# More Truths about Generic Truth

Nicholas Asher & Jeff Pelletier

# Introduction

The topic is characterizing genericity, as illustrated by sentences like

(1) Dogs bark

(2) Lions have manes

Such sentences are “generically true” in a sense that is difficult to describe precisely, but which seem to mean something like *The normal dog barks* or *Lions normally have manes*.

In this they differ from other forms of genericity such as "distinguishing property" generics illustrated by

(3) The Dutch are good sailors,

which (in the sense in which it is true) seems to mean rather that "The Netherlands distinguishes itself from other countries by having good sailors".

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Various authors have complained about the resulting theory, and this talk is intended to be our attempt to defend (but also to expand) our theory.

Not only do we wish to expand the theory’s treatment of certain issues of normalcy, but we also wish to incorporate some features of prosody and how that affects the interpretation of normalcy.

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[Def.] $w_1 \mathcal{R}_\phi w_2$ iff $w_2$ is $\phi$-accessible from $w_1$

[Def.] $\mathfrak{M}, w \models \phi > \psi$ iff $\forall w'$(if $w \mathcal{R}_\phi w'$ then $\mathfrak{M}, w' \models \psi$)

or, if you prefer, where $*$ is a selection function :

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(In words: a formula $\phi > \psi$ is satisfied relative to a model $\mathfrak{M}$ and a world $w$ iff the worlds picked out by the selection function of $\mathfrak{M}$ relative to $w$ and the proposition expressed by $\phi$ in $\mathfrak{M}$ is a subset of the worlds at which $\psi$ is satisfied relative to $\mathfrak{M}$.)

(Or perhaps more intuitively, $wR_\phi w'$ means that $w'$ is a $\phi$-normal world, from the point of view of $w$.)

## Challenges – The Proviso Problem

One problem (already mentioned in P&A) has to do with the fact that many characterizing sentences seem to hold only of certain specifiable members of the kind picked out by the bare plural subject. One such sentence is the already-mentioned *Lions have manes*. Others in the literature are:

(7) Ducks lay eggs. (Krifka *et al* 1995)

(8) Cardinals are bright red. (Leslie 2008)

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The modal analysis offered seems to make the wrong predictions: it seems to predict that normal female lions will have manes, that normal male ducks will lay eggs, and that normal female cardinals will be bright red . . . (all in the appropriate circumstances, of course).

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We do think this is a difficulty with the view in P&A 1997, although we think that we can extend the account to accommodate it.

## Challenges – Weak Existential Generics

(9) Mosquitoes carry the West Nile Virus. (Leslie 2007, 2008)

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We think that our view actually can handle this challenge.

## Explaining and Defending the Modal Account

Our semantics for sentences of the form "$\phi$'s $\psi$" quantifies over all elements of a constant domain.

However, the consequent $\psi$ of the universally quantified conditional $\forall x(\phi > \psi)$ is evaluated relative to each individual *a* only in those worlds where *a* is assumed to be a normal $\phi$.

This makes a difference to how generics are evaluated

(10) Ravens are normally black.

Even in worlds where all the ravens happen to be red, (10) can be true, if those worlds are embedded in the right modal structure – that is, if for any object *b* and every accessible world *w* that is a normal "*b*-raven" world, *b* is black in *w*.

A normal "*b*-raven" world is one where *b* is a normal raven, and has the properties of a normal raven.

This relies on what are the most normal $\phi(a)$ worlds for each $a$ in the domain (when $\phi(x)$ is the antecedent of a $>$ conditional).

This is opposed to (a) an account where *all* the $\phi$'s are normal. (Forestalling certain objections alleging that it would be a *very* abnormal world if all ducks laid eggs.)

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We are *not* considering what is a normal "Opus-bird" world when we evaluate (11).
We *are* instead evaluating whether in the normal *Opus-penguin* worlds, Opus flies or not. And we do this for each object in the domain.

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Of course there are normal Opus-bird worlds, but in those worlds Opus flies and is most definitely *not* a normal penguin.

The notion of what is a normal $\phi(a)$ world has some "give" to it (or, to use our technical term, "slop"). Consider

(13) Turtles live to be 100 years old

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A variety of contextual factors, including preceding discourse, typically fixes or narrows down the sense of normality at issue.

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These will each receive somewhat different truth conditions.

(15) says: Consider any two people in the actual world @, *a* and *b*. Now look at any normal-*a*-girl-accessible-from-@ world *w* (so *a* is a normal girl in *w*). Then in any normal-*b*-boy-accessible-from-*w* world $w'$, *a* does better than *b* in $w'$.

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These conditions are relatively weak: they say that (15) will be true just in case for each *a* and *b*, in all the *b*-normal boy worlds determined by the *a*-normal girl worlds, *a* does better than *b*. Because of the way we understand our quantifier and our $>$ operator, this certainly doesn't entail that all the normal girls in some world do better than all the normal boys.

Instead, it entails that in the Bob-normal-boy worlds, Alice (who is a normal girl there) will do better than Bob. But in the normal-Alice-girl worlds, Alice may in fact do worse than many boys, even normal ones (with respect to the world of evaluation). In fact, Alice will do better than all the normal boys (as well as the really bad boys) in only the normal boy worlds relative to any given normal-Alice-girl world.

(16) gives us slightly different truth conditions. It looks at pairs of objects $< a, b >$ and worlds where both *a* is a normal girl and *b* is a normal boy. It implies that in such worlds *a* does better than *b*. Once again this is compatible with the fact that Alice does worse in a normal-Alice-girl world than lots of boys. But in the normal-Alice-and-normal-b-boy worlds she will do better than all the normal boys. That is, in worlds where Alice does worse than a single normal boy, she's not a normal girl. (These conditions may be too strong for many normal understandings of (14).)

One might instead think that (14) actually is an “extensional” claim about averages: in school, the average girl does better than the average boy. There are two versions of this interpretation:

In the first, (14) is *not* a generic statement, because what is asserted by (14) is merely that there is some “accidental fact” concerning girls, boys, and their academic successes in our world.

But it could instead be a *generic* statement about averages, as opposed to the “accidental and extensional” reading just discussed. In such a reading (14) says something about the underlying natures of schoolboys and schoolgirls: It perhaps says that in every normal-schoolgirl-and-schoolboy world, girls *on average* do better in school than boys, although it still does not follow that there is a world in which every schoolgirl does better in school than any schoolboy.

One of the most vocal opponents of the modal-normal-worlds account has been Ariel Cohen (Cohen 1999a, 1999b, 2004, 2005 and other places). He prefers a probabilistic account of generics.

- **Cohen truth**: "*A*'s *B*" is true just in case the probability of an arbitrary A's being a B is greater than 0.5, where *an A's being a B* is understood in terms of conditional probability.

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- But what sort of probability, Subjective Probability or Frequency? Both are problematic as an account of generics.

- Frequency Accounts fail for examples like:

(19) This machine crushes oranges.

(20) Kim handles the mail from Antarctica.

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- Subjective Probability Accounts:
  - Confound degree of belief with semantics. I can have all sorts of false beliefs about birds but that doesn't affect the meaning of generics involving birds.

# Modal Probability

There is nothing incoherent about a modalized probabilistic account. They have been offered (for reasons other than generics) by Fagin & Halpern (1994, and others), Gaifman (1986), Segerberg (1971), and Bacchus (1990).

- For an arbitrary formulas $A$, $B$ with one free variable and arbitrary object $a$:

  $$\Pr(B(a)/\ A(a)) = \frac{\mu(\|A(a) \wedge B(a)\|}{\mu(\|A(a)\|)}$$

  where $\mu$ is a measure over sets of worlds that validates the ordinary probability axioms.

# Cohen truth is too weak

- Suppose that for instance the normal cases or relevant possibilities as far as cats are concerned are such that in 50.05% of them cats have tails. We can make the number arbitrarily close to 50%; our intuitions say that in this case, the generic *Cats have tails* isn't true. (Well, unless there is some "non-accidental reason" for this). But it is Cohen true.
- Consider a very slightly biased coin that comes up heads 50.000000001 % of the time. The probabilistic account predicts that *This coin normally comes up heads* is a Cohen true generic.

The probabilistic conditional fails to validate intuitively valid reasoning patterns for generics:

(21) (a) Dogs bark.
(b) Dogs make good guard animals.
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The probabilistic account translates this as

(22) (a) The conditional probability of $x$'s barking given that $x$ is a dog $> .5$
(b) The conditional probability of $x$'s being a good guard animal given that $x$ is a dog $> .5$
(c) So the conditional probability of $x$'s barking and being a good guard animal given that $x$ is a dog $> .5$

But that probabilistic conclusion doesn't follow from the probabilistic premises.

## Embedded generics

There are various other problems with the probabilistic account of generics, but I just turn to one final problem, on the grounds that it also afflicts other theories of generics too.

(23) People who go to bed late don't get up early.

(24) Dogs chase cats that chase mice.

Conditionalization:

- $Pr(A > B|C) = Pr_{\frac{B}{A \wedge C}}$

Conditionalization gives a plausible probability assignment to generics that contain other generics embedded in their consequents—i.e., generics of the form $C > (A > B)$. But. . .

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Then $P(A > B)$
$= P((A > B) \wedge (A \supset B)) + P((A > B) \wedge \neg(A \supset B))$
$\geq P((A > B) \wedge (A \supset B))$
$= P(\frac{A>B}{A \supset B}) \cdot P(A \supset B)$
$= P(A \supset B)$

That is, the probability of a generic would always be at least as great as the probability of the corresponding material conditional!!

From which it follows:

**Fact :** Assuming conditionalization, no generic $A > B$ is Cohen true unless the strict conditional ($A \multimap B$) (that is, $\Box(A \supset B)$) is also true (if $0 < Pr(A) < 1$)

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Other conceptions of probability measures, such as using non-standard probabilities with infinitesimal values (Pearl 1997) or higher-order probabilities (Gaifman, Bacchus, Fagin & Halpern) would be required. But I won't discuss them in this talk. (Paper available for those who want! See one further consideration on handout.)

However, our 1997 account incorrectly left the interpretation of embedded generics on the right unaffected by the antecedent of the outer generic.
$A > (B > C)$ is true at a world $w$ iff $*(w, \|A\|) \subseteq \|B > C\|$

- E.g., *Pheasants normally leave their cover when startled*.

We actually want to look at the normal $p$-pheasant worlds and we want to evaluate what happens there when we have a normal $p$-startling event.

Our semantics did not do this. So we wish to fix it in the way indicated on the handout. . . which is perhaps a bit too much detail to present orally!

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  - (that is, the set of normal-$\phi$ worlds is accessible from each normal-$\phi$ world).

# A limited import-export law

**Definition:** $B$ is independent of $A$ iff

- $*(w, \|A \wedge B\|) = *(w, \|A\|) \cap *(w, \|B\|)$
- $*(w, \|B\|) = *(w', \|B\|)$, for all $w' \in *(w, \|A\|)$

**Fact :**
$(A > (B > C)) \equiv ((A \wedge B) > C)$ iff $A$ and $B$ are independent.

## Why an import export law doesn't always hold

- If it's penguin, it normally doesn't fly
- (Note however: it's a penguin is equivalent to it's a bird and a penguin)
- ?? If it's a bird, then normally if it's a penguin, normally it doesn't fly.
- Given the semantics, the exported version involves the evaluation

  $\|\text{fly}(x)\|_{*(w,\|\text{bird}(x)\|)}$,

  since $*(w, \|\text{bird}(x)\|) \cap *(w, \|\text{penguin}(x)\|) = \varnothing$

Axioms for the generic conditional within a modal language

- axioms of quantified S5 (with constant domain)
- $\forall x(\phi > \psi) \equiv (\phi > \forall x\psi)$, if $x$ is not free in $\phi$
- $\phi > \phi$
- $(\phi > (\phi > \psi)) \supset (\phi > \psi)$
- $(\phi > (\phi > \psi)) \equiv (\phi > \psi)$
- $((\phi > \psi) \wedge (\chi > \psi)) \supset ((\phi \vee \chi) > \psi)$
- $\Box(\phi \supset \psi) \supset (\phi > \psi)$
- $\Box\phi \supset (\psi > \phi)$
- $\Box(\phi \supset \psi) \supset (((\phi > \neg\chi) \wedge (\psi > \chi)) \supset (\psi > \neg\phi))$ (Specificity)
- $\Box(\phi \supset \psi) \supset ((\chi > \phi) \supset (\chi > \psi)$
- $\Box(\phi \equiv \psi) \supset ((\phi > \chi) \supset (\psi > \chi)$
- $(\top > \phi) \supset \phi$ (a useful principle)

## Building logical forms for generics using Asher's 2010 constructs:

- Nouns are $\lambda$ terms whose $\lambda$ bound objectual variable have the type $\textsc{kind} \bullet \textsc{individual}$. Which type gets selected for the noun will depend on the predicate to which it forms an argument .
  - Ducks are swimming in the pond
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- Generics have a silent quantificational element that may combine with a bare plural in the restrictor of the quantifier.
- This null determiner or quantificational element is of polymorphic type, whose value depends on the input of its first argument.
- Bare plurals in the nuclear scope of a quantifier undergo type coercion, $\exists$ closure, to meet the selectional restrictions of the predicate.

- GDet(IND$\rightarrow$T, IND$\rightarrow$T) $\longmapsto$
  $\lambda P \lambda Q\, \forall x(P(x) > Q(x))$.
- GDet(K, K$\rightarrow$T) $\longmapsto \lambda P P(k)$.
- this is not a coercion but a *specification* of the meaning of the null determiner in the bare plural DP based on the selected aspect type of the K•IND type.
- $\lambda P \lambda Q GDet(P, Q)[\lambda x^i \text{duck}(x)] \longmapsto$
  $\lambda Q \forall x(\text{Duck}(x) \ > Q(x))$

## “Existential” generics

(25)    Firemen are available

Purely existential generic readings may result in cases where the nuclear scope takes all the extant material in the sentence (what is known as an *all-focus sentence*).

So what goes into the restrictor?
  The tautologous property $\lambda u\ u = u$

Given the axiomatization, $*(w, x = x) = \{w\}$, for all $x$. In other words, logical truths do not determine any special set of normal worlds; they do not move us from the world of evaluation.

(26) $\forall y(y = y > \exists x(\text{firemen}(x) \wedge \text{available}(x)))$

Given our assumption that $*(w, \top) = \{w\}$, (26) is equivalent to:

(27) $\exists x(\text{firemen}(x) \wedge \text{avalable}(x))$

In Pelletier and Asher (1997), we worried about (28) and gestured at “accommodation”. (Leslie 2007, 2008 makes much of these examples)

(28) Female ducks lay eggs

(29) Male cardinals are bright red

# Troublesome cases: Accommodation

In Pelletier and Asher (1997), we worried about (28) and gestured at "accommodation". (Leslie 2007, 2008 makes much of these examples)

(28) Female ducks lay eggs

(29) Male cardinals are bright red

Leslie's objection: If it were the predicate that engenders the accommodation, then (28) would seem to entail that

(30) Ducks lay eggs and are female

is a true generic, which is clearly wrong.

Further, on the modal analysis it lead to the plainly false *Ducks are female*, since $\forall x(A > (B \wedge C)) \supset \forall x(A > B)$ is valid on our semantics.

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Cohen's use of alternative semantics to the rescue!

(31) $\forall x$((duck($x$) $\wedge$ ($x$ bears live young $\vee$ $x$ lays eggs $\vee$ $x$ reproduces by mitosis))
$> x$ lays eggs)

Leslie's objection no longer follows – any more than $(A \vee B \vee D) \rightarrow C$ follows from $(A \vee B) \rightarrow C$.

But. . .

Once again, we see that there is some “slop” in how the restrictor of the logical form of a generic is constructed. We've cheated, like many others, by specifying a particular and appropriate alternative set. Once again, this comes back to the problem of precisifying the particular conception of normality at issue with respect to the predication. Discourse to the rescue?

(32) These farm animals have different means of reproduction.

(33) Cows bear live young,

(34) Cows bear live young,

(35) Ducks lay eggs.

## Without a specific discourse context

It is difficult to specify precisely the restrictor/nuclear scope partition for a generic quantifier. In “out of the blue” contexts, uttering (35) can lead to confusion about what to put in the restrictor and so may give rise to corrections of the following sort.

(36) FEMALE ducks lay eggs.

## Mosquitoes, Deer Ticks and Other Problems

(37) You be careful about mosquitoes and deer ticks. Mosquitoes carry the WNV and deer ticks do too.

As Leslie argues, this generic can be true even if a vanishingly small proportion of mosquitoes (or deer ticks) actually carry the WNV in any normal world. It is tempting at this point to conclude with Leslie that this is a pure existential generic.

Double genericity:

(38) Russians smoke after dinner.

(39) Mosquitoes carry the West Nile Virus.

(40) Sharks attack an injured bather.

(41) $\forall(\mathit{Russian}(x) > \forall e(\text{ after dinner}(e)) > \mathit{smokes}(x)(e))$

(42) $\forall x(\text{ Mosquito}(x) > \forall e(C(e) > \text{ carry the WNV}(x, e)))$

(43) $\forall x(\text{ Shark}(x) > \forall e(C(e) > \exists x(\text{bather})x \wedge \text{ attack}(x, e)))$

Paraphrase: *Mosquitoes can carry the WNV*. That is, in the appropriate circumstances, Mosquitoes *do* normally carry the WNV. Quantification over circumstances is at least an approximation of modality and quantification over worlds.

## constraints

The appropriate circumstances we appeal to here in the restrictor of the generic obey certain important constraints (as does the modality we appealed to).

(a) The circumstances don't change with regard to whether we look, for instance, at (42) or at its internal negation, *Mosquitoes don't carry WNV*.

(b) In addition, the circumstances described in (41) & (43) must be ones that can plausibly occur to any mosquito or shark and are causally sufficient (in normal cases) to ensure the truth of the restrictor of the generic.

# More generally

The characterization of the circumstances should offer a lawlike explanation of the observed frequency of occurrences of the instances of the consequent of the generic. Typically, the lawlike explanation involves a causal explanation (using assumed background scientific knowledge as in the WNV case), though sometimes it depends on legislation or established convention, as in *Kim handles the mail from Antarctica*, or maybe from as-yet-uncalled-upon promises as in *Members of this club help one another out in tough times*.

## discourse contexts again

And sometimes it depends on the facts in the discourse context.

And sometimes it depends on the facts in the discourse context. Consider, for instance, a situation in which billionaires, e.g., the Koch brothers of Tea Party fame, offer everyone in the state of Kansas a million dollars if they stand on one leg for at least 30 minutes a day. The news gets around Kansas, and pretty soon, visitors as well as the natives observe that citizens of Kansas normally stand on one leg for at least 30 minutes a day. In this case, this generic strikes at least one of us as true. But it isn't true in the actual world, as there is no legislation that would guarantee this (or a significantly instantiated causally efficient mechanism that brings about the result that people in Kansas stand on one leg for 30 minutes a day).

(44) Cardinals are bright red and lay smallish, speckled eggs.

(45) Lions have large manes and rear their young in groups.

(46) Jade is green and black.

(47) Jade is green but also sometimes black.

(48) Jade is green. Jade is also black.

How do you specify the relevant alternatives for these copredications?

I wish I could answer all these questions and I wish I could better shore up the claims made.

But I'm afraid that's . . .

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THE END!! (whew!)