The Anaphoric Potential of Indefinites under Negation and Disjunction*

Lisa Hofmann

University of California Santa Cruz, Santa Cruz, California, U.S.A
lihofman@ucsc.edu

Abstract

This paper extends the analysis of modal subordination presented in Stone (1999); Stone and Hardt (1999) to other cases of non-veridically introduced discourse referents (drefs) with the goal of understanding the circumstances under which a dref is available for subsequent anaphoric reference. The central claim is that a dref introduced under negation can be the antecedent for a pronoun, only if the interpretation does not require that the assertion of its non-existence and the existence presupposition of the pronoun be true wrt the same set of worlds. The analysis is based on relativizing individual drefs to the worlds in which their referent exists (Stone (1999); Stone and Hardt (1999)), and sentential operators introducing propositional drefs that provide a local context for the interpretation of their prejacent (Karttunen (1973); Heim (1983)), and it is framed in intensional CDRT (Muskens (1996); Brasoveanu (2007, 2010)). This allows for a greater empirical coverage than Krahmer and Muskens's (1995) account of drefs under negation and disjunction.

1 Introduction

Indefinite DPs under anti-veridical operators such as negation do not usually introduce a discourse referent (dref) that is available for subsequent reference:

(1) a. *There is* [*no bathroom*]$^{\upsilon}$ *in this house.*
b. #*It*$_{\upsilon}$ *is in a weird place.*

This generalization goes back to Karttunen (1969), who also points out the existence of counterexamples: Indefinites under negation can provide an antecedent for a pronoun when the antecedent is embedded under double negation (Karttunen (1969); Krahmer and Muskens (1995)), when the antecedent is in the first disjunct of a disjunction and the anaphor in the second one (Krahmer and Muskens (1995)), in modal subordination (Roberts (1989)), or when the utterance containing the anaphor rejects the utterance containing the antecedent.

(2) a. Double negation:
It's not true that there is [*no bathroom*]$^{\upsilon_1}$ *in this house. It*$_{\upsilon_1}$ *is just in a weird place.*
b. Disjunction:
Either there is [*no bathroom*]$^{\upsilon_2}$ *in this house, or it*$_{\upsilon_2}$ *is in a weird place.*
c. Modal subordination:
There is [*no bathroom*]$^{\upsilon_3}$ *in this house. It*$_{\upsilon_3}$ *would be easier to find.*
d. Disagreement:
A: *There's* [*no bathroom*]$^{\upsilon_4}$ *in this house.*
B: *(What are you talking about?) It*$_{\upsilon_4}$ *is just in a weird place.*

*This paper has benefited greatly from the comments of anonymous reviewers for the 2019 Amsterdam Colloquium and Simon Charlow, as well as from discussions with Adrian Brasoveanu, Jess Law, Morwenna Hooks, Jack Duff, and the audiences at a practice talk at UC Santa Cruz and at CUSP 2019.

In the examples in (2), *no bathroom* is the antecedent of *it*, although the former is in the scope of negation, and the latter is not. Krahmer and Muskens (1995) note that standard Discourse Representation Theory (DRT, Kamp (1981); Kamp and Reyle (1993)), and classic versions of File-Change Semantics (Heim (1982, 1983)) and Dynamic Predicate Logic (Groenendijk and Stokhof (1991)), were designed to capture Karttunen's basic generalization illustrated in (1), and don't allow drefs to outlive embedding under negation.

This paper presents an account that captures the above (1) and (2), in intensional Compositional DRT (CRDT, Muskens (1996); closely following Brasoveanu's (2010) implementation). The account is based on the assumption that a pronoun may be co-referential with a preceding DP, only if the dref introduced by the DP exists in all the possible worlds in the local context of evaluation of the pronoun. This condition on anaphoric accessibility is captured by relativizing individual drefs to sets of worlds in which they exist (Stone (1999); Stone and Hardt (1999)). The paper therefore extends analyses of modal subordination with *would* based on simultaneous reference to sets of worlds and individuals (Stone (1999); Stone and Hardt (1999); Brasoveanu (2007, 2010)) to other cases of anaphors to non-veridically introduced individual drefs.

The presupposition of the pronoun is evaluated in its local context. The relation between local and global context sets is constrained by the semantics of sentential operators (Karttunen (1973); Heim (1983)), which may introduce drefs for sets of worlds in which their prejacent is interpreted. The global context set is constrained pragmatically to be compatible with the speaker's commitments (Stalnaker (1978, 2002); Gunlogson (2004)). This allows for an account of the influence of the linguistic context, in particular, the veridicality of embedding operators, on the availability of an anaphoric dependency.

2 The analysis informally

The account relies on two basic analytical intuitions: (i) that the use of a pronoun presupposes the existence of a referent[1], and (ii) an indefinite under negation introduces a counterfactual dref, i.e., a dref, s.t. the speaker is committed to its referent not existing in the global context. That explains why a discourse like (1) (repeated here) is infelicitous.

(1) a. *There is* [*no bathroom*]$^{\upsilon}$ *in this house.*
b. #*It*$_{\upsilon}$ *is in a weird place.*

In (1), the speaker counterfactually introduces a dref υ for a bathroom and is committed to it not existing. If the same speaker subsequently uses a pronoun in a veridical context, the existence of a referent is presupposed. Therefore, the pronoun couldn't refer to υ. If it did, the speaker would first assert the non-existence of a bathroom and then presuppose its existence, rendering the discourse inconsistent. This explanation is based on Stone's (1999) analysis of modal subordination. Indefinites in the scope of modals also don't provide antecedents for pronouns in veridical contexts, but they provide antecedents for pronouns in the scope of *would*:

(3) *[A wolf]*$^{\upsilon^5}$ *might walk in.* (Roberts (1989): 11)
a. # *It*$_{\upsilon^5}$ *is gray.*
b. *It*$_{\upsilon^5}$ *would eat you first.*

Stone suggests that the indefinite under *might* in (3) introduces υ^5 as a hypothetical dref, i.e., a dref s.t. the speaker is not committed to the existence of its referent in the global context.

[1] I also assume that singular pronouns like *it* presuppose that the referent is a single individual, which is not further discussed in this paper.

As a result, the use of the pronoun $It_{\upsilon 5}$ in a veridical context (3-a) is impossible, because the existence presupposition is not satisfied. In contrast, $It_{\upsilon 5}$ in (3-b) can refer to a hypothetical dref, because *would* is assumed to be anaphoric to a hypothetical proposition, i.e., a proposition the speaker is not committed to, which provides a context of interpretation for the prejacent. Stone suggests that *would* can be anaphoric to the proposition in the scope of *might*, s.t. a wolf walks in, and $It_{\upsilon 5}$ can be evaluated wrt the hypothetical worlds in which that wolf exists.

This paper extends an analysis along these lines to two new empirical cases: One of them is modal subordination with negative antecedents, such as (2-c) (repeated here):

(2-c) *There is* [*no bathroom*]$^{\upsilon 3}$ *in this house. It*$_{\upsilon 3}$ *would be easier to find.*

The availability of an anaphoric relation can be explained similarly to the classic modal subordination cases. A counterfactual proposition, like the one introduced by the prejacent of negation, is also a hypothetical proposition and may be an antecedent for *would*. The pronoun can be evaluated in the counterfactual context, where the referent introduced by [*no bathroom*]$^{\upsilon 3}$ exists, and the existence presupposition is satisfied locally. The other empirical case to which the analysis is extended involves cases where the discourse segment containing the antecedent and the discourse segment containing the pronoun are not required to be consistent with each other. This includes disjunction and inter-speaker disagreement ((2-b) + (2-d), repeated here):

(2-b) Disjunction:
Either there is [*no bathroom*]$^{\upsilon 2}$ *in this house, or it*$_{\upsilon 2}$ *is in a weird place.*

(2-d) Disagreement:
A: *There's* [*no bathroom*]$^{\upsilon 4}$ *in this house.*
B: *(What are you talking about?) It*$_{\upsilon 4}$ *is just in a weird place.*

Here, the pronouns are used veridically, which is inconsistent with a counterfactual antecedent. The discourse segments containing the antecedent and the pronoun are inconsistent with each other, but the contexts of disjunction and inter-speaker disagreement do not place a constraint on the two discourse segments to be consistent, which enables the veridical use of a pronoun with a counterfactual antecedent. This sets the cases in (2-b) and (2-d) apart from (1), where the propositions have to be compatible because they are assertions of the same speaker.

A formalization needs to keep track of the introduced drefs, the sets of worlds in which they exist, the local context sets of indefinites and anaphoric expressions, and who is committed to these propositions as being true, false, or neither. The formal system introduced in the following section is designed to do that.

3 An account of anaphoric accessibility

3.1 The account

The system uses four basic types: $\mathtt{t}$ (truth-values), e (entities), w (possible worlds), and $\mathtt{s}$ (variable assignments). Following Stone (1999); Stone and Hardt (1999), individual drefs are formalized as drefs for individual concepts. An individual dref υ is a function of type $\mathtt{s}(we)$ from assignments $\mathtt{i}_{\mathtt{s}}$ and worlds w_w to individuals $\mathtt{x}_e$ (subscripts on terms indicate their type). The individual $\upsilon_{\mathtt{s}(we)}(\mathtt{i}_{\mathtt{s}})(w_w)$ is the individual that the assignment $\mathtt{i}$ assigns to υ in w. A propositional dref ϕ is a function of type $\mathtt{s}(w\mathtt{t})$ from assignments $\mathtt{i}_{\mathtt{s}}$ to sets of worlds $(w\mathtt{t})$. The proposition $\phi_{\mathtt{s}(w\mathtt{t})}(\mathtt{i}_{\mathtt{s}})$ is the set of worlds that $\mathtt{i}$ assigns to ϕ.

Natural language sentences are interpreted as DRSs, which are defined as binary relations

of type $s(st)$ between input state i_s and output state j_s, where discourse states are variable assignments. A DRS contains a list of new drefs $(v_1, \ldots, v_n)$, and a series of conditions of type st, i.e., properties of discourse states $(C_1, \ldots, C_n)$, and is defined as (4):

(4) $[v_1, \ldots, v_n \mid C_1, \ldots, C_n] :=$
$\lambda i_s.\lambda j_s.i[v_1, \ldots, v_n]j \wedge C_1(j) \wedge \cdots \wedge C_n(j)$

3.1.1 Variable updates relative to sets of worlds

The dynamic variable update $(i[v]j)$ specifies a binary relation over variable assignments and works as random assignment of values to a variable v. This relation between discourse states i_s and j_s holds if i and j differ at most wrt the values assigned to v (see e.g. Groenendijk and Stokhof (1991); Muskens (1996); Brasoveanu (2007)).

Following Stone (1999); Stone and Hardt (1999), this system formalizes individual drefs as drefs for individual concepts, i.e., functions of type (we), mapping possible worlds to individual referents. To characterize worlds in which no such referent exists, a dummy element # is included in the domain of individuals. $\#_e$ corresponds to the 'indeterminate' value in a trivalent logics, s.t. a term receives an indeterminate truth-value $\#_t$ if any of its arguments evaluate to $\#_e$. This emulates partial functions in a system that uses only total functions (van den Berg (1996); Brasoveanu (2007, 2010)), but still captures that the use of a pronoun results in unacceptability if used in a context where a referent cannot be determined. Using individual concepts allows for the introduction of individual drefs along with the information about the set of worlds in which their referent exists (and does not):

(5) The relation $i[\phi : v]j$ holds (for assignments i_s, j_s, and the drefs $\phi \in \mathbf{Term}_{s(wt)}$, $v \in \mathbf{Term}_{s(we)}$) iff the conjunction of the following holds:

- $i[v]j$
- $\forall w_w.(\phi(j)(w) \rightarrow v'(i)(w) \neq \#$
  (an individual referent of v is determined in each world in $\phi(j)$)
- $\forall w_w.(\neg\phi(j)(w) \rightarrow v(j)(w) = \#)$
  (in each world not in ϕ, v points to the indeterminate value)

(5) guarantees that j is an update of i that differs at most wrt the value assigned to v. The second conjunct requires that for each world w in $\phi(j)$, $v(j)(w)$ doesn't map to # (but an actual individual). The third conjunct states that for each world w not in $\phi(j)$, $v(j)(w)$ maps to #, ensuring that the referent of v exists only in the worlds in $\phi(j)$.

3.1.2 Dref accessibility, DRS conditions, and the local context

Relativizing individual drefs to sets of worlds in which they refer gives rise to an accessibility condition based on an existence condition for pronouns and the notion of a local context (Karttunen (1973); Heim (1983)). The latter involves the idea that expressions are interpreted wrt an intensional context set that is pragmatically constrained on a global level by the speaker's commitments (Stalnaker (1978, 2002); Gunlogson (2004)), and locally constrained by the semantics of sentential operators. Based on this, a dref v is accessible for reference by a pronoun v', only if the referent of v is determined in the local context of v', i.e., if v maps to an individual (other than #), for each world in the local context.

In this system, the local context is defined in reference to the evaluation of DRS conditions and consists of an assignment i_s, of which the condition is predicated, and a dref for a set of possible worlds ϕ, a compositionally supplied intensional argument. (6) illustrates how a

dynamic predicate is defined as an abbreviation for a condition involving the corresponding static predicate and the referents of the argument drefs given i and ϕ.

(6) Predicates with their arguments as basic conditions (type st):
$R_\phi\{v\} := \lambda i_s.\forall w_w.\phi(i)(w) \rightarrow R(v(i)(w))(w)$,
for $R \in \mathbf{Term}_{e(wt)}$, $v \in \mathbf{Term}_{s(we)}$, $\phi \in \mathbf{Term}_{s(wt)}$

The evaluation of a DRS condition in the context $\langle i_s, \phi_{s(wt)}\rangle$ is mapped to a truth-value other than # only if the argument dref is mapped to an individual other than # for each world in $\phi(i)$. The general requirement that drefs refer in each world in their local context follows from the definition of DRS conditions. This is illustrated for the DRS in (7):

(7) S: *There is no bathroom.* $\rightsquigarrow$[2]

$\phi_1, \phi_2, \phi_2 : v_1$
$\phi_{DC_S} \subseteq \phi_1$
$\phi_1 = \overline{\phi_2}$
$\mathtt{bathroom}_{\phi_2}\{v_1\}$

An update with (7) three drefs: A proposition ϕ_1 (for the worlds where there is no bathroom), restricting the set of discourse commitments held by S, a proposition ϕ_2 (for the worlds where there is a bathroom), the complement of ϕ_1, and an individual v_1, (for a bathroom in ϕ_2). The resulting assignment i maps v to an individual relative to each world in $\phi_2(i)$, and maps it to # for each world not in $\phi_2(i)$. The condition $\mathtt{bathroom}_{\phi_2}\{v_1\}$ requires that the referent of v_1 is a bathroom in all ϕ_2-worlds. For the truth-conditional import to be determined, the referent of v_1 needs to be determined in all ϕ_2-worlds. That is the case in (7) since the condition is interpreted wrt a variable assignment that is the result of updating an input state with $[\phi_2 : v_1]$.

As a special case of this general requirement, the condition on anaphoric accessibility also follows from the definition of DRS-conditions:

(8) Accessibility of antecedents:
Given a relation $R_{e(wt)}$, an individual dref $v_{s(we)}$, a propositional dref $\phi_{s(wt)}$, and a discourse state i_s:
   a. A DRS-condition predicated of a discourse state $R_\phi\{v\}(i)$ is defined as $\forall w_w.\phi(i)(w) \rightarrow R(v(i)(w))(w)$
   b. $\forall w_w.\phi(i)(w) \rightarrow R(v(i)(w))(w)$ can be determined only if $v(i)(w)$ is determined for all worlds w s.t. $\phi(i)(w)$, therefore $\forall w_w.\phi(i)(w) \rightarrow v'(i)(w) \neq \#$
   c. As a result, a pronoun in the context of i and ϕ can make reference to the dref v only if the value of $v(i)(w)$ is determined for all worlds w, s.t. $\phi(i)(w)$

Stone's (1999) mechanism introduces individual drefs relative to sets of worlds in which they exist, and gives rise to state this accessibility condition, that captures that pronouns presuppose the existence of a referent and are unacceptable otherwise. This is couched in an intensional version of CDRT, where sentential operators may introduce drefs for sets of worlds to provide a context in which their prejacent is interpreted.

[2] This representation can be derived compositionally based on the contributions of the following components:

(i) a. there is $\rightsquigarrow \lambda\mathcal{P}_{\mathbf{wt}}.\mathcal{P}$
b. no $\rightsquigarrow \lambda P_{\mathbf{e(wt)}}.\lambda P'_{\mathbf{e(wt)}}.\lambda\phi_{\mathbf{w}}.[\phi_i, \phi_i : v_j]; [\phi = \overline{\phi_i}]; P(v_j)(\phi_i); P'(v_j)(\phi_i)$
c. bathroom $\rightsquigarrow \lambda v_{\mathbf{e}}.\lambda\phi_{\mathbf{w}}.[\mathtt{bathroom}_\phi\{v\}]$
d. Assertion by S: $\lambda\mathcal{P}_{\mathbf{wt}}.[\phi_1 \mid \phi_{DC_S} \subseteq \phi_1]; \mathcal{P}(\phi_1)$

The bold-face subscripts denote CDRT 'meta-types' (see e.g. Brasoveanu (2007)) , where **e** abbreviates the type for individual drefs s(we), **w** abbreviates the type for propositional drefs s(wt) and **t** abbreviates the type for dynamic sentence meanings s(st).

3.2 Analysis

3.2.1 The counterfactual bathroom

The rest of this section illustrates how the analysis accounts for the above data in (1) and (2). First, let us see how the veridical use of a pronoun with a counterfactual antecedent where both discourse segments are uttered by the same speaker is ruled out.

(7) S: *There is no bathroom.*

$\rightsquigarrow$

$\phi_1, \phi_2, \phi_2 : \upsilon_1$
$\phi_{DCs} \subseteq \phi_1$ $\phi_1 = \overline{\phi_2}$ $\mathtt{bathroom}_{\phi_2}\{\upsilon_1\}$

(9) # S: *It is in a weird place.*

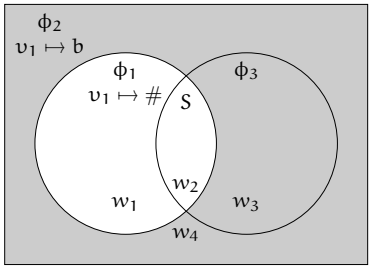
$\rightsquigarrow^{3}$

$\phi_3, \phi_3 : \upsilon_2$
$\phi_{DCs} \subseteq \phi_3$ $\mathtt{place}_{\phi_3}\{\upsilon_2\}$ $\mathtt{weird}_{\phi_3}\{\upsilon_2\}$ $\mathtt{in}_{\phi_3}\{\underline{\upsilon_3}, \upsilon_2\}$

An update with (9) fails for the interpretation of $\underline{\upsilon_3}$ (the underline indicates that it is anaphoric and requires an antecedent). Besides that, it specifies a dref ϕ_3 (the worlds where 'it' is in a weird place), and a dref υ_2 (mapping to a place in the ϕ_3-worlds and to # in the non-ϕ_3-worlds). For illustration of the relationships between these drefs, consider a toy model M_1 where $D_w = \{w_1, w_2, w_3, w_4\}, D_e = \{b, p, \#\}$, b is a bathroom and p is a place. The attempt of updating a discourse-initial discourse state with (7) and (9) wrt M_1 results in an assignment i_1 that assigns static referents to drefs as in (10). The relationship between these sets of worlds and the dref υ_1 storing the counterfactual bathroom are illustrated in (11).

(10) a. $\phi_1(i_1) = \{w_1, w_2\}$
b. $\phi_2(i_1) = \{w_3, w_4\}$
c. $\phi_3(i_1) = \{w_2, w_3\}$
d. $\upsilon_1(i_1) = \left\{\begin{matrix} w_1 \mapsto \# \\ w_2 \mapsto \# \\ w_3 \mapsto b \\ w_4 \mapsto b \end{matrix}\right\}$
e. $\upsilon_2(i_1) = \left\{\begin{matrix} w_1 \mapsto \# \\ w_2 \mapsto p \\ w_3 \mapsto p \\ w_4 \mapsto \# \end{matrix}\right\}$

(11)



Pronominal reference fails because the potential antecedent υ_1 does not exist all the worlds in the local context of the anaphor $\underline{\upsilon_3}$, which is interpreted in the condition $\mathtt{in}_{\phi_3}\{\underline{\upsilon_3}, \upsilon_2\}$. That guarantees that $\underline{\upsilon_3}$ exists in all ϕ_3-worlds. Therefore υ_1, the dref introduced by *no bathroom*, can only be a possible antecedent for $\underline{\upsilon_3}$, if the referent of υ_1 exists in all the ϕ_3-worlds. υ_1 is introduced as $\phi_2 : \upsilon_1$ and its referent exists in all and only the ϕ_2-worlds. As a result, the ϕ_3-worlds have to be a subset of the ϕ_2-worlds for this anaphoric relation to be available. Because all the worlds in ϕ_{DCs} are also ($\phi_{DCs} \subseteq (\phi_1 \cap \phi_3)$), ϕ_1 and ϕ_3 are interpreted in conjunction, they have to be compatible. Therefore, there are ϕ_1 worlds in ϕ_3, where υ_1 does not exist (w_2 in the above example). Resolving $\underline{\upsilon_3}$ to υ_1 would result in undefinedness in the interpretation of the condition, so υ_1 is not an accessible antecedent for $\underline{\upsilon_3}$.

(ii) [3]
a. it $\rightsquigarrow \lambda P_{\mathbf{e(wt)}}.\lambda\phi_{\mathbf{w}}.P(\upsilon)(\phi)$
b. is $\rightsquigarrow \lambda\mathcal{P}_{\mathbf{wt}}.\mathcal{P}$
c. in $\rightsquigarrow \lambda\mathcal{Q}_{(\mathbf{(e(wt))(wt)})}.\lambda\upsilon_{\mathbf{e}}.\lambda\phi_{\mathbf{w}}.$ $\mathcal{Q}(\lambda\upsilon'_{\mathbf{e}}.\lambda\phi'_{\mathbf{w}}.[\mathtt{in}_{\phi}\{\upsilon, \upsilon'\}])(\phi)$
d. a $\rightsquigarrow \lambda P_{\mathbf{e(wt)}}.\lambda P'_{\mathbf{e(wt)}}.\lambda\phi_{\mathbf{w}}.[\phi_i, \phi_i : \upsilon_j];$ $[\phi = \overline{\phi_i}]; P(\upsilon_j)(\phi_i); P'(\upsilon_j)(\phi_i)$
e. weird $\rightsquigarrow \lambda\upsilon_{\mathbf{e}}.\lambda\phi_{\mathbf{w}}.[\mathtt{weird}_{\phi}\{\upsilon\}]$
f. place $\rightsquigarrow \lambda\upsilon_{\mathbf{e}}.\lambda\phi_{\mathbf{w}}.[\mathtt{place}_{\phi}\{\upsilon\}]$

3.2.2 The optional bathroom

In contrast to propositions expressed by two assertions of the same speaker, the propositions expressed by the disjuncts of a disjunction are not required to be compatible with each other, which allows for reference to a counterfactual dref:

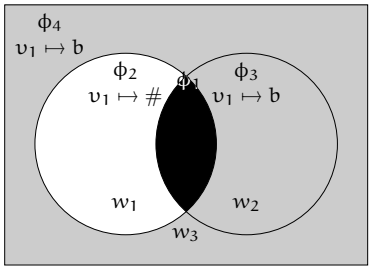
(12) S: *There is no bathroom or it is in a weird place.* $\rightsquigarrow$[4]

$\phi_1, \phi_2, \phi_3, \phi_4, \phi_4 : \upsilon_1, \phi_3 : \upsilon_2$
$\phi_{DCS} \subseteq \phi_1$
$\phi_1 = \phi_2 \cup \phi_3$
$\phi_2 = \overline{\phi_4}$
$\mathrm{bathroom}_{\phi_4}\{\upsilon_1\}$
$\mathrm{place}_{\phi_3}\{\upsilon_2\}$
$\mathrm{weird}_{\phi_3}\{\upsilon_2\}$
$\mathrm{in}_{\phi_3}\{\underline{\upsilon_3}, \upsilon_2\}$

Consider a model M_2, where $D_w = \{w_1, w_2, w_3\}, D_e = \{b, p, \#\}$, b is a bathroom and p is a place. Updating an input state with (12) in M_2 results in an output assignment i_2 that assigns referents as in (13), depicted in (14).

(13) a. $\phi_1(i_2) = \{w_1, w_2\}$
b. $\phi_2(i_2) = \{w_1\}$
c. $\phi_3(i_2) = \{w_2\}$
d. $\phi_4(i_2) = \{w_3\}$
e. $\upsilon_1(i_2) = \begin{Bmatrix} w_1 \mapsto \# \\ w_2 \mapsto b \\ w_3 \mapsto b \end{Bmatrix}$
f. $\upsilon_2(i_2) = \begin{Bmatrix} w_1 \mapsto \# \\ w_2 \mapsto p \\ w_3 \mapsto \# \end{Bmatrix}$

(14)



The anaphor $\underline{\upsilon_3}$ is interpreted in the condition $\mathrm{in}_{\phi_3}\{\underline{\upsilon_3}, \upsilon_2\}$, which ensures that $\underline{\upsilon_3}$ exists in ϕ_3. For υ_1, the dref introduced by *no bathroom*, to be a possible antecedent for $\underline{\upsilon_3}$, υ_1 needs to exist in all the ϕ_3-worlds. υ_1 is introduced as $\phi_4 : \upsilon_1$ and exists in all and only the ϕ_4-worlds, ϕ_3 has to be a subset of ϕ_4. υ_1 exists in none of the worlds in ϕ_2, the complement of ϕ_4. Since ϕ_2 and ϕ_3 are not interpreted in conjunction, updating the context with (12) is compatible with an output state i_s, s.t. υ_1 exists in all ϕ_3-worlds, i.e. the ones where $\phi_2(i) \cap \phi_3(i) = \varnothing$, and $\underline{\upsilon_3}$ can be resolved as υ_1 (e.g. the above i_2). Because disjunction places no requirement on its arguments to be compatible, a dref that is introduced counterfactually in the first disjunct is a possible antecedent for an anaphor in the second disjunct.

3.2.3 The hypothetical bathroom

Following Stone (1999), the modal subordination case is analyzed by assuming that the local context of the pronoun is an anaphorically provided hypothetical proposition, and the pronoun can therefore refer to a hypothetical individual.

(7) S: *There is no bathroom.*

$\rightsquigarrow$

$\phi_1, \phi_2, \phi_2 : \upsilon_1$
$\phi_{DCS} \subseteq \phi_1$
$\phi_1 = \overline{\phi_2}$
$\mathrm{bathroom}_{\phi_2}\{\upsilon_1\}$

(15) S: *It would be (right) there.*

$\rightsquigarrow$[5]

ϕ_3
$\phi_{DCS} \subseteq \phi_3$
$\mathrm{would}_{\phi_3}\{\underline{\phi_4}\}$
$\mathrm{there}_{\underline{\phi_4}}\{\underline{\upsilon_2}\}$

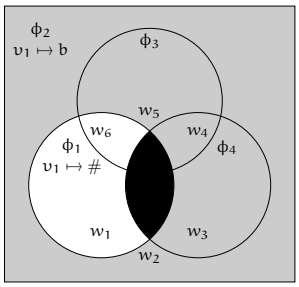
(iii)[4] or $\rightsquigarrow \lambda\mathcal{P}_{\mathbf{wt}}.\lambda\mathcal{P}'_{\mathbf{wt}}.\lambda\phi_{\mathbf{w}}.[\phi = \phi' \cap \phi''];\mathcal{P}(\phi');\mathcal{P}'(\phi'')$

(iv)[5] a. would $\rightsquigarrow \lambda\mathcal{P}_{\mathbf{wt}}.\lambda\phi_{\mathbf{w}}.[\mathrm{would}_{\phi}\{\underline{\phi'}\}];\mathcal{P}(\phi')$ b. there $\rightsquigarrow \lambda\upsilon_{\mathbf{e}}.\lambda\phi_{\mathbf{w}}.[\mathrm{there}_{\phi}\{\upsilon\}]$

Consider a model M_3, where $D_w = \{w_1, w_2, w_3, w_4, w_5, w_6\}, D_e = \{b, p, \#\}$, b is a bathroom and p is a place. Updating an input state with (7) and then (15) in M_3 results in an output assignment i_3 that assigns static referents to drefs as in (16), depicted in (17).

(16) a. $\phi_1(i_3) = \{w_1, w_6\}$
b. $\phi_2(i_3) = \{w_2, w_3, w_4, w_5, w_6\}$
c. $\phi_3(i_3) = \{w_4, w_5, w_6\}$
d. $\phi_4(i_3) = \{w_3, w_4\}$
e. $v_1(i_3) = \begin{Bmatrix} w_1 \mapsto \# \\ w_2 \mapsto b \\ w_3 \mapsto b \\ w_4 \mapsto b \\ w_5 \mapsto b \\ w_6 \mapsto \# \end{Bmatrix}$

(17)



The interpretation of $\text{would}_{\phi_3}\{\underline{\phi_4}\}$ requires that $\underline{\phi_4}$ is a hypothetical proposition wrt ϕ_3[6] ϕ_2, the dref introduced under negation in (7), is a hypothetical proposition, and ϕ_4 can be resolved as ϕ_2, as in (18).

(18)

ϕ_3
$\phi_{DC_S} \subseteq \phi_3$
$\text{would}_{\phi_3}\{\phi_2\}$
$\text{there}_{\phi_2}\{\underline{v_2}\}$

The pronoun $\underline{v_2}$ is interpreted in the condition $\text{there}_{\phi_2}\{\underline{v_2}\}$. For v_1, the dref introduced by *no bathroom*, to be a possible antecedent for $\underline{v_2}$, the referent of v_1 needs to exist in ϕ_2. v_1 is introduced as $\phi_2 : v_1$ and exists in all and only the ϕ_2 worlds, and $\underline{v_2}$ can be resolved as v_1.

3.2.4 The contested bathroom

The case of inter-speaker disagreement is similar to the case of disjunction because the discourse segment containing the antecedent and the one containing the anaphor are not required to be compatible with each other.

(7) S: *There is no bathroom.*

$\rightsquigarrow$

$\phi_1, \phi_2, \phi_2 : v_1$
$\phi_{DC_S} \subseteq \phi_1$
$\phi_1 = \overline{\phi_2}$
$\text{bathroom}_{\phi_2}\{v_1\}$

(19) S_2: *It is (right) there.*

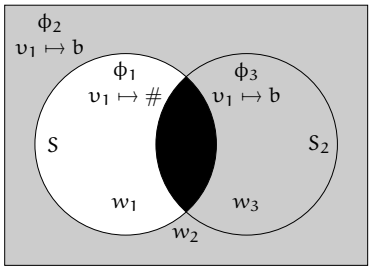
$\rightsquigarrow$

ϕ_3
$\phi_{DC_{S_2}} \subseteq \phi_3$
$\text{there}_{\phi_3}\{\underline{v_2}\}$

Consider a model M_4, where $D_w = \{w_1, w_2, w_3\}, D_e = \{b, p, \#\}$, b is a bathroom and p is a place. Updating an input state with (7) and then (19) in M_4 results in an output assignment i_4 that assigns static referents to drefs as in (20), and illustrated in (21).

(20) a. $\phi_1(i_4) = \{w_1\}$
b. $\phi_2(i_4) = \{w_2, w_3\}$
c. $\phi_3(i_4) = \{w_3\}$
d. $v_1(i_4) = \begin{Bmatrix} w_1 \mapsto \# \\ w_2 \mapsto b \\ w_3 \mapsto b \end{Bmatrix}$

(21)



[6] This is glossing over the specifics of modal semantics of *would* specifying the relationship between ϕ_3 and ϕ_4. See Stone (1999); Stone and Hardt (1999) for discussion.

The anaphor $\underline{\upsilon_2}$ is interpreted in the condition $\mathsf{there}_{\phi_3}\{\underline{\upsilon_2}\}$. υ_1 can only be a possible antecedent for $\underline{\upsilon_2}$, if the referent of υ_1 exists in all ϕ_3-worlds. υ_1 is introduced as $\phi_2 : \upsilon_1$ and exists in all and only the ϕ_2 worlds, so ϕ_3 has to be a subset of ϕ_2. ϕ_1 and ϕ_3 are asserted by different speakers, and therefore they need not be interpreted in conjunction. Updating the context with (7) and then with (19) is therefore compatible an output discourse state i_4, s.t. υ_1 exists in ϕ_3, i.e. the one where $\phi_1(i) \cap \phi_3(i) = \varnothing$, and $\underline{\upsilon_2}$ can be resolved to υ_1. Because a successful resolution of the anaphoric dependency requires that $\phi_1(i) \cap \phi_3(i) = \varnothing$, we get an interpretation where B's utterance is incompatible with A's utterance.

4 Discussion

The presented analysis results in a dynamic semantics where all non-veridical operators are externally dynamic. Indefinites in their scope update the variable assignment globally, along with the information about the sets of worlds in which their referents exist. The analysis provides an understanding of when the surrounding context allows for an anaphoric relation between expressions introducing anaphora and potential antecedents. It constitutes a step forward from previous approaches to anaphoric accessibility in classical DRT (Kamp and Reyle (1993)), as well as analyses of modal subordination (Stone (1999)) and the double negation and disjunction cases (Krahmer and Muskens (1995)), by extending the empirical coverage.

Krahmer and Muskens's (1995) account for the disjunction and double negation cases within the framework of Double Negation DRT involves a semantics for negation that switches from the extension of an expression to its anti-extension, and a semantics for disjunction that analogizes it to conditionals, both in terms of their truth conditions and their dynamic potential. Accordingly, the sentences in (22), respectively, are taken to be equivalent to each other both dynamically and truth-conditionally.

(22) a. Either there is no bathroom in this house, or it is in a weird place.
b. If it is not true that there is no bathroom in this house, it is in a weird place.
c. If there is a bathroom in this house, it is in a weird place.

Their analysis relies on the conventional semantics associated with negation and disjunction and therefore does not extend to cases without overt disjunction or double negation, like the modal subordination and inter-speaker disagreement cases. Further, it completely analogizes the semantics of disjunction to that of conditionals, which predicts that all anaphora pattern analogously in these two contexts. However, propositional anaphora exhibit a contrast between disjunctive and conditional contexts:

(23) a. If Mary is sick, she knows that.
b. #Either Mary is not sick, or she knows that.[7]
c. Either Mary is not sick, or she is and knows that.

This asymmetry provides further evidence against a conditional analysis of disjunctions, besides not being able to account for modal subordination and inter-speaker disagreement. Although the account presented in this paper does not straightforwardly account for this data either, it does leave room for an explanation of this asymmetry, since disjunctions and conditionals may

[7] An anonymous reviewer points out that the acceptability or this sentence somewhat improves when replacing *that* with *it*. Observations of this kind provide an interesting angle for future research on the anaphoric availability of propositional drefs.

have distinct semantic representations. Therefore, the account provides a vantage point over asymmetries between individual and propositional anaphora, to be explored in future research.

References

Adrian Brasoveanu. Structured Nominal and Modal Reference. *Doctoral dissertation, Rutgers University*, 2007.

Adrian Brasoveanu. Decomposing Modal Quantification. *Journal of Semantics*, 27(4):437–527, November 2010.

Jeroen Groenendijk and Martin Stokhof. Dynamic predicate logic. *Linguistics and Philosophy*, 14(1):39–100, February 1991.

Christine Gunlogson. *True to Form : Rising and Falling Declaratives as Questions in English*. Routledge, June 2004.

Irene Heim. *The semantics of definite and indefinite noun phrases*. Doctoral dissertation, University of Massachusetts, Amherst, 1982.

Irene Heim. On the Projection Problem for Presuppositions. In *Proceedings of the Second West Coast Conference on Formal Linguistics*, pages 114–125, 1983.

Hans Kamp. A theory of truth and semantic representation. *Formal semantics-the essential readings*, pages 189–222, 1981.

Hans Kamp and Uwe Reyle. *From Discourse to Logic*. Dordrecht: Kluwer Academic Publishers, 1993.

Lauri Karttunen. Discourse Referents. 1969.

Lauri Karttunen. Presuppositions of compound sentences. *Linguistic Inquiry*, 4:169–93, 1973.

Emiel Krahmer and Reinhard Muskens. Negation and Disjunction in Discourse Representation Theory. *Journal of Semantics*, 12(4):357–376, 1995.

Reinhard Muskens. Combining Montague Semantics and Discourse Representation. *Linguistics and Philosophy*, 19(2):143–186, 1996.

Craige Roberts. Modal subordination and pronominal anaphora in discourse. *Linguistics and Philosophy*, 12(6):683–721, December 1989.

Robert Stalnaker. Assertion. In P. Cole, editor, *Pragmatics*, number 9 in Syntax and Semantics, pages 315–332. London: Academic Press, 1978.

Robert Stalnaker. Common ground. *Linguistics and Philosophy*, 25:701–721, 2002.

Matthew Stone. Reference to possible worlds. *RuCCS Report*, 46, 1999.

Matthew Stone and Daniel Hardt. Dynamic discourse referents for tense and modals. In *Computing meaning*, pages 301–319. Springer, 1999.

Martin van den Berg. *Some Aspects of the Internal Structure of Discourse: The Dynamics of Nominal Anaphora*. PhD Thesis, dissertation, Universiteit van Amsterdam, 1996.