

Artifact Nouns: Reference and Countability*

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1. Introduction

Formal semantic treatments of nominal reference have focused on natural kind nouns (Carlson 1980, Krifka et al. 1995), yet as has been widely recognized by anthropologists, cognitive scientists, philosophers, and others, artifacts (*cup, furniture, chair*) and natural kinds (*dog, water, flower*) differ critically in nature. We argue that these differences have important consequences for how artifact nouns establish reference, as well as for other fundamental nominal properties of central interest to the formal semantic enterprise, such as countability. Our analysis also sheds light on a key puzzle in the countability literature: why are artifact nouns such as *furniture* or *mail*, which seem to have individual entities in their denotation (Barner & Snedeker 2005), non-countable at both the object- and kind-level?

In this paper we develop semantic representations for artifact nouns intended to capture their unique (semantic) properties. The starting point for our analysis is the proposal that while a natural kind is characterized by some often ineffable “natural essence”, an artifact is usually characterized by an intended function, e.g. writing for the noun *pencil*, sewing for the noun *needle*, or furnishing for the noun *furniture*. This proposal receives support from observations that to the extent that the name of an entity may be semantically transparent, the names of natural kinds reflect their essence, while those of artifacts reflect their function. Thus, following Nichols (2008), we argue that the meaning of an artifact noun includes an ‘associated event’, often representing the artifact’s intended function; yet, a certain flexibility in the way such nouns may be used to refer to entities suggests that their meaning may also involve (sub-lexical) modality or temporal components.

The next section develops our semantics for artifact nouns in detail. Section 3 examines the consequences of our account for countability, explaining the non-countability of artifact nouns such as *furniture* at both the object- and kind-level.

*We have presented parts of this material in various venues and thank the audiences for their comments. We are grateful to the attendees of NELS 47 for discussion of the countability properties of artifact nouns.

2. Artifacts and Their Associated Events

The grammatical relevance of the artifact vs. natural kind distinction, including the critical role of an associated event, has been established over the last few decades, primarily by researchers in anthropological linguistics, language acquisition, and psycholinguistics. In particular, the names given to artifacts differ from those of natural kinds: the names of artifacts make — often transparent — reference to an associated event, whereas names for natural kinds refer to properties evocative of their essence, such as perceptual properties and habitat; see Levin et al. (2016) for discussion. Concomitantly, the naming strategies used are appropriately tailored to allow this. Thus, Wisniewski & Love (1998) and Levin et al. (2016) observe asymmetries in compound names for artifacts and natural kinds. For example, in the natural kind compound *leopard lizard*, the modifier evokes the skin pattern of the lizard (Wisniewski & Love 1998, p. 201), while the artifact compound *butter knife* has a modifier which evokes the function of the knife — to allow butter to be spread — and thus suggests that this knife has design characteristics that differentiate it from knives with other purposes (e.g. *fish knife*, *steak knife*, *putty knife*). See Brown (1999), Downing (1977), Kemler Nelson et al. (2003), Levin et al. (2016) for further discussion.

It is possible that naming strategies for nouns, i.e. how speakers/communities choose to describe entities that they refer to, are irrelevant to considerations faced in formal semantic analyses of nominal reference. We argue that the artifact vs. natural kind distinction and corresponding differences in naming strategies have a fundamental impact on how these nouns establish reference. In particular, artifacts establish reference with respect to an associated event. We show that artifact nouns diverge from natural kind nouns in how they pick out referents, and we argue that the particular relation between the entities designated by the noun and the predicate designating the associated event depends on the noun involved. We show that artifact nouns fall into two classes with respect to how they pick out their referents. For what we call FUNCTIONAL ARTIFACT NOUNS, the associated event is an intended function which entities must have the potential to fulfill. For what we refer to as STAGE-LEVEL ARTIFACT NOUNS, the associated event describes a temporary property that characterizes an entity, e.g. *a delivery* characterizes an entity while being delivered, but not at other times. We begin by setting out the core of our analysis.

2.1 Basics of the Analysis

The semantics of an artifact noun relates entities in the world to the associated event relevant for that artifact noun. We analyze artifact nouns, like all common nouns, as properties, but properties which encode the relation between entities referred to and the predicate designating an associated event. This captures, for instance, the intuition that *cup* designates the set of things that people drink out of, or, more formally, $\lambda y[x \text{ drinks-out-of } y \text{ in } e]$.

The types of events referred to via the associated event must be refined to the appropriate granularity. Permitting arbitrary events would lead to the set of entities which participated in the complex event fused from all the drinking events from, say, the last year to be included in the denotation of *cup*. Rather, the events that are important are the minimal events: events which make the proposition true and cannot be further decomposed into

sub-events which also make it true. A minimal event of drinking out of something will then just be the simple action where one drinking act is performed. We build on the analysis of minimal situations pursued in Berman (1987), Heim (1990) and von Stechow (1995), but since we are not concerned with minimal events in any absolute sense, we define minimal events with respect to an eventive predicate. The definition in (1) restricts the set of events to the set of smallest events which still satisfy the predicate. We give a first approximation of the representation of *cup* in (2).

(1) *Minimal event with respect to a predicate*: $\min(e, P) = P(e) \wedge \neg \exists e' [e' < e \wedge P(e')]$

(2) $\llbracket \text{cup} \rrbracket$ (preliminary version) := $\lambda y [x \text{ drinks out of } y \text{ in } e \wedge \min(e, \text{drinks-out-of})]$

In the representation in (2), the agent argument is left free; it can be bound during the composition, or it will undergo existential closure. This analysis allows the agent to be specified, typically through a Saxon genitive; that is, one reading of *John's cup* is ‘the cup which John drinks out of’. The event argument and other possible arguments (e.g. recipient) are analyzed in the same way.

2.2 Typical or ‘Functional’ Artifacts

The denotation of artifact nouns in (2) falls short in that it necessitates that, for instance, *cup* holds only of entities which are actively engaged in drinking events. In other words, a cup in a cupboard would cease to be in the denotation of *cup*—clearly an incorrect result. Rather, it is evident that the class of artifact nouns that we term functional artifact nouns, such as *cup* or *hammer*, designate entities which stand in a *potential* relation to the associated event. We alter the representation for functional artifact nouns by modalizing the associated event with an ability modal.

Modalizing the associated event requires a modal semantics applicable to property-level meanings. We build on the work of Brennan (1993), which extends Kratzerian modal semantics (Kratzer 1977, 1981) to root modal phenomena, e.g. deontic uses of *must* as in *Kim must submit the report today*. Such uses of modals do not scope over propositions, but relate individuals and properties. Thus, Brennan adapts the components of the Kratzer model so they apply at the property-level. The conversational background, which standardly is a function from a world to a set of propositions, is now the set of relevant properties relative to an individual. The conversational background takes the individual in the actual world, the pair $\langle w, d \rangle$, and assigns a set of properties to it, as given in (3). In the formalization in (4) and following, this is mnemonically represented by subscripting the conversational background function with the variable of individuals, h_x . The relevant properties depend on the type of modal and the specific context. Here, for ability modals and artifact entities, the relevant properties are typically related to physical and design properties of the entity.

(3) *Conversational background for properties*:
 $h : W \times D \rightarrow P$

Brennan incorporates the second feature of Kratzer’s treatment of modals, the ordering source, without alteration. The ordering source relevant to the semantics of artifact nouns is the ‘stereotypical’ conversational background. Using a set of worlds ordered according to stereotypicality ensures that we consider interpretations close to the normal course of events. That is, when determining whether a concrete entity is capable of being a cup, we do not need to consider worlds without liquids; rather, interpretation can proceed according to our standard expectations about the world. Formally, the ordering source is arrived at through a function, designated by j , which establishes an ordering on the set of worlds.

Based on Brennan’s (1993) definition of the ability modal use of *can* (p. 185), we define an operator ABLE in (4), where again what is relevant to the accessibility relation are the design and physical properties of the entity. We incorporate this property-level modality into the lexical meaning representation of a functional artifact noun, as illustrated in (5).

$$(4) \quad \llbracket \text{ABLE}[\langle \hat{P}(x) \rangle] \rrbracket^{w,g,h_x,j} = 1 \text{ iff } \exists w' \in W \text{ s.t. (i)-(iii) hold: (i) } w' \text{ is accessible from } w \text{ for } d \text{ given } h_x \text{ (ii) } w' \text{ is maximally close to the ideal established by } j(w), \text{ and (iii) } \langle w', d \rangle \in \llbracket P \rrbracket$$

$$(5) \quad \llbracket \text{cup} \rrbracket := \lambda y [\text{ABLE}[x \text{ drinks out of } y \text{ in } e_{\min}] \rrbracket^{w,g,h_y,j}$$

In prose, *cup* is true of an entity (at the world w and assignment function g), for which, given the actual properties of the entity, there exists an accessible (and maximally close) world in which one can drink out of this entity.

This analysis already provides an explanation for a major difference in how artifact nouns and natural kind nouns refer. Many artifact nouns and, in particular, the functional artifact nouns permit what we call ‘opportunistic reference’: they may refer to an entity which is used opportunistically to serve the relevant function, even if in ordinary circumstances the entity would not qualify as an instance of that artifact noun. Various examples are cited in the broader literature (Dennett 1990, 184, Keil 1989, Ch. 9). This property extends to nouns of critical interest to the semantics literature as well, e.g. a crate can serve as ‘furniture’ in a student apartment. This flexibility in reference is not possible with natural kind nouns: if a grapefruit is injected with orange food coloring and sugar so it takes on the color and taste of an orange, the grapefruit remains a grapefruit and cannot be correctly referred to as an orange (Keil 1989, p. 307).

On our account, opportunistic reference is expected with artifact nouns due to the ability modal in their representation. If a crate is currently furnishing a location, then trivially there is an accessible world in which it can furnish a location, viz. the actual world.

2.3 Stage-Level Artifacts

A separate issue bound up with nominal reference arises with a smaller class of artifact nouns. Unlike functional artifact nouns, certain artifact nouns describe entities which stand *not* in a potential relationship to their associated event, but in an actual relationship. This class includes countable nouns like *delivery*, *tip*, *gift*, and *present* and non-countable nouns like *mail*, *change*, and *laundry*. For instance, a sock qualifies as *laundry* only while it is in

the process of being laundered, but not when bought or worn. Similarly, a package qualifies as mail while it is in the postal system, but after its delivery, the label *mail* is no longer appropriate. These nouns contrast with natural kind nouns, where, for instance, an entity would qualify as a *dog* stably and throughout its lifetime.

This behavior is reminiscent of stage-level predicates, such as *tired* or *available*, which are only true of their subjects during particular stretches of time, contrasting with kind-level predicates, such as *female* or *extinct*, which are true (roughly) through the lifetime of the subject of predication (Carlson 1980). Accordingly, we refer to members of this class of artifact nouns as stage-level artifact nouns. Although we are unaware of any discussion of stage-level artifact nouns, there is another class of nouns which also pattern with stage-level predicates. These are certain nouns designating temporary roles assumed by individuals, such as *president* or *juror*, as well as some *-er* nominals, such as *passenger* or *batter*. See Gupta (1980), Carlson (1982), Barker (2010), among others.

We claim that the representation of a stage-level artifact noun includes a temporal parameter, t , as shown for the nouns *tip* and *laundry* in (6). These representations stipulate that the associated event must hold of the entities described at a particular time.

- (6) a. $tip := \lambda y[x \text{ remunerates } z \text{ for good service with } y \text{ in } e_{min} \text{ at } t]$
b. $laundry := \lambda y[x \text{ launders } y \text{ in } e_{min} \text{ at } t]$

Further motivation for regarding these nouns as stage-level as well as for this representation comes from the ease with which they combine with temporal modifiers. *Yesterday's mail* clearly refers to the mail that was in the postal system (in some manner) yesterday; in contrast, it is more difficult to interpret temporal modifiers with natural kind nouns (*yesterday's dog*) or with functional artifact nouns (*yesterday's hammer*) unless some further relation is contextually supplied between the entity and an event at the time specified by the temporal modifier. For instance, *yesterday's dog* is readily interpretable in a context where different dogs are being auditioned for a television commercial over several days.

3. Artifact Nouns and Countability

We now show how our analysis can explain the countability properties of artifact nouns, including both object- and kind-level interpretations. In particular, we address the contrast between nouns such as *chair*, which are countable at both the object-level (*three cups* = three individual, physical cups) and kind-level (*three cups* = three types of cups), and nouns such as *furniture*, which are not countable at either the object- or the kind-level (*two furnitures* \neq two pieces or kinds of furniture). We focus on the ‘why’ question: why do these particular nouns differ in the way they do? We argue that the explanation resides in the differing properties of their respective associated events.

3.1 Object-Level Countability

Canonical artifact nouns such as *cup* and *chair* are count nouns; however, as often noted, *furniture*-type artifact nouns, often called object mass nouns, are not countable, just like

substance mass nouns (*water, clay*). There has been considerable discussion of this contrast. Touchstones include Chierchia (1998) and Barner & Snedeker (2005), although to our knowledge the contrast has not been directly related to considerations of how artifacts refer.

We attribute the basic countability of an artifact noun to an interaction between its associated event and the minimality condition on this event. Artifact nouns whose minimal associated event involves a single entity are countable nouns, while those whose minimal associated event involves multiple entities are typically not countable nouns.

For canonical artifact nouns, the minimality condition restricts the domain of entities which can satisfy the associated event to single entities. Consider *cup*: a minimal drinking event typically only involves a single cup. Any event in which more than one cup is used requires drinking out of multiple entities in separate drinking events; thus, this event is decomposable into smaller sub-events, a violation of the minimality condition.

In contrast, the minimality condition does not restrict nouns like *furniture* to single entities. These nouns have associated events that permit, and typically imply, multiple, often diverse participants. Thus, we name them ARTIFACTUAL AGGREGATES. For example, the event of furnishing a study may involve a bookcase, a desk, and a chair. This furnishing event is minimal since these items jointly furnish the study. Any attempt to break this event into sub-events would require dividing the spatial region involved in unintuitive ways, e.g. the bookcase ‘furnishes’ the left half of the study, while the desk ‘furnishes’ the right half. Similar thought experiments produce the same result for other artifactual aggregate nouns, such as *mail* or *laundry*.

In summary, the object-level countability of an artifact noun depends on its associated event. If it canonically involves single entities, the noun supports singular reference and a contrastive plural value. If it canonically involves multiple entities, the noun supports aggregate reference, and pluralization is superfluous and accordingly barred; the result is grammatical non-countability.

3.2 Kind-Level Countability

We now show how our analysis extends to the less discussed observation that, unlike canonical artifact nouns or substance mass nouns, artifactual aggregate nouns disallow ‘taxonomic plurals’, i.e. ‘multiple kind’ readings. Examples (7)–(9) show the contrast between canonical artifact nouns such as *car*, which have taxonomic plural uses, and artifactual aggregates, which do not.

- (7) This dealer sells various cars: Audis, Toyotas, and Volvos.
- (8)
 - a. *The store sells many furnitures from France.
 - b. *Chairs and tables are two furnitures that I like.
- (9) *This museum show features Roman and Greek jewelries.

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We frame our discussion in the context of Krifka (1995), which provides an explicit representation of taxonomic plurality. Two building blocks are needed. First, a taxonomic relation T from Krifka et al. (1995) which relates kinds and sub-kinds: $T(x, y)$ means y is a sub-kind of x . Second, Krifka (1995) introduces a ‘kind unit operator’ KU : $KU(x, y) = n$ indicates y contains n number of sub-kinds of the kind x . With these elements in place, Krifka’s (1995) analysis states that a taxonomic plural is licensed when a noun designates an entity standing in a taxonomic relation to a kind, and that entity counts as at least two ‘kind units’, as given for the taxonomic plural interpretation of *wines* in (10).

$$(10) \quad \llbracket \textit{wines} \rrbracket := \lambda x [T_w(\textit{wine}, x) \wedge KU_w(\textit{wine}, x) \geq 2]$$

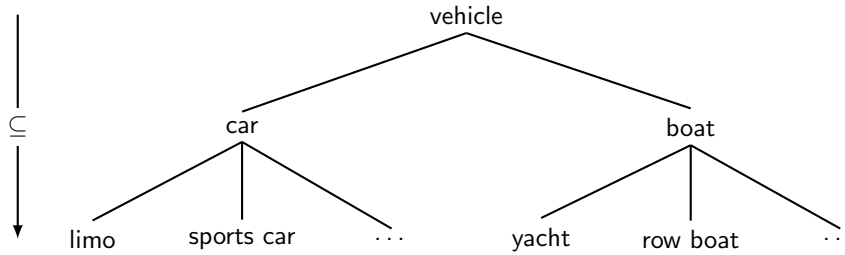
Critically, the licensing of a taxonomic plural depends on a noun’s participation in a taxonomic relation. We show that this condition is behind the lack of taxonomic plurals for artifactual aggregates. Artifactual aggregates, unlike natural kind nouns (*water*) or many artifact nouns (*car*), fail to satisfy this condition.

Natural kind nouns naturally stand in kind–sub-kind relations (e.g. $\llbracket \textit{dog} \rrbracket \subseteq \llbracket \textit{mammal} \rrbracket$), and thus have taxonomic plurals. We propose that for artifact nouns taxonomic relations are defined via the associated event: the sub-type’s associated event must be a more specific instantiation of the super-type. Consider the noun *vehicle*, an uncontroversial artifactual superordinate. The noun *car* stands in a sub-type relation to it since they share the associated event ‘provide transportation’, although *car* further specifies the event through other properties, which is approximated here via the inclusion of the property ‘has four wheels’. Representations for *vehicle* and *car* are given in (11), which allow $\llbracket \textit{car} \rrbracket \subseteq \llbracket \textit{vehicle} \rrbracket$ to be verified. Thus, *vehicle* has a taxonomic plural.

$$(11) \quad \begin{array}{l} \text{a. } \llbracket \textit{vehicle} \rrbracket := \lambda y [\text{ABLE}[x \text{ uses } y \text{ for transport in } e_{min}]^{w,g,h_y,j}] \\ \text{b. } \llbracket \textit{car} \rrbracket := \lambda y [\text{ABLE}[x \text{ uses } y \text{ for transport in } e_{min} \wedge \text{has-four-wheels}(y)]^{w,g,h_y,j}] \end{array}$$

As evidence that shared associated events are the basis for artifact taxonomies, we show that such taxonomies have the three key properties of well-defined taxonomies (Murphy 2002): (i) a sub-element bears a ‘kind-of’ relation to the super-element, (ii) a sub-element inherits properties from the super-element, and (iii) the super-/sub-element relation is transitive, i.e. if A is a sub-element of B , and B is a sub-element of C , then A is a sub-element of C . Consider the taxonomic hierarchy for *vehicle* in (12). Each sub-element is intuitively a ‘kind’ of its super-element. Due to the denotations of artifact nouns, the sub-elements are entailed by the super-elements; thus, inheritance of properties and transitivity are satisfied.

(12) Taxonomic Hierarchy for *vehicle*

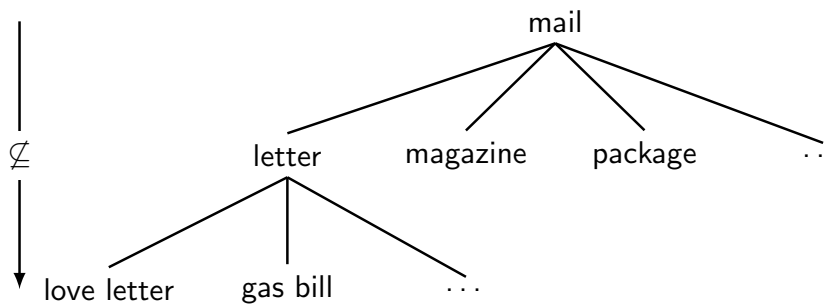


However, an artifactual aggregate and its constituent entities have different associated events. For example, *furniture* furnishes, while a *chair* is for sitting, as shown in (13). Accordingly, $\llbracket chair \rrbracket \not\subseteq \llbracket furniture \rrbracket$, although chairs (in stereotypical worlds) always satisfy the associated event of *furniture*. Therefore, artifactual aggregate nouns cannot stand in a taxonomic super-/sub-element relation, explaining why they lack a taxonomic plural.

- (13) a. $\llbracket furniture \rrbracket := \lambda z[\text{ABLE}[x \text{ furnishes } y \text{ with } z \text{ in } e_{min}]]^{w,g,h_z,j}$
 b. $\llbracket chair \rrbracket := \lambda y[\text{ABLE}[x \text{ sits on } y \text{ in } e_{min}]]^{w,g,h_y,j}$

This proposal may seem surprising as some researchers take artifactual aggregate nouns to be Roschian superordinates (Markman 1985, Rosch 1975): just as a typical count superordinate noun (*vehicle*) gathers heterogeneous subordinate nouns with common properties, so does an artifactual aggregate noun. Yet, other researchers show the relation of artifactual aggregate nouns to their purported subordinate nouns lacks the properties of a well-formed taxonomy (Atran 1990, Mihatsch 2007, Wierzbicka 1985, Wisniewski et al. 1996).

(14) Attempted Taxonomic Hierarchy for *mail*



We demonstrate that for such nouns the key properties of taxonomies are indeed lacking. An ostensive taxonomic hierarchy for *mail* is given in (14). As has been noted, the ‘kind-of’ relation is strained here: it seems strange to call a *magazine* or a *letter* a kind of *mail*. Second, the properties of the purported super-kind *mail* do not trickle down: *mail* is delivered, but the purported sub-kind nouns do not inherit this property, since not all magazines

are delivered nor is being delivered an essential property of a magazine. Consequently, transitivity does not hold among the sub- and super-elements in (14). Failure of transitivity holds more generally for artifactual aggregates. For example, while some kinds of mirrors are ‘kinds’ of furniture, not all are—compare *hall mirror* and *rear view mirror*. What is happening here is that ‘a kind of’ actually is being used to mean ‘is used as’ (Murphy 2010, p. 114; see also Hampton 1982).

In summary, the kind-level countability of an artifact noun depends on the nature of its associated event. If the associated event is shared with other ‘sub-kind’ nouns, which also impose more specific requirements on it, a taxonomic relation may be licensed and, in turn, so is the use of a taxonomic plural. If an artifactual noun and its purported sub-kind do not share an associated event, no taxonomic plural is licensed.

4. Conclusion

We have provided a uniform semantics for several types of artifact nouns which naturally accounts for the unique properties of artifactual aggregate nouns. Key to our analysis is the recognition that artifact nouns encode a relation between entities and an associated event.

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