Definitional Generics

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1 Introduction

This article[1] investigates a particular use of generic sentences (or "characterizing" sentences, in the terminology of Krifka e.a. 1995), which is most prevalent with indefinite singular subjects. Such subjects cannot always be interchanged with bare plural NPs, as has been famously pointed out by Lawler (1973):

(1) a. *Madrigals are polyphonic.*
b. *A madrigal is polyphonic.*

(2) a. *Madrigals are popular.*
b. *#A madrigal is popular*.

Lawler suggests that "indefinite generics seem most natural in definitional sentences, or ones used somehow to identify the nature of the thing specified by the generic by means of properties peculiar to it; they are less acceptable when an accidental quality is predicated on them" (p. 112). Judgements of this type have been repeated in subsequent research. For a recent experimental study, cf. Leslie e.a. (2009), who found that sentences that express "principled" and "characteristic" generic assertions are nearly equally well expressed with indefinite singulars as with bare plurals (*Dogs have / A dog has four legs* and *Ducks lay / A duck lays eggs*), whereas "majority" assertions fared generally lower but were better expressed with bare plurals (*Barns are red* vs. *#A barn is red*). Interestingly, assertions referring to a minority but "striking" property where generally judged slightly less natural but, in comparison, more equally (*Sharks attack bathers* vs. *A shark attacks bathers*).

Why do generic sentences with indefinite singular subjects (in short, IS-generics) have this limited distribution? I suggest to take Lawler's first characterization as "definitional sentences" serious, which hasn't been done so far in most of the subsequent literature. That is, I propose that (1)(b) is not about madrigals, but about the way how the term *madrigal* is interpreted. It is not a statement about the world, but a statement about the language that is being used. However, the situation is made more complex by the fact that sentences with other types of subjects, like bare plural terms, can have a definitional reading as well, that definitional sentences may be based on empirical facts, and that generic sentences with indefinite subjects are not in all cases definitional.

Before I will motivate, elaborate and defend this view, we will have a short look at previous accounts for the distinction.

2 Previous Accounts

The earliest account of the peculiarity of IS-generics is Lawler (1973), who considers (2)(b) odd because its "putative meaning ... seems to be that a thing cannot be a madrigal unless it is popular".

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This is not just false, but a strange thing to say, because we cannot imagine that being popular can be a definitional criterion for madrigals. But IS-generics express definitional statements, in contrast to generics with bare plurals, which also can express empirical generalizations. Dahl (1975) argues for a somewhat related distinction between generic statements, which he calls "nomic" and "descriptive". Descriptive generalizations inform about the physical world, whereas normative generalizations inform about what should be the case according to certain "moral" rules. The specific nature of IS-generics was taken up in subsequent work. I will discuss here the contributions of Burton-Roberts (1976, 1977), Cohen (2001) and Greenberg (2003, 2007).

Burton-Roberts (1976) proposed that sentences like (3)(a) have the same meaning as (b). In terms of the theoretical model he is using, Generative Semantics, this means they are transformationally related to each other.

(3) a. *A kangaroo is a marsupial.*
b. *To be a kangaroo is to be a marsupial.*

Burton-Roberts (1977) takes on a suggestion by Dwight Bolinger that this equivalence holds because (3)(b) is an analytic sentence, and (a) can express an analytic sentence. But this is not the case with all IS-generics. Bolinger, as reported by Burton-Roberts, considers (4)(b), an analytic statement, false, but (a) true.

(4) a. *A tiger climbs trees.*
b. *To be a tiger is to climb trees.*

If we follow Bolinger's reported intuitions, then IS-generics may not have the uniform interpretation that is generally assumed in later work – a point I will return below. Burton-Roberts himself assumes a uniform interpretation of IS-generics. He proposes that with such sentences, the speaker is "claiming analytic status for the predicate of the sentence with respect to the subject," which is independent of the issue whether the proposition the claim is about actually is an analytic statement or not. He considers IS-generic sentences the more acceptable, the more their predicates are "conceivable as analytic." Claiming analytic status, according to Burton-Roberts, involves what he calls a "meta-predication." For (4)(a), this means that the subject is not the regular meaning of *a tiger*, but rather something that is better expressed by the meaning of the subject of the paraphrase (4)(b), *to be a tiger*. It is suggested that these meta-predications involve concepts, in the sense of Frege: (4) relates the tiger-concept to the tree-climber-concept.

Cohen (2001) addresses specifically the nature of IS-generics, in contrast to other generic sentences. He takes as his point of departure the discussion of the nature of generic sentences in Carlson (1995), who contrasted an "inductionist" view and a "rule-and-regulations" view of generic sentences. According to the inductionist view, a generic sentence is true if it is true for a sufficiently high proportion of relevant individuals, which depends on the way how things are in the world. According to the rule-and-regulations view, generic sentences refer to rules, which are considered to be irreducible entities. Cohen's proposal is that IS-generics denote such rules, whereas generic sentences with plural subjects are ambiguous; they denote rules or express inductionist generalizations. These rules can be physical, biological, moral, legal, or linguistic:

(5) *An electron has / Electrons have a negative electric charge.* (Physical rule)

(6) *A gentleman opens / Gentlemen open doors for ladies.* (Moral rule)

(7) *A bishop moves / Bishops move diagonally.* (Legal rule in chess)

(8) *A pomegranate apple costs / Pomegranate apples cost 49 cents.* (Legal rule)

(9) *A madrigal is / Madrigals are polyphonic.* (Linguistic rule, definition of *madrigal*).

For the meaning of IS-generics (and the rule-denoting use of generic sentences with bare plurals), Cohen suggests that they express that a rule is in effect. This notion is not analyzed further.

Greenberg (2003, 2007) proposed that IS-generics are a sub-case of generic sentences, which generally express a modalized universal statement over the entities in the set identified by the subject. Such statements allow for exceptions, as the universal quantification is said to hold in certain ideal worlds only. IS-generics have a more specific interpretation. We can specify certain typical or essential properties by virtue of which the expressed generalization holds – hence the name that Greenberg proposes, "in-virtue-of" generics. Greenberg contrasts them from "descriptive" generics, typically expressed with the help of bare plurals.

Which properties are permissible as "in-virtue-of" properties of a particular class of entities? Greenberg says that they must be properties that are "associated" with the property described by the subject, which means that it must follow from known facts, norms, or stereotypes that the restricting rule holds in all accessible worlds. One problem of this account is that it assumes rather complex semantic representations of IS-generics. It might well be that IS-generic sentences express properties that follow from essential properties, but it is unclear that they have to refer to these essential properties directly in their semantic representation – a point that is particularly important, as it does not seem possible to actually give a list of these properties.

3 A theory of descriptive generic sentences

My own proposal follows the leads of Burton-Roberts, Cohen, and ultimately Lawler, in assuming two distinct kinds of generic statements with fundamentally different semantic representations, which I will call "descriptive" and "definitional." Descriptive generics make generalizations about patterns that appear in the world; definitional generics restrict the language used to describe the world. While these appear to be two radically different kinds of statement, it turns out, as we will see, that they are actually deeply intertwined.

3.1 Definitional talk

What are definitions, and how do they differ from descriptions? Definitions have not been treated prominently in semantics so far. The study of Cormack (1998), which is dedicated to definitions, contains interesting insights in the various forms that definitions can take, including IS-generics like *a rabbit is an animal.* But it does not make a principled difference in the semantic representation between definitions and descriptions; definitions are treated as universally quantified sentences.

The fundamental difference between definitions and descriptions appears to be this: Descriptions presuppose that the language is fixed, and is the same for all participants in conversation. Using this shared language, the participants can communicate about the world. In contrast, definitions communicate about the language that is being used. The speaker wants to introduce a new term, or impose a certain understanding of existing terms.

Frege was aware of this distinction in his *Begriffsschrift* (1879): In his formal language, assertions are marked with one vertical stroke, |, whereas definitions are marked by a double stroke, ||. Definitions contain symbols that were not explained before, but receive their interpretation by assuming that the formula in which they occur is true. Frege remarks that as soon as a definition is introduced, the corresponding assertion will be true. This is reminiscent of the speech act type of declarations, like *I hereby declare you husband and wife*, which show both a word-to-world and world-to-word direction of fit.

To capture this difference formally, let us assume that the meaning of expressions is dependent on two indices, one for a possible world as usual, the other for an interpretation. Speakers can communicate about the world, assuming that their language is fixed; they can also communicate about the language, assuming that the world that they talk about is known. This was proposed for a linguistic phenomenon quite different from generic sentences by Barker (2002). Barker observes that a sentence like *John is tall* have a descriptive and a "metalinguistic" use.

(10) A: *Who is tall?* B: *Feynman is tall.*

(11) A: *What counts as tall here?* B: *Well... Feynman is tall.*

In the descriptive use (10), B assumes a shared standard of interpretation for tallness, and informs A about persons that are tall under this standard. In the metalinguistic, or definitional use (11), B assumes shared information about the height of Feynman, and informs A about the standard of tallness. Hinterwimmer (2010) has applied a similar analysis to cases like (12), which can be understood as saying: If *hate* is interpreted such that only one thing falls under it, then bad acting falls under it.

(12) *If I hate anything, it is bad acting.*

We can apply this to the descriptive and definitional use of generic sentences. Take the following example:

(13) Boys don't cry.

In the descriptive use, the speaker assumes a shared interpretation of *boys*, and wants to communicate to the addressee that under this shared interpretation, the generalization that the entities that fall under *boys* do not cry when in situations that could lead to crying. In the definitional use, the speaker proposes to the addressee to restrict the interpretations such that it holds that the entities that fall under *boys* do not cry when in situations that could lead to crying.

We can model the descriptive and the definitional mode of interpretation with the notion of a common ground that is mutually known to be shared by the participants of conversation, and which undergoes continuous change in the course of conversation. Normally, it is assumed that expressions are interpreted with respect to a possible word parameter (leaving aside a separate context parameter for deictic expressions) that captures both the way how expressions are interpreted, and how the world is like. Here, we differentiate between these aspects by distinguishing an interpretation index and a world index. The general format of assigning extensions will be $[\![.]\!]^{i,w}$, where i is an index of interpretation, and w is a possible world index. That is, we dissect the traditional notion of an index into an interpretation index and a possible world index, effectively a pair $\langle i,w \rangle$. The world index w captures differences in the extensions that correspond to different factual states of the worlds. That is, if for any i, w, w′ and expression α it holds that $[\![\alpha]\!]^{i,w} \neq [\![\alpha]\!]^{i,w'}$, then there must be some factual difference between the indices $\langle i, w \rangle$ and $\langle i, w' \rangle$. The interpretation index i covers differences in the interpretational part. That is, if for any i, i′, w and expression α it holds that $[\![\alpha]\!]^{i,w} \neq [\![\alpha]\!]^{i',w}$, then $\langle i, w \rangle$ and $\langle i', w \rangle$ differ in the way how expressions are interpreted, but not primarily in the way how the worlds are like. Why the hedge in this sentence? Because different interpretations may be due to factual differences: After all, different interpretation rules are different conventions, and the setting up of conventions leads to particular events in the worlds under considerations (e.g., think of different ways how dictionary makers may have defined the notion of "madrigal").

Corresponding to the more refined notion of an index as a pair of an interpretation and a possible world, I also suggest to model common grounds as pairs of two sets of indices, a set of admissible interpretations I and a set of possible worlds W. Communication consists of subsequent changes of the common ground. We consider two kinds of change here: Descriptive change, which leaves the

interpretations constant and reduces the set of possible worlds, and definitional change, which does not affect the possible worlds but changes the interpretations:

(14) $\langle I,W \rangle + DES([\![\Phi]\!]) = \langle I, \{w \in W | \exists i \in I\ [\![\Phi]\!]^{i,w}\} \rangle$

(15) $\langle I,W \rangle + DEF([\![\Phi]\!]) = \langle \{i \in I\ | \forall w \in W\ [\![\Phi]\!]^{i,w}\}, W \rangle$

If a proposition $[\![\Phi]\!]$ is accepted descriptively at a common ground $\langle I, W \rangle$, as in (14), then the set of possible worlds W which contains the factual information is reduced to those possible worlds such that there is at least one admissible interpretation under which the proposition is true. The existential meaning rule reflects the idea that it is not determined yet which interpretation is the one that the participants will ultimately settle on, and so all the options have to be kept open. We interpret a sentence as if it were in the scope of a possibility operator: Under the interpretations that are to be considered, Φ might be true.

If a proposition $[\![\Phi]\!]$ is accepted definitionally at a common ground $\langle I,W \rangle$, as in (15), then the set of possible worlds stays the same, but only such interpretations i remain admissible for which the proposition $[\![\Phi]\!]$ is true in all possible worlds of the common ground. If, as argued above, this involves slight changes of the set of possible worlds, then such changes would have to be accommodated.

To illustrate the two changes with Barker's example first, assume three possible worlds w_1, w_2, w_3 and three interpretations i_1, i_2, i_3 with the following properties:

(16) $F(i_1, w)(\textit{tall}) = \{x |\ x \geq 1{,}90m \text{ in } w\}$
$F(i_2, w)(\textit{tall}) = \{x |\ x \geq 1{,}80m \text{ in } w\}$
$F(i_3, w)(\textit{tall}) = \{x |\ x \geq 1{,}70m \text{ in } w\}$
height of Feynman in w_1: 1,95m, in w_2: 1,85m, in w_3: 1,75m
height of Teller in w_1: 1,85m, in w_2: 1,75m, in w_3: 1,65m

First, consider an example of an descriptive interpretation, (17). The common ground allows for two interpretations, i_2 and the stricter interpretation i_1. This excludes the possible world w_3 in which Feynman's height is only 1,75m, which does not count as tall under either admissible interpretation.

(17) $\langle \{i_1, i_2\}, \{w_1, w_2, w_3\} \rangle + DES([\![\textit{Feynman is tall}]\!])$
$= \langle \{i_1, i_2\}, \{w_1, w_2\} \rangle$

Now, consider an example of a definitional interpretation. Barker's setting of defining standards of tallness is a bit complicated, as a sentence like (11) presupposes that there are alternatives to Feynman, for which the sentence is negated (notice the accent on *Feynman* under this reading). If Teller is the only alternative, and if the definitional use of *Feynman is tall* scalarly implicates that Teller is not tall, we get the following common ground change:

(18) $\langle \{i_1, i_2, i_3\}, \{w_1, w_2\} \rangle + DEF([\![\textit{Feynman is tall}]\!] \wedge \neg [\![\textit{Teller is tall}]\!])$
$= \langle \{i_2\}, \{w_1, w_2\} \rangle$

We assume that the factual information excludes the worlds w_3 (typically, the definitional interpretation presupposes that more is known about facts). The three admissible interpretations i_1, i_2, i_3 are reduced to i_2. The interpretation i_1 is excluded semantically, because Feynman would not be tall according to it in all the common ground worlds. The interpretation i_3 is excluded by implicature, because Teller would be tall according to it in all the common ground worlds.

Not every random set of interpretations can be admissible in common grounds. For example, the set $\{i_1. i_3\}$ should not be admissible, as i_2 cannot be eliminated when we just consider the interpretation of *tall* without also eliminating either i_1 or i_2 if we start out with the set $\{i_1, i_2, i_3\}$. This is because interpretation indices show a systematic relationship to factual properties of entities. For example, the

interpretation of *tall* relates to the factual relation of being at least tall as, ≥. In general, it holds that if there are three interpretations i, i′, i″ that differ only insofar as $\{w \mid [\![tall]\!]^{i,w}\} \subset \{w \mid [\![tall]\!]^{i',w}\} \subset \{w \mid [\![tall]\!]^{i'',w}\}$, then it holds for any common ground ⟨I, W⟩: If i∈I and i″∈I, then i′∈I. Similar relations hold for other lexical items. For example, it should be guaranteed that if a wider interpretation and a more narrow interpretation of *red*, or *apple*, or *madrigal* is admissible, then interpretations that are "in between" these two interpretations are admissible as well. This effectively captures the notion that natural-language expressions apply to convex regions in conceptual spaces (cf. Gärdenfors 2000).

It should be pointed out here that the definitional mode of talking is quite important for language acquisition. Imagine a caretaker and a child with a box with two apples in their shared attention space. Caretaker and child have the same information about the world with respect to the scene. In this situation, the caretaker can utter the following sentence:

(19) *Look! There are two apples in the box.*

This sentence does not contain any information about how the world is like that would not already be known by the participants. Its purpose is to show how the scene that the caretaker and the child are watching is to be expressed in language. This is an example of definitional talk. It will restrict the shared interpretations of (19) in such a way that this sentence is true in the situation observed by the participants. In doing this, it can help to teach the meaning of the nouns *apple* or *box*, or the number word *two.*

Let us now turn to the definitional use of generic sentences. Consider the following example: In w_1 and w_2, madrigals are generally popular (perhaps with a few exceptions), and in w_3, they are not. There are three interpretations i_1, i_2 and i_3 that differ in the interpretation of *madrigal.* In i_1 and i_2 madrigals have to be polyphonic, whereas i_3 allows for monophonic madrigals. We then have the following effects on the common ground:

(20) $\langle \{i_1, i_2, i_3\}, \{w_1, w_2, w_3\} \rangle$ + DES([[*Madrigals are popular*]]) = $\langle \{i_1, i_2, i_3\}, \{w_1, w_2\} \rangle$

(21) $\langle \{i_1, i_2, i_3\}, \{w_1, w_2, w_3\} \rangle$ + DEF([[*Madrigals are polyphonic*]]) = $\langle \{i_1, i_2\}, \{w_1, w_2, w_3\} \rangle$

As before, the descriptive use assumes that the interpretations stay constant, and only the worlds of the common ground change. In the definitional use, the common ground worlds stay constant, and only the admissible interpretations change.

The idea that there is a type of generic sentence that informs about the interpretation itself takes up the idea of Lawler that IS-generics are definitional, and of Burton-Roberts that they are analytic, that is, true because of the rules of language. It also relates to the proposal of Mari (2008), who suggests that IS-generics in French (which have a more limited distribution than in English) crucially involve a judge parameter. This judge parameter, which has been invoked for the interpretation of predicates of personal taste like *tasty*, refers to inter-individual differences of interpretation that do not correspond to actual differences in the world being described. It appears to me that invoking the judge parameter is not quite the right choice, as this applies to cases in which there can be faultless disagreement, as in the following case:

(22) A: *This pizza is tasty.* B: *No, it isn't.*

The resulting conversational state is that A judges the pizza tasty, whereas B doesn't. Arguably, this does not constitute a difference in the interpretation i itself. Speakers A and B do not express a difference about the meaning of *tasty* in (22) as they would express a difference in interpretation of *madrigal* in (23):

(23) A: *A madrigal is polyphonic.* B: *No, madrigals can be polyphonic!*

In (22), the interlocutors still adhere to how *tasty* means – something like 'generating a flavorful and pleasant impression in one's mouth.' They acknowledge that they might differ in what they perceive to be tasty due to extra-linguistic reasons. In (23) they disagree about the meaning of *madrigal*, which is a more serious conflict, as it is preferred that interlocutors use language in the same way.

3.2 Definitions and topicality

In the preceding section it was proposed that definitional generic sentences restrict the interpretation indices of the language that is used. However, the way how this was implemented is problematic: We did not make any provisions as to which meanings should be changed in definitions, and which should be kept constant. Yet, a sentence like *A madrigal is polyphonic*, under its standard prosody, is used to define the meaning of *madrigal*, not the meaning of *polyphonic.* We have to provide for means to distinguish a "definiendum" from a "definiens".

This structuring is a special case of the topic-comment structuring that is pervasive in human communication. Statements in ordinary discourse usually have an aboutness topic, some entity or set or other semantic object that the statement delivers information about. For example, while the following two sentences have the same truth conditions, one is about Jacqueline Kennedy, the other one about Aristotle Onassis.

(24) a. *Jacqueline Kennedy married Aristotle Onassis.*
b. *Aristotle Onassis married Jacqueline Kennedy.*

Definitions are about the definiendum. They supply information about the meaning of the term to be defined. The formal evidence for this is that definienda are marked in the same way as topics in descriptive talk: First, they tend to occur sentence-initially. This holds even in the artificial language of mathematics, where the definiendum occupies the left-hand side in formulas like $\alpha := \beta$. Second, they are de-accented relative to the definiens. This is particularly important when, for grammatical reasons, the definiendum cannot occur sentence-initially. If we want to convey the definitional interpretation of *Feynman is tall*, then we have to de-accent *tall*, the topic, and consequently accent *Feynman*.

Let us assume that topic-comment structure leads to a structuring of propositions into a topic part α and a comment part β. We then can give the following rule for definitional interpretations, where X is a variable of the appropriate type.

(25) $\langle I, W\rangle + \mathrm{DEF}(\langle [\![\alpha]\!], [\![\beta]\!]\rangle)$
$= \langle \{i \in I \mid \forall w \in W \forall X[[\![\alpha]\!]^{i,w}(X) \rightarrow \forall i' \in I\ [\![\beta]\!]^{i',w}(X)]\}, W\rangle$, if α is a predicate,
$= \langle \{i \in I \mid \forall w \in W \forall X[[\![\alpha]\!]^{i,w} = X \rightarrow \forall i' \in I\ [\![\beta]\!]^{i',w}(X)]\}, W\rangle$, if α is a term.

The case distinction between predicates and terms is similar to the one made for the so-called "normal forms" of definitions, cf. Gupta (2008). Notice that this procedure can only restrict the accessible interpretations in so far as the meaning of the topic expression α is concerned.

For illustration, let us consider the case where the topic of definition α is a predicate. Assume that there are three admissible interpretations i_1, i_2, i_3, and that the conditional statement holds for i_1 and i_2 but not for i_3. This means that there is a world w in the common ground and an X such that X is α at i_3 in world w, but X is not β in w under every of the previously admissible interpretations i_1, i_2 and i_3. Hence i_3 is excluded from the common ground, while the set of possible worlds W stays the same. For a concrete example, consider the following:

(26) $\langle I, W \rangle + DEF(\langle [\![a\ madrigal]\!], [\![is\ polyphonic]\!] \rangle)$
$= \langle \{i \in I \mid \forall w \in W \forall x[[\![a\ madrigal]\!]^{i,w}(x) \rightarrow \forall i' \in I\ [\![is\ polyphonic]\!]^{i',w}(x)]\}, W \rangle$
where $[\![is\ polyphonic]\!]^{i,w}(x) = \lambda P[P]([\![polyphonic]\!]^{i,w})(x) = [\![polyphonic]\!]^{i,w}(x)$

This restricts the set of admissible interpretations I to those interpretations i that guarantee that in each of the accessible worlds w, each x that falls under the predicate *a madrigal* at i also falls under *polyphonic*, under every of the original admissible interpretations.

In our example, the copula in *is polyphonic* is the copula of predication, λP[P]. In the following example, it is the copula of identity, here expressing identity between two sets, λP′λP[P = P′]. This restricts the admissible interpretations to those in which it is guaranteed that whenever the set X is the extension of *an oculist* it is also the extension of *an eye-doctor*.

(27) $\langle I, W \rangle + DEF(\langle [\![an\ oculist]\!], [\![is\ an\ eye\ doctor]\!] \rangle)$
$= \langle \{i \in I \mid \forall w \in W \forall X[[\![an\ oculist]\!]^{i,w} = X \rightarrow \forall i' \in I [\![is\ an\ eye\ doctor]\!]^{i,w}(X)]\}, W \rangle,$
where $[\![is\ an\ eye\ doctor]\!]^{i,w}(X)$
$= \lambda P' \lambda P[P = P'](([\![an\ eye\ doctor]\!]^{i,w})(X)$
$= [X = [\![an\ eye\ doctor]\!]^{i,w}]$

Definitions involving identity give a full, classical definition, whereas predicational definitions are partial only. The expression that is defined can be part of the language already, that is, have an interpretation; in this case, a predicative definition restricts an existing interpretation further. The expression might also be a new. Such expressions start out with a maximally wide interpretation that allow any for any meaning assignment; this interpretation is then restricted by a term definition, or by one or more predicative definitions. One classical example for this case is the beginning of Karl May's novel *Winnetou I* (1892); in the original German text, the American term *Greenhorn* is defined.

(28) *Dear reader! Do you know what the word "greenhorn" means?* (...) *A greenhorn is a fellow who doesn't get up from his chair when a lady wants to sit down, and who greets the man of the house before having paid his respect to the wife and daughter. He slips the cartridge in backward when he loads his gun, or first rams the primer, then the bullet, and finally the powder into his muzzleloader. A greenhorn either speaks no English at all or sounds stilted when he does.* (...)

Arguably, these are all predicational definitional sentences that successively fix the notion of *greenhorn* (an English loan in the German original) in the common language of speaker and addressee.

3.3 Definitions and facts

If IS-generics are analyzed as definitional statements, then the rules that they express ultimately should be linguistic rules. At first sight, this seems to be a problem. Recall that Cohen (2001) distinguishes between different kinds of rules, and the properties that Greenberg invokes for IS-generics are not only based on linguistic conventions. Burton-Roberts, who assumes that IS-generics express analytic sentences, hence true on the basis of linguistic conventions, also mentions that not every generic sentence with an indefinite subject seems to be true by the rules of language alone. But he refers to Chomsky (1976), who considers the possibility that there is "no sharp delimitation between semantic properties that are 'linguistic' and those that form part of common sense understanding".

I would like to maintain that there is a sharp distinction between descriptive and definitional sentences on the level of representation of sentence meanings. But linguistic properties are intertwined with empirical facts, which may blur this distinction. Consider the following example:

(29) *A donkey has 62 chromosomes*.

Does it belong to the linguistic interpretation rules that donkeys have 62 chromosomes? Donkeys have been known to humans for thousands of years, but their chromosome number has been discovered only recently. This is a classical example of an empirical finding; so how can the number of chromosomes follow from the way how *donkey* is interpreted? Contrary to first appearance, this is indeed possible, and actually follows from the views of Kripke (1972, 1980) and Putnam (1975) and their causal theory of reference.

Let us consider their argument first with an identity statement. Kripke argues that (30) does not just express a contingent truth (as both terms refer to the planet Venus), but a logical necessity, even though it is based on an empirical finding (that is, it is a truth a-posteriori, not a-priori).

(30) *Hesperus is Phosphorus.*

According to Kripke, (30) is logically necessary because the names *Hesperus* and *Phosphorus* are rigid designators; they refer to whatever the persons in classical Greece that gave these names intended them to refer. With *Hesperus*, they referred to a particular celestial object that appeared in the evening; with *Phosphorus*, they referred to a particular celestial object that appeared in the morning. When it was found out that these objects are identical, the planet Venus, the names *Hesperus* and *Phosphorus* referred to the same object. And as Venus is necessarily identical to Venus, Hesperus is necessarily identical to Phosphorus; hence (30) expresses a necessary, analytic truth. This does not mean that this sentence states an a-priori truth. It could have turned out that what has been named *Hesperus* and what has been named *Phosphorus* refer to different celestial bodies. But then the meanings of *Hesperus* and *Phosphorus* would have been different, and (30) would not express a necessary truth – it would express a necessary falsity instead. In a slightly paradoxical sounding statement: As *Hesperus* and *Phosphorus* happen to refer to the same entity they do so necessarily.

This line of reasoning has been extended by Kripke and Putnam to natural kind terms. In (29), the term *donkey* refers to entities belonging to a natural kind. It is the set of entities that includes the specimens that have been called *donkey* originally. For many species, such specimens actually are housed in natural science museums; they are called ‘type specimen’ and are identified by red labels. The set is then defined by the relation “belonging to the same species as.” This relation is based on the similarity of the genetic makeup of animals. Having the same number of chromosomes is a property of the genetic makeup on the species level – for example, if x and y belong to the same species, then they have the same number of chromosomes. We can say that the same number of chromosomes “runs” in biological species. Under these conditions, it is a necessary, or analytic, or indeed definitional property of donkeys to have 62 chromosomes. Thus, a rule that is based on empirical facts results in a “linguistic” rule about the meaning of expressions.

Let us discuss the consequences of these considerations with respect to the interpretation format of definitional interpretations introduced in (25), using the following scenario:

(31) *They have determined the number of chromosomes of a particular donkey, Chiquita.*
Now we know: A donkey has 62 chromosomes.

We assume an initial state $\langle I_0, W_0 \rangle$ to which the descriptive information is added that a particular donkey, Chiquita, has 62 chromosomes. Following (14), this reduces the common ground to $\langle I_0, W_1 \rangle$, where all worlds in W_1 contain the information that Chiquita, a donkey, has 62 chromosomes under at least one interpretation.

(32) $\langle I_0, W_0 \rangle + \mathrm{DES}([\![\textit{Chiquita, a donkey, has 62 chromosomes}]\!])$
$= \langle I_0, \{w \in W_0 \mid \exists i \in I_0 [[\![\textit{chrom.}]\!]^{i,w}(ch) = 62 \wedge [\![\textit{donkey}]\!]^{i,w}(ch)]\} \rangle$
$= \langle I_0, W_1 \rangle$

Assume now that in the input common ground it is already established that that *donkey* is a natural kind term referring to a biological species, and that for such terms, the chromosome number is a de-

fining property. If the information is added that Chiquita has 62 chromosomes, and Chiquita is a donkey, it follows that every donkey has 62 chromosomes. This descriptive statement translates into a definitional statement about the word *donkey*.

One way to model this effect is to lift the notion of a common ground from pairs of interpretation indices and world indices to sets of such pairs that satisfy certain properties, $\{\langle I, W\rangle | \ldots\}$. The update of such common grounds consists of updating the elements of this set in the usual way. Let us assume a common ground C_0 that contains the above-mentioned pieces of information:

(33) $\forall \langle I, W\rangle \in C_0$
$[\forall i \in I\ \forall w \in W\ \forall x \forall y [[\![\textit{donkey}]\!]^{i,w}(x) \wedge [\![\textit{donkey}]\!]^{i,w}(y) \rightarrow [\![\textit{chrom.}]\!]^{i,w}(x) = [\![\textit{chrom.}]\!]^{i,w}(y)]$

This states that for all pairs $\langle I, W\rangle$ in C_0 it holds for all interpretations i and all worlds w that all donkeys have the same chromosome number. This should follow from a more general rule about biological species in C_0; here, only the consequence of this rule for donkeys is given. For different elements in C_0, the chromosome number of donkeys might be different; all that (33) guarantees is that the chromosome number of donkeys will be the same within each element of C_0.

Context C_0 is now updated with the descriptive information that Chiquita, a donkey, has 62 chromosomes, applying rule (14) to all pairs in C_0:

(34) $C_0 + \mathrm{DES}([\![\textit{Chiquita, a donkey, has 62 chromosomes}]\!])$
$= \{\langle I, \{w \in W \mid \exists i \in I_0 [[\![\textit{chrom.}]\!]^{i,w}(\mathrm{ch}) = 62 \wedge [\![\textit{donkey}]\!]^{i,w}(\mathrm{ch})]\}\rangle \mid \langle I, W\rangle \in C_0\}$
$= C_1$

Only those pairs $\langle I_1, W_1\rangle$ survive in C_1 for which it holds that in all the worlds of W_1, Chiquita has 62 chromosomes under at least one interpretation of I_1. Due to the prior information (33), this means that in the worlds of W_1 every donkey has 62 chromosomes, and furthermore, that this holds for all interpretations of I_1. Consequently, it also holds for all pairs $\langle I_1, W_1\rangle \in C_1$:

(35) $\langle I_1, W_1\rangle =$
$\langle \{i \in I_1 \mid \forall w \in W_1 \forall x [[\![\textit{a donkey}]\!]^{i,w}(x) \rightarrow \forall i' \in I\ [\![\textit{chrom.}]\!]^{i',w}(x) = 62]]\}, W_1\rangle$

Now, this is the same as if we had updated C_0 with the corresponding definitional statement:

(36) $C_0 + \mathrm{DEF}(\langle [\![\textit{a donkey}]\!], [\![\textit{has 62 chromosomes}]\!]\rangle)$
$= \{\langle I, W\rangle + \mathrm{DEF}(\langle [\![\textit{a donkey}]\!], [\![\textit{has 62 chromosomes}]\!]\rangle) \mid \langle I, W\rangle \in C_0\}$
$= C_1$.

In particular, notice that a definitional statement can have factual consequences, as only those pairs $\langle I, W\rangle$ are carried on for which the worlds W follow the rule (33) which connects interpretation indices and world indices. Thus, the empirical discovery that Chiquita has 62 chromosomes results in a definitional property of the term *donkey*.

In examples like *A donkey has 62 chromosomes* we refer to a natural kind somehow indirectly, by the indefinite noun phrase *a donkey*. This presupposes that *donkey* actually denotes the specimens of a natural kind, otherwise we could not make a definitional generic statement about it. For example, (37) is deviant as a generic sentence because the subject term fails to pick out a natural kind on which species-based generalizations could be expressed.

(37) *#An animal in this cage has 62 chromosomes.*

Also, as we have seen, the predicate must count as one that is plausibly related to being a member of a kind – it must be "conceivable as analytic" (Burton-Roberts 1977), or in our words, it must be plausible that it runs in a kind. If this fails, this leads to the known reduction in acceptability, as in *#A madrigal is popular*, or *#A barn is red*. Carlson (2009) has pointed out that there is experimental evidence for a difference between principled (essential) and mere statistical correlations (cf. Prasada

& Dillingham 2006). Which predicates can be understood as running in a kind depends on the kind itself; sentences like *A football hero is popular* (Nunberg & Pan 1975) or *A cardinal is red* are fine. This requires that interlocutors know beforehand which expressions can be plausibly understood as being co-extensive with the specimens of a kind, and which can be plausibly understood as expressing something essential that may be turned into a definitional property.

In the present reconstruction, the properties used in definitional generics apply to all members of the kind. This may be difficult to reconcile with examples like the following, which are judged to be relatively similar to their bare plural counterparts as expressing generalizations (cf. Leslie e.a. 2009):

(38) *A duck lays eggs*.

(39) (#) *A shark attacks bathers*.

We can stick with the universal interpretation and allow for exceptions in the sense that a property that holds of individuals because they belong to a natural kind may be suppressed in particular individuals (sometimes even the vast majority) due to independent reasons. For example, (38) is literally true of all ducks except that the egg-laying property is suppressed in immature or male ducks.

Definitional generic sentences are not restricted to natural kinds. But we can assume that other kinds essentially have the same structure. Consider (6), *A gentleman opens doors for ladies.* The noun *gentleman* applies to a social kind, a set of entities that belong to a particular social type defined by reference to a set of shared ideals rooted in the medieval chivalric code of conduct. The term has certain reference examples. From the behavior of these reference examples, and from the fact that helping ladies is a property that can be seen as running in certain social kinds, (6) can be justified as a definitional statement. Similarly, for (1)(a), *A madrigal is polyphonic*, we assume that *madrigal* refers to an "artificial" kind, a set of musical pieces that are considered similar enough to have a new name bestowed on them (as a matter of fact, the madrigal developed from precursors like the frottola and the canzonetta, and the name *madrigal* is first known from the work of the French composer Philippe Verdelot, around 1530). These musical pieces are connected by a similarity relationship referring to certain properties that constitute the type identity, and being polyphonic is one of the properties that run in musical kinds.

In (7), *A bishop moves diagonally*, the notion of *bishop* in chess is well-defined by the rules of chess, which can be specified comprehensively. That is, they can be given a linguistic form, and hence are based on linguistic rules. In (8), *A pomegranate in this shop costs 49 cents*, we refer to a set of entities defined by a natural kind and a property, *in this shop*. If the shop manager has determined that the prize of an pomegranate apple is 49 cents, then this is a property that each pomegranate that is offered in this shop has by definition, based on the decision of the shop manager. This prize can easily change the next day, but then one definition would be superseded by another one.

3.4 The form of definitional generic sentences

In past work, it has been stressed that generic sentences with indefinite singular subjects have the reading that in the present article is identified as definitional. However, it is generally acknowledged that generic sentences with bare plurals and mass nouns can have this reading as well.

(40) a. *A madrigal is polyphonic.*

b. *Madrigals are polyphonic.*

c. *Honey is made by bees.*

These terms all should allow for a definitional predicative use, as the topics – here *a madrigal*, *madrigals* and *honey* – have a predicative interpretation in which they apply to entities. In our analysis, both descriptive generics and definitional generics have a conditional structure, where these predicates can specify the restrictor of the conditional.

Now, the question is why bare plurals and bare mass nouns can occur in descriptive generic sentences, while indefinite singulars presumably cannot. We can follow Cohen (2001) and assume that descriptive generic sentences always imply reference to kinds. If indefinite singulars cannot be kind-referring (except in the taxonomic reading), while bare plurals and mass nouns can, then the observed difference between definitional and descriptive generic sentences follows.

The difference between indefinite singulars on the one hand and bare plurals/mass terms on the other is an essential property of Carlson (1977). It also follows from Chierchia (1998), who assumed that properties can be coerced into kind individuals provided that the properties are cumulative. However, it is not generally assumed that descriptive generic sentences require kind individuals. In their discussion of such sentences, Krifka e.a. (1995) assume, among others, readings that involve a generic quantifier that expresses a modalized quantification. This modalized quantification can be restricted by nominal predicates, as in the following example:

(41) $[\![\textit{Madrigals are popular.}]\!]^{i,w}$
$\forall w' \in R(w) \forall x [[\![\textit{madrigals}]\!]^{i,w'}(x) \rightarrow [\![\textit{popular}]\!]^{i,w'}(x)]$

If we do not subscribe to theories that assume that bare plurals and mass nouns are always kind-referring in descriptive generalizations, and allow for representations as in (41), then the question arises why indefinite singulars like *a madrigal* apparently cannot serve as restrictor of a definitional generic sentence. If *madrigals* and *a madrigal* both denote properties, then it is difficult to see a systematic reason why the indefinite singular, *a madrigal*, should be excluded from descriptive generic sentences.

But the impression that IS-generics always express analytic or definitional statements is not shared by everyone. Recall that Burton-Roberts discussed Bolinger's intuition concerning the sentences (4)(a) *To be a tiger is to climb trees*, and (4)(b) *A tiger climbs trees*. Bolinger considers (4)(a) a sentence that claims analytic truth (but wrongly so), and (4)(b) to be true because it is not an analytic sentence. According to this intuition (which apparently was not shared by Burton-Roberts), IS-generic can be used for descriptive sentences as well.

However, this argument is not very convincing. One can argue that in order for (4)(a) to be true, a tiger has to show tree-climbing behavior, whereas for (4)(b), it is sufficient that a tiger has the potential of climbing trees. This is the distinction between "universal" generics and "existential" generics introduced in Lawler (1973), which may cross-cut the distinction between descriptive and definitional generics. For example, we might make a difference between the property of tree-climbing as an essential way of locomotion, as with squirrels, and of an optional way of locomotion, as with tigers, both of which can run in species, and hence be the basis of definitional generics.

More serious objections against IS-generics being restricted to definitional interpretations come from the observations that modified indefinite singulars show a wider distributional pattern. Cohen (2001) draws attention to the fact that while (42)(a) is odd, (b) is fine. And Carlson (2009) points out that (43) is good.

(42) a. *#A king is generous.*
b. *A good king is generous.*

(43) *A banana that has been sat on by a rhinoceros is flat.*

For such modified generic sentences, the modification must deliver the motivation why the predication holds. A good king is generous because he is good; a banana that has been sat on by a rhinoceros is flat because it has been sat on by a rhinoceros. Mari (2008) tries to develop from this observation a general theory for IS-generics, where IS-generics involve alternatives of the type that can be invoked by modifiers (e.g. a good vs. a bad king).

I would like to argue that it is not in general modification that is at issue, and that we actually have to distinguish between cases like (42)(b) and (43). As for (42)(b), this clearly is a definitional sentence, of the type we have discussed above; it does not give an empirical generalization about good kings, but rather gives a partial definition what a good king is, and hence, what it is that makes a king good. (43), however, obviously is not definitional, but expresses a descriptive generalization. This also holds for the following IS-generic sentences:

(44) a. *A trout can be caught by many different methods.*
b. *A hedgehog makes a good pet.*
c. *A poodle should be clipped by a professional groomer.*
d. *A madrigal sounds best with all the voice-parts doubled.*

An attempt to claim that (44)(a) is definitional would have to argue that the ways that a trout can be caught are determined by the genetic makeup of trouts, hence runs in species. But this seems to be far-fetched, and the methods for trout-catching certainly depend on other things as well, such as the tools available. Rather, examples like (44) show that indefinite singular subjects can occur in descriptive generics as well, just as we suspected for systematic reasons at the end of the section 3.4 .

This sends us back to the issue that this article started out with: Why is it that IS-generics, in contrast to generics with bare plurals and mass nouns, tend to have a definitional interpretation, when actually – as the examples in (44) show – they are compatible with descriptive interpretations?

There is one important difference between indefinite singulars and bare plurals: Indefinite singulars apply strictly to atomic individuals; the property expressed by *a madrigal* applies to single madrigals. Bare plurals apply to sum individuals that consist of atoms; the property expressed by *madrigals* applies to sum individuals consisting of two or more single madrigals. (Bare mass nouns also apply to sum individuals; the property expressed by *honey* applies to quantities of honey that typically contain sub-quantities that are honey as well.) When expressing a generalization based on a count noun, speakers have a choice between indefinite singulars (predicates that apply to atomic entities), and bare plurals (predicates that apply to sum individuals). The choice of one over the other depends on a number of factors.

First, in order to express a definitional statement, indefinite singulars seem to be ideally suited, as such statements express criteria that specify conditions under which an entity falls under a concept. Typically, these criteria do not hinge on the number of entities considered, but can be checked with single exemplars. To check whether music can be called *madrigal* it is sufficient to look at single pieces of music. Hence, we find a preference of definitional statements for singular indefinites. But this is only a preference. Sentences like *Madrigals are polyphonic* are fine as definitional statements, as the definiens part *polyphonic* distributes over sum individuals to atomic values.

Second, in order to express descriptive generalizations, bare plurals seem to be better suited for the reason that generalizations are typically based on the observation of many instances. For example, in order to judge whether madrigals are popular, the observation of single instances is not sufficient; one has to look at larger samples. This makes sentences with bare plurals more natural for descriptive generic sentences. But the use of bare plurals is not essential for descriptive generalizations, as we have seen with examples like (43). Presumably, the flatness is not a generalization from repeated observations of bananas sat on by rhinos here, but follows from more general rules. The examples

in (44) arguably express generalizations where single, atomic entities matter. For example, when judging whether animals make good pets for children, in many cases single animals are considered; hence the indefinite singular in (44)(b). When the animal is typically held in larger quantities, this is unnatural:

(45) a. *Guppies make good pets.*
b. *#A guppy makes a good pet.*

Hence, the choice of indefinite singular vs. bare plural subjects in generic sentences that we set out with, and which has led us to distinguish between definitional and descriptive generalizations, turns out not to be strictly determined by that distinction after all. There is just a correlation: Descriptive generalizations are typically expressed by bare plurals because they typically rely on observing many instances; definitional statements are typically expressed with indefinite singulars because it can be determined with single individuals whether or not they fit to the defining properties. But these are tendencies only, not strictly grammatical forms . These tendencies are comparable to the preference for the plural in *John smokes cigarettes* and the singular in *John smokes a pipe,* which solely rests on the fact that cigarettes vanish in the process of smoking and have to be replaced, while pipes have a longer life-span.

4 Conclusion

In this article I have reviewed some of the literature that has claimed a fundamental difference between two kinds of generic sentences that often were illustrated with minimal pairs involving singular indefinites and bare plural subjects. I have argued that one kind expresses descriptive generalizations, restricting the possible worlds in the common ground, whereas the other expresses definitional statements, restricting the interpretation of the language shared by the interlocutors. I developed representation formats that can distinguish between these two cases, either by integrating a set of admissible interpretations in the notion of common ground, or by extending the notion of a possible world to include admissible interpretations. Definitional statements then turn out to be modal statements with a particular accessibility relation, the set of all indices that correspond to the admissible interpretations. I have argued that many apparent descriptive generalizations can be phrased as definitional interpretations, following Kripke's discovery that analytic (= definitional) statements can be a-posteriori (based on empirical findings). I then turned to the issue of how descriptive and definitional generics can be expressed. The predominant view of the literature, that descriptive generalizations are encoded by bare plurals and definitional statements are expressed by indefinite singulars, can only be seen as a tendency. All that we can say is that indefinite singular subjects are particularly well suited for definitional statements because the decision whether entities falls under a concept can typically be made by looking at single individuals.

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