

A counterfactual analysis of adnominal modifiers

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Abstract. In this article, I shall argue for a counterfactual analysis of the semantics of some adnominal modifiers. This analysis formalizes the intuition that adnominal modifiers are always restrictive in some sense. Technically, the proposal is formalized with an operator that applies to two intensional entities of type $\langle s, et \rangle$ and returns as the value the same type of semantic entity (type: $\langle s, et \rangle$). In terms of how the rule works, it resembles Predicate Modification since it requires a special rule. However, it does not intersect the two sets in question. Rather, the rule yields a set of entities that are not necessarily a subset of the entities specified by the common noun in the actual world. I call this semantic procedure Restrictive Modification (RM). Essential reasoning is given as follows: the property of being x that has the modifier property and if in all closest worlds w in which x had a crucial property that all CN entities have, x would also have the CN property. For example, in the case of *stone lion*, it denotes the property of being x made of stone such that if x were to possess a crucial property that a real lion has (say, the property of being alive with flesh and blood), then x would be a real lion. This reasoning applies to a variety of adjective types. Some problematic examples such as *house key* and *ice water* remain, and they are reserved for a future study.

Keywords. adjective; adnominal modifier; intensional adjective; privative adjective; subjective modifier; predicate modification.

1. Introduction. In his book-length review of the literature on modification, Morzycki (2016) speculates on the possibility that adnominal modifiers – adjectives in particular – can only be “true modifiers” if their semantics is specified in terms of Predicate Modification (PM). Although this is not the major claim he makes in his book, I find this suggestion counterintuitive in the following sense. First, PM assumes that both the modifier and the modifiee denote properties and they are “intersected.” What this means is that the modifier and the modifiee noun are of the same semantic type. This goes against the syntactic fact that the noun is the head of the NP and the semantic intuition that the modifier “restricts” the meaning of the noun. This asymmetric syntactic fact cannot be captured by adopting PM.

Let us step backwards and discuss how PM is used for the semantics of adnominal modifiers such as PPs. For example, Heim and Kratzer (1998) assume that the denotation of a PP is of type $\langle e, t \rangle$. In (1a) the PP *in Texas* denotes the function $\lambda x . x \text{ is in Texas}$ and modifies the noun *city* in (1a) where *city* also denotes the same type of semantic entity, namely $\lambda x . x \text{ is a city}$. In order to obtain the denotation of the entire phrase, Heim and Kratzer posit PM to “intersect the two sets” as in (1b).

(1) a. *city in Texas*

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$$b. \lambda x \in D_e . \llbracket \text{city} \rrbracket(x) = \llbracket \text{in Texas} \rrbracket(x) = 1$$

(1b) shows that the entire phrase denotes $\lambda x . x \text{ is a city and } x \text{ is in Texas}$. This accords with our intuitions about the meaning of the entire expression. This approach also accounts for the semantics of relative clauses as shown in (2). A book that I bought yesterday is definitely a book and something that I bought yesterday. Thus, the semantic prediction made by (2b) is accurate here.

- (2) a. book (that) I bought yesterday
 b. $\lambda x \in D_e . \llbracket \text{book} \rrbracket(x) = \llbracket \lambda y . \text{I bought } y \text{ yesterday} \rrbracket(x) = 1$

The same technique can be used to account for the semantics of a group of adjectives called intersective adjectives. A couple of examples are given in (3a, b).

- (3) a. red car
 b. Canadian surgeon

It seems reasonable to assume that *red* denotes $\lambda x . x \text{ is red}$, and *Canadian* denotes $\lambda x . x \text{ is Canadian}$. Therefore, we can use PM for cases like (3a, b).

However, PM cannot account for all instances of adnominal modifiers, at least not straightforwardly. For example, adjectives such as *big* and *small* are known to exhibit different characteristics depending on the nouns they modify. For example, suppose that (4a) and (4b) are both true.

- (4) a. Dumbo is a small elephant.
 b. Mumbo is a big ant.

Does this mean that Dumbo is small, and Mumbo is big? This is not the right way of characterizing their sizes. Specifically, our intuitions about elephants and ants tell us that Dumbo must be much bigger than Mumbo. If so, we definitely cannot posit the set of small entities and the set of big entities in an empirically accurate account of adjective meanings. Additionally, our semantic system must also be such that it accounts for the data about comparatives (such as *bigger* and *smaller*).

The problem with an intersective approach is also apparent with so-called intensional adjectives such as *alleged* and privative ones such as *fake*. Some relevant examples are given in (5).

- (5) a. alleged criminal (*alleged* is intensional)
 b. fake gun (*fake* is privative)

An alleged criminal is not necessarily a criminal, and a fake gun is, by definition, not an actual gun. Thus, the (extensional) intersective approach definitely does not give us the right denotation for the entire phrase. This is shown in (6).

- (6) $\llbracket \text{alleged criminal} \rrbracket \not\subseteq \llbracket \text{criminal} \rrbracket$
 $\llbracket \text{fake gun} \rrbracket \cap \llbracket \text{gun} \rrbracket = \emptyset$

In order to account for the fact that what counts as *small* or *big* depends on the nouns they modify, Functional Application (FA) (Heim and Kratzer 1998) does the job. For example, if the meaning of *small* is not context-sensitive, then it would have to denote a function given in (7), which is of type $\langle\langle e, t \rangle, \langle e, t \rangle\rangle$. Adjectives like *small* and *big* are referred to as subsective adjectives in that they yield a subset of the denotation of the noun to which it applies.

- (7) $\llbracket \text{small} \rrbracket = \lambda f \in D_{\langle e, t \rangle} . \lambda x \in D_e . f(x) = 1$ and the size of x is below the average size of the elements of $\{y : f(y) = 1\}$

We can do something similar with *big*. The semantics of such extensional subjective adjectives are therefore correctly described in terms of their interpretations in the $\langle\langle e, t \rangle, \langle e, t \rangle\rangle$ type.

Regarding intensional and privative adjectives, we can use the intensional version of the functional application approach. This is proposed by Montague (1970) and Parsons (1972). This takes care of extensional non-intersective adjectives like *big* and *small* as well. Here is the schematic representation of how this proposal works.

- (8)
- ```

 $\langle s, \langle e, t \rangle \rangle$
 / \
 $\langle\langle s, \langle e, t \rangle \rangle, \langle s, \langle e, t \rangle \rangle\rangle$ $\langle s, \langle e, t \rangle \rangle$
 Adj CN

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$\llbracket \text{alleged} \rrbracket$  maps  $\llbracket \text{criminal} \rrbracket$  to  
 $\{\langle w, x \rangle \mid x \text{ is an alleged criminal in } w\}$   
 $\llbracket \text{small} \rrbracket$  maps  $\llbracket \text{elephant} \rrbracket$  to  
 $\{\langle w, x \rangle \mid x \text{ is a small elephant in } w\}$

Here,  $\llbracket \text{criminal} \rrbracket$  and  $\llbracket \text{elephant} \rrbracket$  represent their intensional meanings.

In this system, *alleged* then denotes the function given in (9a), and the intensional version of *small* denotes the function in (9b).<sup>1</sup>

- (9) a.  $\llbracket \text{alleged} \rrbracket = \lambda f \in D_{\langle s, \langle e, t \rangle \rangle} . \lambda w \in D_s . \lambda x \in D_e . \text{there is someone } y \text{ such that in all the worlds } w_1 \text{ compatible with what } y \text{ alleges in } w, f(w_1)(x) = 1$   
 b.  $\llbracket \text{small} \rrbracket = \lambda f \in D_{\langle s, \langle e, t \rangle \rangle} . \lambda w \in D_s . \lambda x \in D_e . f(w)(x) = 1$  and the size of  $x$  is below the average size of the elements of  $\{y : f(w)(y) = 1\}$

Unfortunately, this analysis of “subjective” adjectives cannot account for their predicative use as shown in (10a, b).

- (10) a. That basketball player is short.  
 b. That five-year-old girl is tall.

The problems with (10a, b) are multifaceted. If *short* is of type  $\langle\langle s, \langle e, t \rangle \rangle, \langle s, \langle e, t \rangle \rangle\rangle$ , then it would have a type mismatch problem in the post-copular position as exemplified by (10a). The subject denotes a specific entity and is of type  $e$  (or a generalized quantifier of type  $\langle\langle e, t \rangle, t \rangle$ ). If so, the predicate should be of type  $\langle e, t \rangle$  to make the computation possible. However, since the lexical meaning of the adjective *short* is of type  $\langle\langle s, \langle e, t \rangle \rangle, \langle s, \langle e, t \rangle \rangle\rangle$ , its type must be reduced to  $\langle s, \langle e, t \rangle \rangle$  or  $\langle e, t \rangle$  somehow to make the compositional semantic calculation possible. What needs to happen is that the denotation of *short* applies to a phantom common noun and reduces the denotation to  $\langle e, t \rangle$  before it applies to the subject denotation. (11a, b) exhibit the paraphrases of the semantic composition being entertained.

- (11) a. That basketball player is a short basketball player.  
 b. That five-year-old girl is a tall five-year-old girl.

(11a) is now interpretable and presumably yields the right interpretation, but this shows that the information about the restriction has to come from the subject, which is not adjacent to the adjective. We have no way of doing this compositionally. The same is true of (11b). Indeed, we may even have to worry about cases in which this restriction must be completely context dependent

<sup>1</sup> (9a) is essentially the same as what Morzycki (2016) provides.

and may not be available from the sentence in question. For example, knowing that Bill is a basketball player, one might utter (12).

(12) Bill is short.

In this case, (12) could be interpreted to mean that Bill is short for a basketball player. The relevant restriction can only be retrieved from the context. This means that assigning a  $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$ -type meaning to *short* may not be necessarily better than assigning a generic  $\langle e,t\rangle$  type and obtaining a restriction from the context. This type of discussion is well known and is given in an introductory textbook like Heim and Kratzer (1998).

Suppose that we retreat to the position that the meaning of adjectives is always context dependent and their semantic type is  $\langle e,t\rangle$ . Let us see if this analysis is sufficient to cover all adjectives. Privative adjectives such as *fake* were originally analyzed as having an intensional meaning because fake guns are necessarily non-guns. However, Partee (2007) presents a different view. Partee argues that *fake* may be a subsective adjective after all. Partee’s idea is that when *fake* applies to a noun, the denotation of the noun can be widened to include entities that are not covered by the literal meaning of the noun. For example, we could argue that a fake gun is a special type of gun. Therefore, it is a gun, after all. If so, *fake* could be treated like any other subsective adjectives such as *happy*, *skillful*, *big*, etc. One example that Partee cites to support her perspective is the example in (13).

(13) I don’t care whether that fur is fake or real.

(13) sounds natural, and this suggests that the speaker assumes that the object referred to as *that fur* is fur even if it is not genuine (i.e., fake). If so, the extension of *fur* must include both artificial as well as real fur. Although this proposal does not extend straightforwardly to other intensional adjectives, the intersective approach to the semantics of adjectives gives us a natural way of restricting the meaning of the noun in that the resulting nominal is necessarily a subset of the original set:  $\llbracket \text{Adj CN} \rrbracket \subseteq \llbracket \text{CN} \rrbracket$ .

**2. Residentialous city.** As mentioned above, Morzycki (2016) speculates on the possibility that “true (adjectival) modifiers” are intersective. He discussed the problem of a made-up adjective *residentialous* attributed to von Stechow and Heim (1999) and Landman (2001). The issue raised by this adjective is given in (14).

(14)  $\llbracket \text{residentialous} \rrbracket = \lambda P \lambda y \exists x [P(x) \wedge \text{lives-in}(y, x) \wedge \text{resident}(y)]$   
 $\llbracket \text{residentialous city} \rrbracket = \lambda y \exists x [\text{city}(x) \wedge \text{lives-in}(y, x) \wedge \text{resident}(y)]$   
 $\llbracket \text{Mary is a residentialous city} \rrbracket = 1$  iff Mary is a city resident.

The problem is that *residentialous* is of type  $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$  and combines with the noun *city* to yield a good meaning. However, the problem with this adjective is clear when we look at the interpretation of the sentence *Mary is a residentialous city*. This sentence is true iff Mary is a city resident. Our intuition is that a residentialous city has to be a specific type of city. This intuition is not reflected in the predicted meaning of *residentialous city*. Morzycki’s (tentative) conclusion about this very telling example is that the problem was caused by the fact that *residentialous* was given a higher type meaning of type  $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$ . This can be avoided by assigning the semantic type  $\langle e,t\rangle$  to all adjectival modifiers.

It is clear that the problem with *residentialous* is avoided by restricting “true adjectival modifiers” to intersective ones since that would guarantee that a structure of the form [Modifier CN] denotes a subset of  $\llbracket \text{CN} \rrbracket$ . However, this would restrict adjectives to a relatively small group of

expressions, and many actual adjectives (or other adnominal modifiers) would be excluded from this group.

I think it is important for a formal theory to preserve the intuition that adnominal modifiers always restrict the meaning of the head noun in some sense. However, it is clear that we cannot always use the subsective or intersective operations to obtain the semantic result we want. In the rest of this article, I shall discuss how to capture this intuition in a formal system even when the result is not a subset of a noun's denotation.

**3. Nouns modifying nouns.** We cannot discuss all adnominal modifiers in this study. We will restrict our attention to nouns modifying nouns such as *stone* in (15a), and *paper* in (15b). Needless to say, modifying nouns have semantic properties different from adjectives modifying nouns. Nevertheless, they are genuine modifier expressions in (15a, b) and their semantic properties need to be accounted for.

- (15) a. stone lion  
b. paper plane

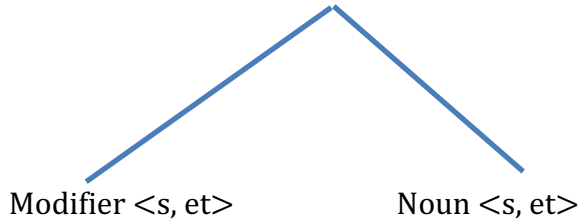
Examples like (15a, b) are discussed by Kamp and Partee (1995) and exhibit interesting properties. They are very natural examples and we immediately understand what they refer to. However, they are not subsective modifiers in that stone lions are not (real) lions, and paper planes are not (really) airplanes. Although these adnominal modifiers do have different properties than true adjectives, they are still modifiers and not the head of each phrase. In this sense, they comprise an interesting subset of adnominal modifiers that we would like to account for.

What I should like to argue for is the idea that a counterfactual reasoning is at play when we calculate the semantic interpretation of phrases like (15a, b). This idea preserves the intuition that a modifier must be “restrictive” in some sense in that the denotation of the entire phrase means “a special type of CN.” In the following discussion, let us assume that so-called subsective adjectives (e.g. *tall*, *short*, *big*, *small*) are also of type  $\langle e,t \rangle$  and receive an appropriate meaning in the utterance context.

Here is the gist of the proposal in informal terms. First, we assume as the default option that [Modifier CN] denotes a subset of the extension of the CN. This corresponds to intersective or subsective cases such as *red car* and *big ant*. Second, when [Modifier CN] does not denote a subset of the CN denotation, this invokes the following counterfactual reasoning. For concreteness, consider the case of *stone lion*. Assume that the modifier *stone* gives us the set of entities made of stone. We then perform the following test to see if a specific entity made of stone counts as a stone lion: if this entity were alive with flesh and blood, would it be a real lion? If the answer is yes, then it is a stone lion; if not, it is not. For example, if the entity being tested looks like a lion, then it would count. By contrast, a gravestone is made of stone but does not look like a lion. Therefore, it does not count.

In order to implement the idea described in the previous paragraph in a formal system, we shall adopt a system in which two properties are combined to yield a new property. This is like Predicate Modification (PM), but it yields a very different outcome. I call this rule Restrictive Modification (RM).

(16)



We would need a rule that combines the two properties but yields something other than their intersection. This is given in (17).

- (17) **Restrictive Modification (RM) Operator:**  $\lambda P \lambda Q \lambda w \lambda x . [P(w)(x) \wedge \exists S [Q \subset S \wedge \forall w' [[w' \text{ is most similar to } w \text{ among those in which } x \text{ has } S] \rightarrow Q(w')(x)]]]$   
Notation: P, Q, S are property variables (of type <s,et>). P: Modifier, Q: CN  
Shorthand:  $Q \subset S$  (Q is a proper subset of S) abbreviates  
 $\forall w \forall x [Q(w)(x) \rightarrow S(w)(x)] \wedge \exists w' \exists y [\neg Q(w')(y) \wedge S(w')(y)]$

(17) is the operator that applies to two properties P and Q in turn to yield the property of being x such that x has P and would be a Q if x had a (crucial) property that every Q has.<sup>2</sup> The counterfactual semantics is based on Lewis (1973).

(18) shows the meaning of the entire phrase after the operator has applied to the two sister properties, which should be easier to process:

- (18) A structure of the form [Modifier CN] denotes  $\lambda w \lambda x [[\text{Modifier}](w)(x) \wedge \exists S [[\text{CN}] \subset S \wedge \forall w' [[w' \text{ is most similar to } w \text{ among those in which } x \text{ has } S] \rightarrow [\text{CN}](w')(x)]]]$   
Notation: S is a property variable (of type <s,et>).  
Shorthand:  $[\text{CN}] \subset S$  abbreviates  
 $\forall w \forall x [[\text{CN}](w)(x) \rightarrow S(w)(x)] \wedge \exists w' \exists y [\neg [\text{CN}](w')(y) \wedge S(w')(y)]$   
The *stone lion* case: S is instantiated by the property of being alive with flesh and blood

In words, (18) specifies the following property regarding the case of *stone lion*: the property of being x such that x is made of stone and if x had a property that any (real) lion has (e.g., being alive with flesh and blood), then x would be a (real) lion. This requires x to be something made of stone resembling a real lion in terms of overall shape so that if x were alive with flesh and blood, then x would be a real lion. Just so that the point is clear, let us imagine that we are looking at a sculpture of a dog. Even if it were to obtain the property of being alive with flesh and blood, which any real lion has, it would only be a (real) dog; it would not be a (real) lion. I believe that the proposal delineated above accounts for the semantics of (15a, b).<sup>3</sup>

**4. Privative and intensional adjectives.** In this section, I wish to discuss whether this proposal can account for special types of adjectives that were previously discussed in the literature. Consider the case of *fake*, which is said to be a privative adjective. Let us assume that this means that

<sup>2</sup> See Anderson (1951) for an example in which the antecedent of a subjunctive conditional in English is actually true.

<sup>3</sup> Other modifiers that are assumed to be intersective such as (reduced) relative clauses are not always intersective. Consider examples like (i).

(i) (a/the) lion made of stone

Thus, the utility of the proposal advocated here extends to more “ordinary” adnominal expressions, too.

it denotes a contextually given property  $F$  such that  $F \cap \llbracket \text{CN} \rrbracket = \emptyset$ . If so, *fake gun* would denote the property of being  $x$  that is not a gun and if in all worlds  $w'$  closest to the actual one such that in  $w'$ ,  $x$  possessed a property that every real gun possesses then  $x$  would be a real gun. In this case, the property that every gun possesses would be the property of being able to propel bullets, shells, etc. The object referred to as a fake gun would have to look like a real one to begin with because the ability to propel bullets alone would not make any object a gun. For example, if we have a metal box with a hole on the side, it is not a fake gun since adding the ability to propel bullets from the hole would not make it a (real) gun even though it would be some type of weapon.

Let me now turn to *alleged*, which is an intensional adjective. Consider (19).

(19) alleged murderer

When we think about what (19) means, we conclude that it means someone who is/was alleged to be a murderer. This means that the noun *murderer* is semantically incorporated into the meaning of the adjective. Obviously, this imposes a difficult problem for the syntax-semantics interface, but for the purpose of this discussion, we assume that the syntactic “transformation” has been applied to the original phrase so that the semantic component can deal with the structure in (20), instead.

(20) someone who is/was alleged to be a murderer

This then is treated as an instance of intersective modification, which does not require a counterfactual reasoning.

I think the same idea applies to temporal adjectives like *former* and *future*, and a temporal-intensional adjective like *prospective*. Consider examples like (21a, b).

(21) a. former student  
b. prospective student

Just like the case of *alleged*, we can see that the paraphrases of (21a, b) include the meaning of the nominal in the modifier, as shown in (22a, b).

(22) a. person who was a student and is no longer a student  
b. person who may become a student in the future

We can then say that on the basis of these paraphrases, RM can be used straightforwardly; they are sub-cases of intersective modifiers.

**5. The case of *residentialous* revisited.** Let us return to the case of the made-up adjective *residentialous*. The adjective *residentialous* would be prescribed to denote the function in (23) in our system since it has to be of type  $\langle s, et \rangle$ .

(23)  $\llbracket \text{residentialous} \rrbracket = \lambda w \lambda y \exists x [y \text{ lives in } x \text{ in } w \wedge y \text{ is a resident in } w]$

This combines with the meaning of *city*, which is given in (24).

(24)  $\llbracket \text{city} \rrbracket = \lambda w \lambda y [y \text{ is a city in } w]$

They combine via RM and provides the following property as its output: the property of being a resident  $y$  of some place  $x$  such that in the worlds  $w$  closest to the actual one where  $y$  had a (crucial) property that every city has,  $y$  would be a city. The crucial property of any city could be that of being a human settlement. This reasoning does not work since no resident can become

a city by having the property of being a human settlement. In this way, we can account for the fact that the expression *residentialous city* could not mean ‘city resident.’

**6. Context sensitivity.** An anonymous reviewer points out that the meaning of an example like (25) depends on factors other than the noun. For example, the extension of *tall snowman* in a particular situation depends on who made it (Siegel 1976, Kamp and Partee 1995).

(25) tall snowman

This is consistent with the proposal defended here since all subjective modifiers such as *small*, *big*, *tall*, and *short* are of type  $\langle e, t \rangle$  and context-sensitive. This then allows them to be used predicatively with no stipulation. It is important in this context to point out that intensional adjectives such as *alleged* are different in that they have to incorporate the meaning of the noun to be semantically “complete” as mentioned in Section 4. This explains the fact that they cannot occur in the predicate position on their own as demonstrated by the anomaly of (26).

(26) \*/# The murderer is alleged.

**7. Problematic cases.** The proposal I advocated works in a variety of adnominal modifier cases. However, it does have some issues with some nouns modifying nouns. Consider examples like (27a, b).<sup>4</sup>

(27) a. house key  
b. ice water

It is clear that a house key is not a house. Similarly, ice water is not (just) ice. In fact, it is mostly water. Therefore, nouns used as adnominal modifiers do not always provide a property directly. I believe that in many such cases, nouns provide a property that is related to the property that the noun itself denotes. A house key is a key that is used to enter a house. Ice water is water that contains some ice. Therefore, I do concede that there are many different types of adnominal modifiers, and the proposal I made in this article only covers a subset of such possibilities. I can only say informally that cases like (27a, b) present instances in which the modifier brings in an aboutness relation as a mediator. This is just a speculation, however.

**8. Conclusion.** In this article, I have discussed instances of nouns modifying nouns such as *stone lion* and *paper plane*. The proposal I defend employs a counterfactual reasoning to obtain the right interpretation for the larger nominal structure. This idea successfully extends to many adjectival expressions such as privative adjectives, and the oddity of the made-up adjective *residentialous* is also accounted for. Intensional adjectives such as *alleged*, temporal adjectives like *former*, and temporal-intensional adjectives like *prospective* are treated as exceptions in that the head noun is incorporated into the modifier meaning, leaving behind a generic noun like *person*. Although this analysis may look ad hoc, it explains why these adjectives cannot be used predicatively: they inherently require nouns to be predicates. There are examples that cannot be explained by the proposed account. I hope to conduct a more comprehensive study of adnominal modifiers in a future study and account for them as well.

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<sup>4</sup> I owe these examples to the audience of the semantics roundtable meeting at the University of Washington. Other examples that have a similar property include *garage sale*, *moving sale*, etc.



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