages. The GaD view has mainly focused on BP generics and on *all* universal statements. BPs are only one of the possible NP-types that can appear in generic characterising statements. In English, generics can be also expressed with indefinite singulars like *a cat has a tail* or with definite singulars like *the cat is a domestic animal*.

Finally, a paraphrase task does not provide conclusive evidence to exclude the sub-kind interpretation. The distinction between implicit knowledge and explicit knowledge is one of the most fundamental distinctions in the cognitive sciences: just because participants were not consciously aware that they were interpreting *all ducks* as 'all species of duck' does not mean that they did not do so.

On the basis of these objections, we argue that alternative explanations for the GOG effect have not been ruled out. The main alternative that remains to be investigated is QDR. Domain restriction is routinely invoked in quantification (Heim, 1991) and listeners are known to be 'charitable' in seeking interpretations that would render statements true (Grice, 1975). Furthermore, such 'charitable' domain restriction is more likely if the universally quantified statement used does not require linking with a set under discussion, as is the case with *all* and *every*, compared to *each*, which does (Partee, 1995). Given that *all* so easily lends itself to a domain restricted interpretation, it is an unfortunate choice for a universal quantifier to test the predictions of the GaD view.

In addition to these issues, we also believe that the proponents of this view have not adequately tested one of the clear predictions that follow from the GaD view. If generics are the default interpretation, this makes predictions about their processing. If generics are part of fast and effortless System 1, they are predicted to be faster to process than quantified statements, which are part of slower and more effortful System 2. Meyer et al. (2011) found that participants did sometimes judge universally quantified statements (*all dogs have four legs*) as true when participants were instructed to respond as quickly as possible, but not when there was no time pressure, consistent with predictions, but that study again used *all* and did not include any measure to assess whether participants fully read each word (Ferreira and Henderson, 1990). Lazaridou-Chatzigoga and Stockall (2013) address this issue by recording two time measures: the time it takes

participants to read the statements and the time it takes participants to make the necessary TVJ. Lazaridou-Chatzigoga and Stockall compare generic statements to statements with *all*, *all the*, and *every*. Statements involved either a majority or minority characteristic property read after a preceding context. They find that the time to read the statements was significantly faster for the generic majority characteristic condition than any other condition. This suggests that some generic statements are *easier* to process than the corresponding universally quantified statements, consistent with the GaD view. However, the time to make the TVJ for minority characteristic generic and *all* statements was much *longer* than for the other two universal quantifiers (*all the*, *every*), or for majority characteristic statements, contrary to the GaD, but consistent with participants engaging in a costly process of QDR.

In work in progress, we begin to address this issue by carefully manipulating factors such as quantifier type (generic, *all*, *all the*, and *every*), and preceding context, in order to contrast an emphasis on supporting evidence vs. contradictory evidence. Using different levels of context, and quantifiers with different domain restriction properties will help to clarify the influence context might have on both generics and universally quantified statements, and the reading and response time measures allow us to distinguish between costs associated with initial sentence processing vs. subsequent meta-linguistic decisions.

Furthermore, if generics are the default interpretation, then that would mean that cross-linguistically, the most common form for generics should be less marked than other quantificational statements. This, however, is not true. As we saw in 1.4, in Greek, generics are formed with the definite determiner as in *i tighris* (the tigers) rather than a BP, and are therefore not less marked than quantified statements such as *mia tighri* (a tiger). Not only are generics marked, in this sense, in Greek, Spanish, Arabic etc., but also generic statements are ambiguous between generic and specific readings. *I tighris ehun righes* can also mean 'the (specific) tigers have stripes', so the generic form is not differentiated from the specific, raising issues for Gelman's (2010) proposal about how children learn to make the distinction. Since there is no marked difference between generic and specific interpretations, the GaD view is committed to the view that children learning Greek will interpret *i tighris ehun righes* as a generic by default. In other words, generics are not just the default mode of interpreting generalisations, but also the default mode of interpreting

statements that may be either generic or specific. We are currently running experiments with English and Greek adults to systematically compare the interpretation of generic and quantified statements across languages with distinct generic morpho-syntax. Follow up studies will investigate specific vs. generic interpretation in adults, and in developmental studies testing the markedness claims.

Focusing on the developmental literature, very few studies report any instances of over-generalisation, or other behaviour consistent with the proposal that generics are the default, privileged mode of making generalisations. In two studies, the observations seem to be compatible with the GaD view, but the majority of other studies find that even very young children make systematic, and adult-like, distinctions between generics and quantified generalisations. Thus, children seem to know the morpho-syntax and aspects of the semantics/pragmatics of quantifiers early on, without any attested delay in the acquisition of quantifiers compared to generics. This lack of an asymmetry is more consistent with the formal semantic analyses than the GaD view.

Finally, the literature has mainly focused on whether children are able to distinguish generics from quantifiers, and on whether children use the frequency with which a property holds of a kind in licensing generic interpretations. But as discussed above, genericity cannot be reduced to statistical generalisation or prototypicality. Building on Chambers, Graham and Turner (2008), we are investigating whether children are more tolerant of exceptions when the property is striking, rather than neutral, in order to test whether children truly have adult-like generic interpretations.

4.2 Issues from the theoretical literature

Two issues arise from the theoretical literature that experimental work could profitably address. The first is the possible tension between contextual restriction in Krifka's (1987) terms, and domain restriction as invoked by Stanley and Szabó (2000) and Carlson (1999)/Greenberg (2007). Contextual restriction is proposed as the mechanism by which a quantified, but not a generic, statement can be interpreted with respect to specific individuals *explicitly* mentioned in the previous discourse. Domain restriction, by contrast, is proposed as the mechanism restricting the interpretation of *ducks lay eggs* to only the 'relevant' female fertile

ducks, via an *implicit* connection between the predicate *lay eggs* and some real world knowledge about the individuals who could potentially be denoted by this predicate. Lazaridou-Chatzigoga and Stockall (2013) find that minority characteristic generics like *ducks lay eggs*, and *all* quantified statements (*all ducks lay eggs*), preceded by a context making specific male ducks salient, elicit very slow TVJs, as compared to *all the* or *every* statements, consistent with participants having to engage in a costly process of domain/context restriction in both cases. However, this initial study did not manipulate enough features of the context to be conclusive. Our ongoing work will help us investigate these different kinds of restriction.

The second issue is the learnability and processing challenge raised by any theory in which generic interpretations are determined by one or more covert elements, which are never realized by an unambiguous overt morpho-syntactic form. The GaD hypothesis offers a solution to this problem (exchanging it for the problem of how children acquire a generic vs. specific difference in languages like Greek), but the formal semantics literature does not. Our ongoing work comparing generics in English and Greek will, we hope, allow us to begin to understand what effect the form of a generic statement has on its processing and interpretation, and thus begin to address this question.

5. Conclusions

Both the formal semantics research exploring a compositional, modal semantics approach to generics and the experimental research investigating the GaD hypothesis, have substantially contributed to our understanding of how generics work. However, by juxtaposing these two lines of research, we highlight the significant challenges for each approach. The formal semantics models do not offer any clear explanation for the robust child language findings that generic utterances and generic interpretations are prevalent in children as young as 2 years old, despite not being associated with any overt morpho-syntactic marker in any known language. On the other hand, the evidence for the *generics-as-default* proposal is significantly weakened by a lack of cross-linguistic comparison, or serious engagement with the formal semantics of quantification and specificity. Resolving either of these issues will require interdisciplinary work, integrating the

tools and perspectives of both strands of investigation. We hope this paper will serve to stimulate such research.

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Supporting Information

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Appendix: Summary of Child Data Studies on Genericity

APPENDIX: SUMMARY OF CHILD DATA STUDIES ON GENERICITY						
No	Study	Ages	Language	Task	Manipulation	Results
1	Gelman and Tardif 1998	19-23 months (10 Mandarin, 20 English)	English and Mandarin Chinese	mother-child interaction	Study 1: naturally-occurring speech samples of children interacting with their caregivers in or around the home. Study 2: natural speech gathered within a laboratory setting Study 3: generic comprehension with adults	1. Generic noun phrases were reliably identified in both languages, although they occurred more than twice as frequently in English as in Mandarin 2. Generic usage was domain-specific, with generic noun phrases used most frequently to refer to animals 3. The coding of utterances as generic versus non-generic has psychological reality for ordinary speakers of both English and Mandarin
2	Pappas and Gelman 1998	26 mother-child pairs: 12 younger children (range 1;11-3;0), mean age 2;6) and 14 older children (range 3;2-4;9, mean age 3;9).	English	mother-child interaction	Mother-child pairs were videotaped while looking through a book of animal pictures and using generic/non-generic NPs. Each page depicted either a single instance of a particular category (e.g. a crab) or multiple instances of a particular category (e.g. many crabs)	1. With respect to the manipulation, the form of non-generic NPs was closely linked to the structure of the page, the form of generic NPs was independent of the information depicted 2. 24 of the 26 mothers produced at least 1 generic, with rates ranging across mothers from 0 to 41% of all utterances produced. Overall, fully 11% of mothers' utterances produced during the picturebook reading sessions included a generic. 3. Generics were also found in the speech produced by young children. Although the overall percentage of generics was rather modest (1% of the utterances produced the two y.o. and 5% of the utterances produced by three- and four y.o.), more than half the subjects produced at least one generic noun phrase during the book-reading session (50% of the twoy.o. and 79% of the three- to four y.o.).
3	Gelman, Star, Flukes 2002	Study 1: 37 4y.o. mean age 4;7 (range 3;11-5;5), 36 adults	English	Study 1: inference estimation task with familiar kinds and new facts about them Study 2: percentage estimation task (adults only): what percentage of the category applies to the category (rating scale 0% to 100% in increments of 10%)	Study 1 and 2: {All bears/Bears/Some bears} like to eat ants.	1. Sensitivity to type of wording among both preschoolers and adults, with "all" eliciting the most inferences, "some" eliciting the fewest inference, and generics in between "all" and 2. Children made fewer category-based inferences from generics than did adults.
4	Hollander, Gelman and Star 2002	Study 1:18 3y.o., 18 4y.o., 36 adults Study 2: 48 4y.o., 37 adults	English	Study 1: comprehension study with 3-and 4 y.o. and adults Study 2: elicited production study with 4 y.o. and adults (prompts for children, paper-and-pencil for adults) 3 kinds of cues: "What can you tell Zorg about {dogs/all dogs/some dogs}?	Study 1: Are {fires/all fires/some fires} hot? 3 kinds of properties: a) wide scope b) narrow scope c) irrelevant scope Study 2: 12 categories	1. 4-year-old children—like adults—treated generics as distinct from both indefinites ("some") and universal quantifiers ("all"). In contrast, 3 y.o. did not differentiate among generics, "all," and "some". 2. Preschool children and adults distinguished generics from "some" in scope. Generics are consistently broader in scope than "some" statements. Furthermore, adults but not children treat generics as narrower in scope than "all" statements.
5	Gelman and Raman 2003	Study 1A: 16 4y.o. + 25 adults Study 1B: 18 2y.o. + 16 3y.o. Study 2B: 12 2y.o., 12 3y.o., 12 4y.o. Study 2C: 12 2y.o., 12 3y.o., 12 4y.o.	English	Study 1A: TVJ task with atypical individuals Study 1B: same as 1A Study 2B: Question Answering Study 2C: same as 2B	Study 1A,B: generic/non-generic (dogs/the dogs) Study 2B: mismatch/singular match Study 2C: mismatch/plural match	1. Studies 1A,B: children by 2 years of age use linguistic form to differentiate generic from non-generic 2. Studies 2B,C: children by 3 years of age use pragmatic context as a cue for generic meaning
6	Gelman and Raman 2007	Study 1: 32 3y.o., 35 4y.o., 33 adults Study 2: 24 4y.o. Study 3: 30 4y.o., 33 adults Study 4:36 4y.o., 47 adults	English	Recall task	A picture with generic "Bears climb trees"/non-generic condition "This bear climbs trees"	1. Participants in all age groups correctly distinguished generic from non-generic ir their recall 2. Memory for predicate content (e.g. "climb trees") was largely unaffected for genericity, although memory for category labels (e.g. "bears") was at times better for the generic condition

7	Gelman and Bloom 2007	Study 2: 21 5y.o. Study 3: 16 5y.o.	English	Yes/No task	Study 2: generic vs. specific: Do {dobles/these dobles} have claws? Study 3: Property origins information (either present from birth or acquired artificially) was provided about ''my dobles''	1. Children and adults distinguish generic from non-generic and they interpret generics as referring to kinds (under certain contexts both children and adults accepted 'dobles have claws' even when all the dobles in the available context were claw-less) 2. Adults distinguished inborn from acquired properties, judging inborn properties even when lost as predicated of a generic kind, whereas children did not distinguish inborn from acquired properties
8	Chambers, Graham and Turner 2008	Study 1: 96 4y.o. Study 2: 24 4y.o.	English	Property verification (see whether the property would be extended to a new exemplar of a novel kind)	Study 1: 2 conditions (generic/non-generic, i.e. this/these) x 2 conditions (strong/weak evidence) Study 2: 2 conditions (generic/non-generic) + presentation of exceptions	1. Children reliably extended the property to new instances after hearing generic but not non-generic sentences. 2. The influence of generic language was much greater than effects related to the amount of tangible evidence provided (the number of creatures bearing the critical property). 3. Mean verification rates were higher when the property was expressed in generic sentences compared with non-generic sentences even when incompatible evidence was presented.
9	Cimpian and Markman 2008	Study 1: 36 3y.o. and 36 4y.o. Study 2: 24 3y.o. and 24 4y.o. Study 3: 24 3y.o. and 24 4y.o. Study 4: 3y.o. and 24 4y.o.	English	Determine whether an utterance with ambiguous scope is generic (e.g. 'They are afraid of mice', spoken while pointing to 2 birds)	Study 1: non informative/generic/non-generic NP Study 2: generalizable/non-generalizable property Study 3: doctor/teacher condition Study 4: conflict condition (generic)/no NP	1. 4y.o. take advantage of a) the immediate linguistic context, b) their previous knowledge and c) the social context to determine whether an utterance with ambiguous scope is generic, while 3y.o. were sensitive only to the first two 2. 4y.o. prefer to base their interpretation on the explicit NPs in the linguistic context compared than on previous knowledge, 3y.o. showed no clear preference
10	Gelman, Goetz, Sarnecka and Flukes 2008	8 children (2;0 to 3;7 at first recording, followed longitudinally through to ages 3;1 to 4;11; 6 males, 2 females) from the CHILDES database	English	CHILDES Mother-child interaction	Phase 1: identifying generics, Phase 2: Coding of discourse sequences, Phase 3: Content and form coding	1. Children talk about kinds from an early age, from 2 1/2 y.o. 2.Children initiate generic talk 3. Generics are most often used to refer to kinds of animals or people
11	Gelman, Waxman and Kleinberg 2008	48 mother-child pairs with children aged from 3.5 to 5.0 y.o.	English	Mother-child interaction about 24 sets of items (12 animal sets and 12 artifact sets)	Each set had 4 instantiations: simple object, simple picture, complex object, and complex picture: 2 conditions (simple/complex)	Mothers and children provided relatively more focus on kinds when talking about pictures, and relatively more focus on individuals when talking about objects. The current results demonstrate that this effect is independent of the items' complexity.
12	Brandone and Gelman 2009	Exp 1: 33 adults and 25 4/5y.o. Exp 2: 29 adults and 24 4/5 y.o. Exp 3 : 16 preschoolers	English	Elicited production (generate properties about novel animals and artifacts)	Exp 1: real animals vs. artifacts and generic vs. neutral prompt Exp 2: new matched pairs of maximally similar novel animals and artifacts Exp 3: same as Exp 2 with some modification on the artifacts	The likelihood of producing a generic even without prior knowledge about these items is significantly greater for animals than artifacts

13	Graham, Nayer and Gelman 2011	Study 1: 96 30m.o. Study 2: 48 24m.o. Study 3: 100 30m.o.	English	Study 1: Imitate the target action Study 2: Imitate the target action Study 3: Imitate the target action	Study 1: Sentence-prompt group/sound effect prompt group + generic/non-generic condition Study 2: generic/non-generic paired with an action on an object Study 3: Study 2: generic/non-generic paired with an action on an object + plurality controlled	After hearing nongeneric phrases, 30-month-olds, but not 24-month-olds, imitated more often with the model than with the nonmodel exemplar. In contrast, after hearing generic phrases, 30-month-olds imitated equally often with both exemplars.
14	Leslie and Gelman 2012	Study 2A:26 3y.o., 30 4y.o. Study 2B: 16 preschoolers Study 3: 16 3y.o. Study 4A: 32 preschoolers + 42 adults Study 4B: 16 preschoolers + 10 adults	English	Recall task of novel facts about familiar animal kinds	Study 2A: same as 1A Study 2B: same as 1B Study 3: generic vs. no Study 4A: one-kind vs. subkind + generic/all Study 4B: all/all of these (one-kind only)	Study 2A: a) GEN correct recall 41% + Q correct recall 18%, b) Q more often recalled as GEN (36%) than GEN recalled as Q (12%) Study 2B: Marked tendency to recall Q as GEN Study 3: GEN correct recall 52% + Q correct recall 21% Study 4A: adults (86%) and children (76%) endorse generics similarly, while there is a difference with *all:* adults <1%, children 58% Study 4B: adults rejected *all of these* on 100%, while children agreed to *all of these* at 21%
15	Brandone, Cimpian, Leslie and Gelman 2012	Study 1: 14 5 y.o., 14 adults Study 2: 12 5 y.o.	English	TVJ task: yes/no task (for adults the choice was between 'definitely yes/definitely no' and for children 'a little yes/a little no')	Study 1: Characteristic/non-characteristic property Study 2: Characteristic/non-characteristic property (only with *is*)	Children gave significantly more 'yes' responses for characteristic than non- characteristic items (i.e. they evaluate generics based on more than just quantitative information)
16	Tardif, Gelman, Fu and Zhu 2012	Study 2: 13 3 y.o., 18 4y.o., 18 7y.o. Study 3: 60 5y.o., 60 7y.o., 35 adults, 92 adults	Mandarin Chinese	Study 2: confirmation of generic NPs Study 3: Elicited production	Studies ,2,3:{generic/all/some} and property of {broad/narrow/irrelevant} scope	Mandarin-speaking children begin to distinguish generics from 'all' or 'some' as early as five years. The developmental trajectory for Chinese appears prolonged relative to English and this seems to reflect difficulty with 'all' and 'some' rather than difficulty with generics.
17	Gelman, Leslie, Was and Koch 2015	48 3y.o., 48 5y.o., 121 adults	English	TVJ task with novel animal kinds	Wording: General Q (all/some)/Specific Q (all of these/some of these)/generic Frequency levels: 0%, 25%, 75% and 100%	Generics: both adults and children demonstrate a stepwise increase with frequency level, though the patterns differ for children: 3y.o. reached ceiling at 75% and 5y.o. indicated a break between the lower and the higher frequency levels Generics: both adults and children demonstrate a stepwise increase with frequency level, though the patterns differ for children: 3y.o. reached ceiling at 75% and 5y.o. indicated a break between the lower and the higher frequency levels Existential Qs: Children: 3y.o. a) general Qs: scores at 0% and 25% levels are lower than at 75% and 100% levels, b) 3y.o. for specific Qs and c) 5y.o. for both general and specific Qs: all frequency levels differ from one another, with the exception of 75% and 100%, which are equal

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