The Semantics of Implicitly Relational Predicates

Daniel R. McCloy

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Daniel R. McCloy

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Committee Members:

_____

Toshiyuki Ogihara

_____

Karen Zagona

Date: _____

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Abstract

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Daniel R. McCloy

Chair of the Supervisory Committee:
Associate Professor Toshiyuki Ogihara
Department of Linguistics

This thesis offers a semantic account of implicitly relational predicates — adjectival or nominal predicates such as *to be popular* and *to be a wanted man*. Implicitly relational predicates are characterized by unique entailment properties when combined with locatives (and other PPs headed by words like *with* and *among*). It is argued that implicitly relational predicates take PPs as arguments via functional application, rather than as adjuncts via predicate modification, and a formal account of that interaction is presented.

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DEDICATION

To my wonderful friends and shipmates: Taylor, Jonathan, and Ben.
Thanks for putting up with me through all this.

1 Introduction

Locative expressions exhibit a wide variety of interpretations. They can locate individuals by combining with grammatical subjects (1a); they can locate an action by modifying other predicates (1b); they can supply instrumental information as to the manner of action (1c); and they can supply temporal information as to when a claim holds (1d).[1]

(1a) Aki is in the shower

(1b) Aki walked on the sidewalk

(1c) Aki commutes on a bicycle

(1d) Aki is happy in Osaka

A further complexity of locatives is that their interpretation seems to be sensitive to the kind of predicate they co-occur with. Consider, for example, (2) and (3):

(2) Taro plays baseball in Seattle ($\rightarrow$ Taro plays baseball)

(3) George is popular in Texas ($\not\rightarrow$ George is popular)

One obvious difference between these two pairs of sentences is that the truth of the antecedent in (2) guarantees the truth the consequent, while the corresponding entailment does not hold for the sentences in (3). In this thesis I will examine the interpretation of sentences like *George is popular in Texas*. I will argue for the

[1] I will not address lexicalized locatives such as *in a fury*, *under the weather, on fire*, etc.

existence of a class of predicates like *popular* that appear to be ordinary ‹e,t›-type predicates but in fact implicitly express a relation between individuals and sets, and are best analyzed as ‹‹e,t›,‹e,t››-type expressions. I will call such expressions "implicitly relational predicates." A partial list of implicitly relational predicates is given below:

> adjectival predicates: *famous*, *admired*, *(well-)liked*, *(un)known*, *(un)popular*, *(be)loved*, *demonized*, *hated*, *loathed*, *reviled*, *wanted*, *marked*, *emulated*, *duplicated*, *reflected*, *rivaled*, *scorned*, *spurned*, etc.
>
> predicate nominals: *to be a wanted man*, *to be a star*, *to be a celebrity*, *to be a laughingstock*, *to be a role model*, etc.

More concretely, I will argue that of the two arguments that an implicitly relational predicate takes, the ‹e,t›-type argument is a contextually determined function that characterizes the set of individuals to which the subject is being related (the e-type argument is just the subject). Furthermore, I argue that the meaning of overt locative expressions is incorporated into this function.

One notable feature of these predicates is that the class seems to be exclusively made up of adjectivals and nominals (as indicated above).[2] For the sake of simplicity, most of the examples herein will be adjectival predicates, except in cases where a particular predicate nominal displays unique behavior or is particularly illustrative.

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[2] Possible exceptions to this generalization are verbs like "to kill" (when used euphemistically to describe a entertainer's exceptional performance and a corresponding favorable reaction from the audience).

1.1 Outline of the Thesis

One of the crucial pieces of evidence for the uniqueness of implicitly relational predicates is their characteristic interaction with locatives. Accordingly, after offering an informal characterization of implicitly relational predicates in section 2, I will present existing typologies of both predicates and locatives, and show how those analyses fail to account for the phenomena we are interested in. In section 3, I review the major accounts of predicate typology beginning with Carlson's (1977) distinction between individual-level and stage-level predicates, and later refinements of this distinction, particularly Kratzer's (1995) theory based on eventuality arguments. I show that these accounts do not suffice to differentiate implicitly relational predicates from other predicate types; ultimately I will conclude that this class of predicates is characterized by common lexical and pragmatic features rather than syntactic ones. In section 4 I introduce Maienborn's (2001) typology of locatives, followed in section 5 by a critical analysis of her semantic treatment of locatives with respect to implicitly relational predicates. Section 6 comprises a formal semantic account of implicitly relational predicates and a formal characterization of their interaction with locative expressions; section 7 offers a summary of the thesis and concluding remarks.

2 Informal Description of Implicitly Relational Predicates

Before addressing existing accounts of predicate typology, we must first introduce the conceptual basis of our semantic treatment of implicitly relational predicates. Recall from above the hypothesis that implicitly relational predicates are of type ‹‹e,t›,‹e,t›› and thus are structured to take two arguments (one a predicate and the other an individual). The data below in (4) summarize the motivation for this claim:

(4a) *When the predicate is implicitly relational, the locative does not express a property of the subject:*
George is popular in Texas ↛ George is in Texas

(4b) *When the predicate is implicitly relational, the locative does not merely specify the location of the event or experience (i.e., it does not modify the eventuality argument of the predicate)*
Taro plays baseball in Seattle → Taro plays baseball
George is popular in Texas ↛ George is popular

(4c) *When the predicate is implicitly relational, the locative does not merely describe a specific instantiation or set of instantiations that constitutes a subset of those situations under which the main claim holds (* i.e.*, the predicate is not true everywhere and thus trivially true at a specified location):*
Kristi is strong → ? Kristi is strong in Seattle[3]
George is popular ↛ George is popular in Texas

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[3] This example sounds somewhat odd, but that is the point: it sounds odd to say *Kristi is strong in Seattle* precisely because *strong* is the kind of predicate that is usually thought of as location-independent. What is important here is the contrast between *strong* and *popular*: clearly popularity is not location-independent in the same way.

(4d) *Implicitly relational predicates require some relation between the subject and some other entity or set of entities (hereafter the "reference set"):*
Phil was raised by wolves who have since left him, and he lives in a remote mountain cave and has no contact with other humans. #Phil is popular.

(4e) *The reference set is not accurately characterized as "everyone everywhere" but is a set of contextually relevant individuals:*
Blue's Clues is popular ↛ Most people like *Blue's Clues*
Blue's Clues is popular → Most young children who watch TV like *Blue's Clues*

(4f) *Locatives do not serve to locate all members of the reference set:*
Darren is admired in Japan ↛ Darren's admirers are (all) in Japan

(4g) *Rather, locatives intersect with the reference set:*
Blue's Clues is popular in France → Most young children in France who watch TV like *Blue's Clues*

These observations constitute the foundation of our hypothesis. The task now is to articulate a formal semantic structure that can accommodate this characterization. The means of interaction between the reference set and the locative is of particular interest, since the need for a reference set is a feature of these predicates that sets them apart from "ordinary" predicates such as *bored* or *happy*. Thus, after reviewing the major predicate typologies in the literature, we will turn to an evaluation of Maienborn's (2001) account of locative semantics, with an eye toward how locatives might interact with implicitly relational predicates.

3 Predicate Typologies

In this section I introduce several predicate typologies from the literature, and show that each is insufficient to characterize implicitly relational predicates as a class.

3.1 Carlson's Theory of Predicates

Since Carlson's 1977 dissertation, the distinction between individual-level predicates (ILPs) and stage-level predicates (SLPs) has been a common starting point for linguistic analyses of predicate-related phenomena. A rough first approximation of Carlson's idea is that the ILP/SLP distinction is one between permanent properties and temporary ones; more concretely, it is a distinction between predicates that hold of an individual throughout its existence and predicates that obtain for a finite temporal slice of an individual. The classic examples and their formalizations in Carlson's system are given in (5).

(5a) firefighters are altruistic (ILP: GENERIC)
ALTRUISTIC(firefighter)

(5b) firefighters are available (SLP: EXISTENTIAL)
$\lambda x\, \exists y\, [R(y, x) \wedge \text{AVAILABLE}(y)\,]$ (firefighter)
$= \exists y\, [R(y, \text{firefighter}) \wedge \text{AVAILABLE}(y)\,]$

Under Carlson's theory, bare plurals were kind-denoting terms semantically on par with individuals (hence they can be the arguments of predicates as in (5a)). In (5b) the relation R is one of realization (*i.e.*, *y* realizes the kind *firefighter*). Carlson was primarily concerned with the interpretation of bare plural subjects, and the broad

division between ILPs and SLPs does correlate with differences in bare plural subject interpretation: bare plural subjects of ILPs tend to receive generic interpretations, while bare plural subjects of SLPs tend to receive existential interpretations.[4] His conclusion was that ILPs are simple predicates of individuals (or kind-referring terms) whereas SLPs additionally include an implicit existential quantifier and a realization relation.

Several facts are accounted for by this analysis, including the combination of ILPs/SLPs with indefinite DPs as in (6a,b) and the related existential sentences in (6c,d).

(6a) ?? Three firefighters are altruistic

(6b) Three firefighters are available

(6c) * There are three firefighters altruistic

(6d) There are three firefighters available

Ultimately, however, Carlson's treatment of the ILP/SLP distinction will not help us distinguish implicitly relational predicates from non-relational ones: all we need notice is that some but not all SLPs and some but not all ILPs express a relation between the subject and some other individual or community. Examples of non-relational predicates are *strong* (ILP) and *bored* (SLP).

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[4] Carlson was himself aware that his typology was not unproblematic: sentences like (i) are ambiguous in a way not predicted by Carlson's theory (example (i) adapted from Krifka 2003).
(i) typhoons arise in this region

3.2 Kratzer's Revision

Turning now to Kratzer's (1995) revision of the ILP/SLP distinction, her basic idea was that the observed differences between ILPs and SLPs are not due to lexical information about the permanence or impermanence of the property expressed by the predicate, nor to the presence or absence of an implicit existential quantifier. Rather, Kratzer argued that the differences between ILPs and SLPs depend on whether or not the predicate introduces an event argument position into the computation. This idea was primarily motivated by data showing that ILPs do not readily combine with locatives whereas SLPs do. Kratzer's underlying theoretical assumptions are: (i) SLPs have an argument structure that introduces an event variable whereas ILPs do not, (ii) locatives serve to spatiotemporally locate an action, (iii) such spatiotemporal location is accomplished by a (locative) modifier that combines with the event variable and thereby imposes restrictions on it.[5] This is an attractive idea, if only because it aligns fairly well with the intuition that predications of temporary properties are in some sense spatiotemporally restricted or event-related, whereas predications of permanent properties seem not to be. The data are more complex however; the sentences in (7) show that there are at least some pragmatic factors at play: the predicates in (7a-c) are all prototypical examples of temporary properties, and yet their behavior varies widely depending on what appear to be pragmatic considerations (*viz.*, the difference between

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[5] Kratzer (1995: 128)

the expected duration of happiness, boredom, hunger, etc., and the typical span of time in which people are in cities vs. in cars).

(7a) Aki was tired/hungry/#available in the car

(7b) Aki is #tired/#hungry/?available in Seattle

(7c) Aki is bored/happy/lonely in Seattle

Additionally, there is a question as to whether locatives always interact with the eventuality argument (on this point see section 4 below as well as Maienborn 2001 and 2004). Nonetheless, Kratzer's innovation was successful in its ability to better account for observations about bare plural subject interpretation, and has a variety of other advantages over Carlson's theory (*e.g.*, in its treatment of quantifiers). I will not address these issue here; for our purposes what is important is that Kratzer's account does not drastically change the typological division between ILPs and SLPs, but instead offers a new account of why these two types of predicates differ grammatically and semantically in the ways they do. As such, her account does not help us distinguish implicitly relational predicates from other predicate types any better than Carlson's original formulation of the ILP/SLP distinction did; that is, regardless of whether Kratzer would treat *popular* as an ILP or an SLP, her theory does nothing to separate such implicitly relational predicates from non-relational ILPs (such as *strong*) or SLPs (such as *bored*).

3.3 Other Eventuality-Based Predicate Typologies

Glasbey (2007) proposes another predicate typology based on the eventive/non-eventive distinction (as Kratzer's was), but offers a more nuanced typology than the traditional ILP/SLP one, drawing on Levin's (1993) work on English verb classes. But Glasbey's account still fails to pick out implicitly relational predicates, in part because she proposes that all adjectival predicates are non-eventive (thus making eventiveness unable to serve as a distinguishing factor between implicitly relational adjectives like *popular* and non-relational adjectives like *bored*).[6,7] Indeed, it seems that the eventive/non-eventive distinction cuts across the distinction between implicitly relational and non-restricted predicates, as evidenced by examples like (8):

(8a) (due to his new wardrobe) Bill was popular at the nightclub (last night)
(IMPLICITLY RELATIONAL, EVENTIVE)

(8b) (due to his natural dancing talent) Bill is popular at the nightclub
(IMPLICITLY RELATIONAL, NON-EVENTIVE)

Thus it seems that no account that relies on the presence or absence of eventuality arguments will be sufficient to pick out implicitly relational predicates. Nor are there any apparent syntactic differences between implicitly relational adjectives like *popular* and non-relational adjectives like *bored*. Thus our preliminary conclusion is that the

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[6] Glasbey was aware that classing all adjectival predicates as non-eventive may be an oversimplification, in light of examples like "Yesterday night, John was boring to every guest" (Glasbey 2007, note 7), but does not address the issue further.

[7] Maienborn (2004) also argues that all copular predicates lack eventuality arguments.

distinction must be a lexical or pragmatic one. A formal account of lexico-semantic features that characterize implicitly relational predicates will be given in section 6; the nature of our formalization will depend crucially on characteristics of the interaction between implicitly relational predicates and locatives, and thus we must first turn our attention to a characterization of the typology and semantics of locative modifiers.

4 Maienborn's Locative Typology

To review thus far: our hypothesis is that implicitly relational predicates take as arguments a predicate that characterizes a reference set, and an individual (the grammatical subject). Furthermore, locatives (when present) seem to intersect with other (contextual) information in the reference set (cf. (4d) through (4g) above). The task, then, is to characterize the semantic contribution of locatives, then proceed to a formal account of implicitly relational predicates and their mechanism of interaction with locatives. To begin this task, we now turn to an evaluation of Maienborn's locative typology (one of the few attempts in the literature to provide a unified treatment of the syntax and semantics of locatives). This evaluation takes form in the following questions: is Maienborn's formal treatment of locatives compatible with implicitly relational predicates? Which (if any) of Maienborn's three types of locatives is the best description of locatives as they behave in combination with implicitly relational predicates? Once a robust semantics of locatives is in place, we can proceed to a formal characterization of implicitly relational predicates and the mechanism by which they interact with locative expressions within the formal structure.

4.1 Maienborn's Semantic Description of Locatives

Recalling examples (1-3) in the introduction, we are challenged to account for the difference in the semantic contribution of the locative in a variety of sentences. To address this issue, Maienborn looks primarily at data from German and, using a variety of syntactic and semantic tests, concludes that there are three general types of locatives

(termed *external*, *internal*, and *frame-setting* modifiers) distinguished by their base-generated positions in the syntactic structure (which is correlated with variations in their possible interpretations). Examples of these three types are shown in (9). In each sentence in (9), the portion of the sentence which the locative seems most naturally to be modifying has been italicized.[8,9]

(9a) our chefs prepare *fish* in saffron sauce (not in red wine sauce) (INTERNAL)

(9b) our chefs *prepare fish* in the kitchen (not out on the deck) (EXTERNAL)

(9c) *our chefs prepare fish* in Mexico (but in the U.S. their assistants do it) (FRAME-SETTING)

According to Maienborn, *external* locative modifiers locate the overall event (by combining with the eventuality argument of the verb) and are generated within the VP. *Internal* locative modifiers describe a relevant part of the event (which may be one of the verbs grammatical arguments or other entities inferred on the basis of conceptual knowledge), are generated at the edge of the VP, and can receive instrumental

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[8] Each sentence in (9) is ambiguous, but prosodic, pragmatic or conceptual considerations lead us to prefer one interpretation over another, so that in (9a) it is clear that it is not the act of preparation that takes place in the saffron sauce, but rather it is the fish itself that is in the sauce. Similar considerations contribute to our preference for an external interpretation of (9b) and a frame-setting interpretation of (9c), despite the fact that the same subject and predicate appear in all three sentences.

[9] Note that for Maienborn, the locative PP in (9a) is syntactically not a part of the DP *fish in saffron sauce*, since according to her the object DP merges with the verb prior to the locative entering the derivation. The mechanism governing how internal modifiers enter the derivation is discussed below.

interpretations. Finally, *frame-setting* modifiers restrict the conditions under which the speaker makes their claim, do not relate to the eventuality argument of the verb but rather to the proposition of the sentence, and can receive temporal interpretations. Maienborn's central claim is that all three types of locatives have the same basic semantic contribution, given in (10a):[10]

(10a) PP_{LOC}: λx [LOC (x, *reg*)]

(10a) says that a locative PP takes an argument (x) and locates it (LOC) with respect to some spatiotemporal region (*reg*). On this account, the locative *in Texas* would be translated as: λx [LOC (x, IN(Texas))]. Since the semantic contribution is thought to be the same for all three types of locatives, Maienborn claims that the differences in interpretation are accounted for by differences in the time and method of the locative's entering into the computation. In the case of external modifiers, the locative combines with the eventuality argument of the verb via the standard predicate modification rule in (10b). This is taken to be the paradigm case, and is alleged to occur after the verb has combined with all of its internal arguments but before it combines with the subject.[11] In contrast, both internal and frame-setting modifiers are argued to be semantically underspecified and as such require a different version of the predicate modification rule, given in (10c).

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[10] (10a-c) from Maienborn (2001: 216, 235).

[11] Here Maienborn is assuming (following Kratzer 1996) that the subject is introduced by a functional head *Voice* located above the verb.

(10b) MOD: $\lambda Q\, \lambda P\, \lambda x\, [P(x) \,\&\, Q(x)]$

(10c) MOD^{v}: $\lambda Q\, \lambda P\, \ldots\, \lambda x\, [P(\ldots)(x) \,\&\, Q(v^{x})]$

In (10b) the verb is represented by P and the locative by Q, and the verb's eventuality argument *e* would take the place of *x*. In (10c) a similar interpretation of P and Q is possible for internal modifiers, with the ellipses indicating that there may be some number of other arguments (*e.g.*, direct objects) that first combine with P; the verb's eventuality argument again takes the place of *x*. Frame-setting modifiers are differentiated from internal modifiers by the fact that "internal modifiers are embedded within the conceptual structure of the verb, [whereas] frame-setting modifiers must be embedded within the discourse structure of the sentence" (Maienborn 2001: 225); Maienborn goes on to propose that frame-setting modifiers are best analyzed as adjuncts at the level of the Topic phrase (TopP), and treats P as an ordered pair ‹COMMENT, TOPIC› (Q is still the locative), but she is not firmly committed to this treatment of discourse structure.

For our purposes the crucial point is the difference between (10b) and (10c) in that in (10c) the locative's target of modification is not *x* but rather some other entity v^{x}. Maienborn tells us that: " '$Q(v^{x})$' [indicates] that *v* is assigned a value such that Q(*v*) is anchored w.r.t. the conceptual structure accessible through *x*" (Maienborn 2001: 220). One of Maienborn's examples of this phenomenon is given in (11) below:

(11a) Maria zog Paul an den Haaren aus dem Zimmer.[12]
Maria pulled Paul at the hair out of the room.

(11b) Maria zog Paul mit einer Zange an den Haaren aus dem Zimmer.
Maria pulled Paul with a pair of pincers at the hair out of the room.

In (11a), the key point is that it is not the case that the subject (*Maria*) is *at the hair*; the most natural interpretation is that her hand is *at the hair* and thus her hand is the target of modification for the locative. But as (11b) shows, it is possible for something even more conceptually distant from the subject (*a pair of pincers*) to serve as the target of locative modification. This shows that the target of modification for the locative cannot be determined solely by looking at the grammatical relations of the constituents.

I believe Maienborn faces a serious issue here in defining just what it means for an entity to be "anchored with respect to the conceptual structure accessible through [the subject]"[13] which I return to in section 5; for now, I will merely say that it is at least not always obvious that the subject determines the (frame-setting) locative's target of modification.

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[12] (11a) and (11b) from Maienborn (2001: 219).

[13] Maienborn (2001: 220). I say "the subject" here despite the fact that for frame-setting modifiers the variable *x* is taken to be the discourse topic; this is because in subject-prominent languages the discourse topic is identical with the sentential subject, except perhaps in cases where the subject is indefinite (cf. Li & Thompson 1976).

Maienborn's most important claim with respect to our investigation is that frame-setting modifiers do not necessarily preserve truth under simplification (Maienborn 2001: 194). This suggests that locatives that co-occur with implicitly relational predicates are best treated as frame-setting modifiers. With this in mind that we begin our critical evaluation of Maienborn's theory, with special attention to how it accounts for locatives in combination with implicitly relational predicates.

5 Evaluating Maienborn's Typology

Given Maienborn's modification rule in (10c), we would expect all sentences containing frame-setting modifiers to exhibit entailment: any statement of the form P(*x*) & Q(*y*) must entail P(*x*), regardless of any discourse context or conceptual relationship between *x* and *y*. Thus regardless of the target of locative modification, if a frame-setting modifier combines with the rest of the sentence via Maienborn's MOD^V rule, the sentence should entail its locative-free counterpart. But among the many examples of frame-setting modifiers given in Maienborn's paper, about half demonstrate the lack of entailment mentioned in the previous section.[14]

SENTENCES WITH FRAME-SETTING MODIFIERS THAT EXHIBIT LACK OF ENTAILMENT:

(12a) In Argentina, Eva is still very popular.

(12b) Fast jeder Opernsänger ist in mindestens einem Land berühmt.
"Nearly every opera singer is famous in at least one country."

(12c) In Chile genießt Pinochet diplomatische Immunität.
"In Chile Pinochet enjoys diplomatic immunity."

(12d) Paul hat in Bolivien häufig eine Frühjahrskur gemacht.
"In Bolivia, Paul has frequently taken a spring cure."

(12e) In den Anden werden Schafe vom Pfarrer auf dem Marktplatz an den Ohren gebrandmarkt.
"In the Andes, sheep are branded on the ears by the priest in the marketplace."

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[14] Examples in (12) from Maienborn (2001) pages 191, 197, 199, 206, 209, 226.

(12f) In der Bibel schuf Gott den Himmel und die Erde in 7 Tagen.
"In the Bible, God created the heavens and the earth in 7 days."

(12g) In Australien sind die meisten Schwäne schwarz.
"In Australia most swans are black."

In some of those sentences there are other factors besides the locative that are likely responsible for the lack of entailment (*e.g.*, implicitly relational predicates, frequency adverbs, quantifiers); nonetheless, it seems that her formalism cannot account for this behavior in all cases, if indeed it can be said to work for any of them.

Thus we have good reason to suspect that either there is a fourth type of locative comprising a subset of the frame-setting modifiers, or that the alleged lack of entailment is not a property of frame-setting modifiers at all, but rather is related to some other feature of the sentences examined. The possibility of a fourth type of locative seems unlikely, since Maienborn distinguishes the three types primarily on syntactic grounds and she does not find any relevant syntactic differences between those sentences containing frame-setting modifiers that exhibit entailment and those that do not.

The availability of temporal readings of locatives is likewise inconsistent; while temporal readings are available in some sentences that exhibit lack of entailment, such readings are not available in the sentences containing implicitly relational predicates. Indeed, temporal readings are not available in sentences with implicitly relational

predicates generally (cf. *famous, admired, (un)known, emulated,* etc.) as demonstrated in (13):

(13a) George is popular in Texas ≠ (13b) When in Texas, George is popular

Clearly (13b) cannot serve as a paraphrase for (13a), since (13a) can be true even if George never sets foot in Texas.[15] In a few cases temporal readings seem to be possible however:

(14a) George is a celebrity in Texas (ORIGINAL SENTENCE)

(14b) When in Texas, George is a celebrity (ACCEPTABLE PARAPHRASE)

The plausibility of (14b) as a paraphrase for (14a) cannot be denied, but I believe it trades on an ambiguity in the sense of the predicate nominal *to be a celebrity*. Specifically, for (14b) to be acceptable as a paraphrase of (14a), *to be a celebrity* must mean something like "to receive star treatment" (e.g., to be asked for autographs, followed by photographers, receive preferential treatment, etc). If instead *to be a celebrity* means "to be well-known or famous" then the temporal reading of the locative is unavailable. This distinction suggests that the occurrence of temporal readings for locatives depends on certain lexical features in addition to the syntactic features Maienborn has enumerated. A preliminary guess at the nature of this

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[15] Certain contexts will license temporal readings in the present tense even with predicates like *popular* (*e.g.*, if George travels a lot and is received differently state to state). But these readings can be explained in the same way as *to be a celebrity* is explained in (14) and the discussion following.

constraint is that temporal readings depend on some distinction between eventive and stative properties (though not necessarily the presence or absence of eventuality arguments); however, a precise characterization of when locatives can receive temporal readings is left as an area for future research. For now, the important point is that the distribution of temporal readings seems to suggest that the predicate (or at least some factor other than the locative) is the source of the marked behavior, just as was the case with the entailment properties.

Despite these criticisms, I believe the core of Maienborn's account is sound; her formalization of locative meaning such that the semantic contribution of locatives is consistent across her three locative types is attractive and intuitive. Her account of the mechanism by which the different locative types enter the computation (her MOD and MOD^V rules) is compelling but ultimately incomplete: it cannot account for the entailment behavior seen in sentences with implicitly relational predicates,[16] and her characterization of frame-setting modifiers misrepresents the source of those properties of entailment. In the next section, I offer a formal account of implicitly relational predicates and show how it accounts for the phenomena in question, and show formally why Maienborn's MOD^V rule fails to account for those phenomena.

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[16] …and may have trouble accounting for entailment behavior in other kinds of sentences as well (cf. (12d) through (12g) above).

6 A Formal Account of Implicitly Relational Predicates

If we naïvely thought that implicitly relational predicates were semantically on par with non-relational predicates like *bored*, a formal representation of an implicitly relational predicate like *popular* would be something like (16): [17]

(16) $\textit{popular} \Rightarrow \lambda x\,[\text{MORE-THAN}(\,\lambda y\,[R(y) \,\&\, \neg\text{LIKES}(x)(y)]\,)\,(\,\lambda y\,[R(y) \,\&\, \text{LIKES}(x)(y)]\,)\,]$

$[\![\text{LIKES}]\!] = F \in D_{\langle e,\langle e,t\rangle\rangle}$ such that for any $a, b \in D_e$ $F(a)(b) = 1$ iff b likes a

$[\![\text{MORE-THAN}]\!] = F \in D_{\langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle}$ such that for any $H, K \in D_{\langle e,t\rangle}$

$F(H)(K) = 1$ iff $\left|\{x|K(x)=1\}\right| > \left|\{x|H(x)=1\}\right|$

In (16) R is a free variable that represents the contextually salient function characterizing the set of individuals that determines the popularity of *x* (what I called the "reference set" in section 2, above). In the absence of any overt modifiers, R defaults to something like "is a member of the relevant community" and is determined by context. By now it should be clear that such an analysis cannot work: we are left with quite a puzzle as to how a locative as defined in (10a) (repeated here as (17)) could combine with it:

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[17] I am assuming here that popularity can be defined in terms of how many people like the subject. Obviously this is an oversimplification; other relational states (e.g., admiration or respect) may play a role, and it may not be the case that exactly 50% + 1 persons are needed to establish popularity within a given community. Furthermore, other implicitly relational predicates will have different definitions that may not include cardinality at all, but may trade on existential claims (*e.g.*, to be "unknown" probably means that *no* (or *few*) people in the relevant community know the thing in question). The point is not to characterize every aspect of the meaning of *popular* precisely, but rather to capture the essential elements common to all predicates that are implicitly relational.

(17) *in Texas* $\Rightarrow$ λx [LOC (x, IN(Texas))]

We cannot combine (16) and (17) via any standard predicate modification rule, because we already know that x (the sentential subject) is not an appropriate target of modification for the locative (since we know that x need not be in Texas to be popular there). What we want for the composed expression *popular in Texas* is something like the following:

(18) *popular in Texas* $\Rightarrow$ λx [MORE-THAN(λy [R(y) & LOC(y, IN(Texas)) & ¬LIKES(x)(y)])(λy [R(y) & LOC(y, IN(Texas)) & LIKES(x)(y)])]

That is, we want y to be the target of modification for the locative, but because y is a bound variable within the definition of *popular* (in (16) above), we also need the locative to be copied within each of the λy expressions in order for y to be properly bound. As such, y is inaccessible as a target of modification for the locative under an ordinary PM-type rule. Maienborn's specialized MOD^{V} rule will not work here either:

(19) MOD^{V}: $\lambda Q\, \lambda P \ldots \lambda x$ [P(. . .)(x) & Q(v^x)]
popular $\Rightarrow$ λx[MORE-THAN(λy[R(y) & ¬LIKES(x)(y)])(λy[R(y) & LIKES(x)(y)])]
in Texas $\Rightarrow$ λx [LOC (x, IN(Texas))]
popular in Texas $\Rightarrow$ λx [MORE-THAN(λy[R(y) & ¬LIKES(x)(y)])
(λy[R(y) & LIKES(x)(y)]) & LOC(y, IN(Texas))]

What (19) shows is that even if we grant that the target of locative modification is an entity that is "accessible" in the right way through discourse or world knowledge (and

thus we replace v^x with *y* in the formalism) it will still not have the correct meaning because the locative's target is outside the scope of the operator that binds *y* and is thus a free variable. In other words, even if Maienborn's explanation of how locatives come to modify something other than the subject is correct in some cases, her MOD^{V} rule fails to capture the right kind of relationship here; most obviously, it is unable to account for the observed patterns of entailment. Furthermore, any version of a predicate modification rule that might work here would be so finely tailored to the situation as to be unusable elsewhere in language; indeed, the variety of meanings among implicitly relational predicates suggests that multiple tailored predicate modification rules would be needed to accommodate the variety of meanings observed (cf. note 17 above).

The alternative to using a predicate modification rule is to specify a meaning for implicitly relational predicates that is designed to accept locatives in the right manner, and combines with them via functional application. In this way, the necessary tight connection between the PP and the reference set is achieved by "building it in" to the predicate meaning. An example of this type of solution is given in (20).

(20) $\textit{popular} \Rightarrow \lambda \text{L}\, \lambda x\, [\text{MORE-THAN}(\lambda y[\text{R}(y) \,\&\, \text{L}(y) \,\&\, \neg\text{LIKES}(x)(y)])$
$(\lambda y[\text{R}(y) \,\&\, \text{L}(y) \,\&\, \text{LIKES}(x)(y)])]$

Here L is an ‹e,t›-type expression (in our example *George is popular in Texas*, L would be the overt locative). The crucial feature is that L appears twice (within each of the

two arguments of MORE-THAN) and as such L's argument *y* can be appropriately bound. A further advantage of this analysis is that the argument L in (20) need not necessarily be a locative, which accounts for interactions with other PP types, as in (21):

(21) George is popular with the ladies/among Democrats ↛ George is popular

This formalization accounts nicely for sentences where implicitly relational predicates co-occur with locatives or other PPs, but in the absence of such expressions we must account for the predicate's requirement of an ‹e,t›-type argument. Two possible solutions suggest themselves: we could postulate two meanings for implicitly relational predicates, or we could postulate a covert expression that combines with implicitly relational predicates in the absence of an overt PP. The first option is plausible, but unsatisfactory: if *popular* means two different things in the sentences *George is popular* and *George is popular in Texas* then our statements of logical implication such as "*George is popular in Texas ↛ George is popular*" are true, but only trivially so: the failure of implication can be attributed to the fact that the sentences make use of two different senses of *popular*.[18] If instead we assert that implicitly relational predicates always have meanings like the one given in (20), then the facts about logical implication in (4) remain substantive; the question that remains is how to characterize the covert predicate that serves as the argument L. A natural assumption is that the covert predicate is something like "anywhere/everywhere," so that in the absence of an

[18] I am indebted to my advisor Toshi Ogihara for pointing out the significance of this.

overt locative modifier the reference set is determined only by the contextually determined relevance constraint R and whatever other constraints are part of the lexical meaning of the predicate (*e.g.*, in the case of *popular*, the requirement that entities in the reference set should like or admire *x*). To demonstrate that this treatment of implicitly relational predicates preserves the implicational structure we want, consider (22) below:

(22a) ⟦*George is popular in Texas*⟧ = ⟦*popular*⟧ (⟦*in Texas*⟧) (⟦*George*⟧)
= MORE-THAN (λy [R(y) & LOC(y, IN(Texas)) & ¬LIKES(George)(y)])
(λy [R(y) & LOC(y, IN(Texas)) & LIKES(George)(y)])
= 1 iff the set of relevant, George-liking Texans has more elements than the set of relevant, non-George-liking Texans

(22b) ⟦*George is popular*⟧ = ⟦*popular*⟧ (COVERT: ANYWHERE) (⟦*George*⟧)
= MORE-THAN (λy [R(y) & ANYWHERE(y) & ¬LIKES(George)(y)])
(λy [R(y) & ANYWHERE(y) & LIKES(George)(y)])
= 1 iff the set of relevant, George-likers has more elements than the set of relevant, non-George-likers

It should be clear from this that the sentences represented by (22a) and (22b) do not logically entail each other. As one example, suppose George is an American politician, and as such the relevant population comprises American voters. It is easy to see that George can be popular among American voters while not having a single supporter in Texas, provided that the number of voters in Texas is less than half the number of voters overall. Thus *George is popular* does not entail *George is popular in Texas*.

Similarly, George could be a native son of Texas and enjoy 100% support from Texans, but be disliked everywhere else (perhaps due to a political platform that gave Texas preferential treatment over other states). Thus *George is popular in Texas* does not entail *George is popular*.

At this point there is still a slight problem with our analysis of implicitly relational predicates. If we examine the interaction between implicitly relational predicates, locatives, and tense, we can see why "anywhere/everywhere" cannot be the meaning of the covert argument (as indicated in (22b) above). Consider (23):

(23) George was popular in Texas

The sentence in (23) is ambiguous: one interpretation (the more straightforward one) is that at some past time, the claim "George is popular in Texas" obtained. This interpretation is unproblematic with respect to our analysis. An additional interpretation is available, however, in which the locative receives a temporal reading: a paraphrase of this interpretation would be "When he was in Texas, George was popular." There are at least two interesting observations we can make about this interpretation. The first is that past tense somehow licenses a temporal interpretation of the locative that was unavailable in the unmarked tense.[19,20] The second interesting point is that despite the temporal interpretation of the locative, it seems to still be

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[19] The line of argument in this section is equally applicable to future tense versions of (23).

[20] Though see note 15 above.

contributing to the characterization of the predicate's reference set. This is demonstrated by the unavailability of certain paraphrases of (23), as seen in (24) below:

(24) When he was in Texas, George was popular (among Texans/ #worldwide)

The question raised by examples like (24) is this: is the predicate still taking the locative PP as an argument in sentences where the locative receives a temporal interpretation? If so, we are at a loss to explain how the locative's argument could be anything other than the bound variable *y* (cf. (20) above). On the other hand, if the locative is not taken as an argument of the implicitly relational predicate but instead enters the computation another way (*e.g.*, by combining with the predicate's eventuality argument),[21] then we would not expect the pattern seen in (24), since in that case we are assuming that the covert argument "anywhere/ everywhere" would stand in. This dilemma can be avoided by the following revision to our definition of *popular*:

(25) *popular* $\Rightarrow$
$\lambda P\, \lambda x\, [\text{MORE-THAN}(\, \lambda y\, [P(y) \,\&\, \neg \text{LIKES}(x)(y)]\,)\,(\, \lambda y\, [P(y) \,\&\, \text{LIKES}(x)(y)]\,)\,]$

In (25) the contextually determined relevance constraint R and the external argument L have been combined into a single argument P, which carries information about both the location of the individuals that make *x* popular, and any other contextually relevant

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[21] I do not mean to assert any particular temporal semantics here. The point under discussion stands so long as the temporally-interpreted-locative's argument is *something* other than the bound variable *y*, which I take to be a rather uncontroversial assumption.

properties that serve to characterize that set of individuals (*e.g.*, being a voter, movie patron, TV-watching child, etc.). This structure allows us to account for cases in which the locative PP might not combine with the predicate directly (*e.g.*, in cases where the locative receives a temporal interpretation), and intuitively it makes sense because we would expect that contextual information to come from outside the predicate (*i.e.*, from discourse or from conceptual knowledge about the subject), rather than being part of the predicate's definition (as was our original contextual constraint R). In this way, it can still be the case that implicitly relational predicates are interpreted with respect to "everyone/everywhere" in the absence of contextual information to the contrary, while offering a plausible account of the pattern seen in (24): namely, that the temporally-interpreted locative still constrains the reference set by setting the relevant location contextually, rather than by combining with the predicate directly. This is further borne out by the data in (26) below, in which the sentence from (23) is uttered in a contrastive sense:

(26a) George was popular in Texas
(but in Ohio he has failed to cultivate popularity among Ohioans)

(26b) George was popular in Texas
(# but in Ohio, he is no longer popular among Texans)

The sentence in (26a) exhibits a matched pair-list reading: when the locative is interpreted temporally in contrastive contexts, the contrast can only be between "popular then and there" vs. "popular here and now." In (26b), we see that the contrast

cannot simply be a temporal one; this shows that the temporal locative *in Ohio* is influencing the reference set of *popular* in the second conjunct clause just as *in Texas* influenced the reference set of *popular* in the first conjunct clause.

A nice consequence of this theory is the fact that the variety of surface positions that locatives can take are easily accommodated in the formalism because their meaning is contributed contextually rather than via functional application with the predicate. It also sheds light on why temporal interpretations of locatives are typically unavailable in the present tense: temporal statements given in the present tense tend to have habitual interpretations, and most implicitly relational predicates are not conducive to habitual interpretation because they express relational properties that are independent of the location of the subject (examples such as (14) notwithstanding).

Finally, this formalization is more flexible than earlier ones in that it accommodates predicates like *non-existent*, *rare*, or *ubiquitous* that seem to have a similar structure:[22]

(27a) *non-existent* $\Rightarrow$ $\lambda P\, \lambda x\, [\neg\exists y[R(y, x)\ \&\ P(y)]]$
(where R is a realization relation as defined in section 3.1 above)

(27b) *rats are non-existent in Seattle* $\Rightarrow$
$\neg\exists y[R(y, \text{rat})\ \&\ \text{LOC}(y, \text{IN}(\text{Seattle}))]$

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[22] Example (27) due to Toshi Ogihara (personal communication).

One challenge for this theory is how to characterize the combination of (covert) contextual information and overt locative information into the single predicate P. Sentences like *That movie star is popular in Kansas* contain conceptual information about the reference set (*i.e.*, that they are moviegoers) that must somehow combine with the overt locative information (*i.e.*, that they are in Kansas) before serving as argument for the predicate. Semantically this is easily accomplished via ordinary predicate modification, but for now a plausible syntactic story of how these overt and covert elements come together is left as an area for future research.

7 Conclusion

In this thesis I have characterized a new type of predicate, and have offered a formal semantic account of its meaning, with special attention to its interaction with locative expressions. Specifically, I have claimed that implicitly relational predicates take a predicate (an ‹e,t›-type) argument as well as an individual (e-type) argument. Furthermore, I have argued that the predicate-argument comprises contextually specified information (including overt or covert locative information) about the set of individuals that stand in relation to the subject in the relevant way.

This account achieves a level of descriptive and explanatory adequacy not seen in the foregoing literature, and furthermore offers a plausible semantic mechanism to account for the descriptive generalizations. A more thorough development of these ideas, especially a syntactic account of the difference between spatially and temporally interpreted of locatives, and a syntactic mechanism for the accretion of contextual information prior to its combination with the implicitly relational predicate, is left as an area for future study.

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