Coindexation in Attitude Complements

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Abstract

Coindexed nominals within attitude complements appear unable to be read *de re* as distinct individuals, contrary to judgements previously reported in the literature. Most theories which derive *de re* interpretation of nominals in attitude complements cannot account for this (with the notable exception of Santorio (2014), who links *de re* interpretation to shifting assignments on raised indices). We develop a similar theory of shifting assignments which is able to account for the restriction on coindexed *de re* readings. Locating our proposed quantification over assignment functions in a Speech-Act Projection (SaP) may provide a principled solution to issues of *de se* interpretation.[1]

1 Introduction

In this paper, we demonstrate that the concept generator theory of *de re* interpretation popularized by Percus & Sauerland (2003) incorrectly predicts that coindexed nominal phrases can be read *de re* as distinct individuals. This finding has serious implications for control theory and for the general theory of nominal reference under attitude verbs; insofar as it suggests a connection between coindexation and availability of *de re* readings, it provides strong support for an account like that of Santorio (2014) which derives *de re* interpretation through shifting assignments on nominal indices.

In particular, the central question of this paper is why (1b) below cannot be uttered truthfully in the given context.

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(1) *Context: Obi-Wan Kenobi has told Luke Skywalker that the evil Darth Vader betrayed and murdered his father. Unbeknownst to Luke, Darth Vader* is *his father.*

    a. Luke thinks Darth Vader killed his father.

    b. # Luke thinks [Darth Vader]$_i$ killed himself$_i$.

Similar structures which do not contain nominals read *de se* have not been discussed much in the literature; however, when discussed they have previously been taken to be felicitous (Anand 2006, Charlow 2010, Percus 2010, Charlow & Shavarit 2014). According to Charlow & Shavarit (ibid.), (2) has a reading in which Ralph construes the agent and the patient of the hurting event as distinct individuals.

(2) Ralph believes that Ortcutt$_i$ hurt himself$_i$.

Likewise, Charlow (2010) cites (3) as evidence for the grammaticality of coindexed nominals with distinct *de re* readings.

(3) *Context: Molly, the editor of a fiction journal, receives a short story from Will for review. Will's a plagiarist, and it turns out his submission was something Molly wrote in grad school. Molly, impressed with the piece, doesn't recognize that it's her own work. She decides she wants to publish it. Someone videotapes the sorry affair and shows it to Molly one night when she's drunk. Molly follows the plot but doesn't recognize that the author or the editor are in fact herself, nor that they're in fact identical to each other.*

    Molly thinks SHE published something by HERSELF!

We consider the acceptability judgements for (2) and (3) to be deeply suspect, as such readings appear to be at best marginal and may result from incomplete parsing of context and from extralinguistic repair efforts. there are serious implications for the theory of *de re* interpretation and control. Insofar as these readings have been considered felicitous, this may result from incomplete parsing of context or from extralinguistic repair efforts.

The intended next step in checking the robustness of the judgement that (1b) is infelicitous is to conduct a small study with Mechanical Turk. This study will test several different matrix and embedded verbs in the positions of *think* and *killed*, and so as to make comprehension of context easier will consistently use examples of dual identity from popular culture, like those of Darth Vader or Superman.

For the rest of the paper, we assume that our judgement of (1b) as is essentially correct and that the denotational meanings of (2) and (3) do not permit the readings which have been ascribed to them by the literature. At this point, some preliminary discussion of attitude predicates and *de re* interpretation is necessary in order to proceed. In the subsections

below, we review some basic results of the relevant literature: a reader familiar with these is encouraged to skip to §1.4, where we further problematize (1b) and outline the structure of the rest of paper.

1.1   Attitude Predicates

Attitude predicates like *think, know, believe* can be analyzed as expressing quantification over a set of possible worlds that are compatible with the beliefs of the attitude holder (Hintikka 1969, Lewis 1989).[2] For example, we give the paraphrase (5) to (4) below.

(4)   Luke thinks Darth Vader is evil.

(5)   In every world compatible with Luke's beliefs, Darth Vader is evil.

A nominal phrase within an attitude complement does not necessarily refer to the same individual as it would in the matrix clause. Consider the sentences of (6) below, both of which have true readings in the given context.

(6)   *Context: John is the best football player in Mary's school, but Mary mistakenly thinks that Bill is a better football player. Mary wants to kiss John, but wants to punch Bill.*
     a.   Mary wants to kiss the best football player in the school.
     b.   Mary wants to punch the best football player in the school.

In the given context, it is true of John that Mary wants to kiss him but not punch him, and it is true of Bill that Mary wants to punch him but not kiss him. So in order for the sentence to be true, the nominal phrase *the best football player in the school* must refer to John in (6a) but to Bill in (6b).

1.2   De Re Interpretation

To describe this contrast, two additional terms are needed: the *content* of a nominal phrase is the referent of the entire extended projection of the nominal phrase, and the *intensional referent* of a nominal phrase is the meaning it would have if its meaning were derived only with respect to the embedded world of evaluation. In (6), the intensional referent of *the best football player in the school* is Bill, since Bill is the best football player in the school in all worlds compatible with Mary's beliefs. But (6a) and (6b) contrast in that the content of *the best football player in the school* is John in (6a) but Bill in (6b).

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[2]The semantic analysis of attitude predicates revisited with more detail in §2.2

In the case that the content of the nominal phrase is distinct from its intensional referent, that nominal phrase is said to be read *de re*. In the case that the content of a nominal phrase is identical to its intensional referent, that nominal phrase is said to be read *de dicto*. Most nominal phrases within the complement of an attitude predicate are ambiguous between a *de re* reading and a *de dicto* reading.[3]

The example of *de re* ambiguity quoted below is from Quine (1956), and is well-suited to illustrate the advantages of acquaintance relations in ascribing meaning to *de re* nominals in terms of acquaintance (Kaplan 1968, Lewis 1979). Paraphrases consistent with an acquaintance-based analysis of (7) are given in italics below the sentences they describe.

(7)   *Context: There is a certain man in a brown hat whom Ralph has glimpsed several times under questionable circumstances on which we need not enter here; suffice it to say that Ralph suspects he is a spy. Also there is a gray-haired man, vaguely known to Ralph as rather a pillar of the community, whom Ralph is not aware of having seen except once at the beach. Now Ralph does not know it, but the men are one and the same. Can we say of this man (Bernard J. Ortcutt, to give him a name) that Ralph believes him to be a spy?*   (Quine 1956: 179)

    a. Ralph believes that Ortcutt is a spy.
       In worlds compatible with Ralph's beliefs, an individual (the man in the brown hat) with whom Ralph is acquainted by virtue of having glimpsed him under questionable circumstances, by virtue of which relation he is acquainted with Ortcutt in the actual world, is a spy.

    b. Ralph believes that Ortcutt is not a spy.
       In worlds compatible with Ralph's beliefs, an individual (the gray-haired man) with whom Ralph is acquainted by virtue of vaguely knowing him to be a pillar of the community, by virtue of which relation he is acquainted with Ortcutt in the actual world, is not a spy.

(7a) and (7b) are not contradictory: (7a) is true if *the man in a brown hat* but not *the gray-haired man* describes the content of *Ortcutt*, and (7b) is true if *the gray-haired main* but not *the man in a brown hat* describes the content of *Ortcutt*. In all worlds compatible with Ralph's beliefs, the gray-haired man and the man in a brown hat are different individuals, both of whom have the property of being Ortcutt in the actual world.[4] Since *Ortcutt* is read

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[3]Fodor (1970) discusses a "third reading" which we do not address in this paper, but which would be expected to pattern with regular *de re* interpretation in the discussion below. *De dicto* and *de re* are terms which have been used with different meanings; see Mckay and Nelson (2014) and Keshet & Schwartz (2014). Fodor (op. cit.) calls the two readings *opaque* or *transparent*, which is a terminology perhaps clearer but non-standard.

[4]If proper names are taken to be *rigid designators*, then these cannot truly be distinct individuals, but rather the same individual, Ortcutt. LaPorte (2016) provides a thorough review of the literature on rigidity

de re in both sentences, this example illustrates a *de re* ambiguity.

We proceed to discuss more explicitly how use a notion of acquaintance to account for this contrast. An *acquaintance relation* $\mathfrak{R}$ is a relation which holds of a subject x and an object y in a world w just in case x is acquainted with y in w by virtue of $\mathfrak{R}$.[5] In (7), John is acquainted with Ortcutt by virtue of having glimpsed him under questionable circumstances, and also by virtue of vaguely knowing him to be a pillar of the community. So in (7a), the content of Ortcutt is identified by the acquaintance relation of having glimpsed one under questionable circumstances; in (7b), the content of *Ortcutt* is identified by the acquaintance relation of vaguely knowing one to be a pillar of the community.

What is the nature of this identification? The way that Percus & Sauerland (2003) incorporate acquaintance relations into the compositional semantics by means of *acquaintance-based concept generators* that map individuals to individual-concepts of type $\langle e, se \rangle$.[6] These are discussed in depth in §2.3 below, but for now note that given an individual z that the attitude holder is uniquely acquainted with by virtue of a relation $\mathfrak{R}$, in each belief world of the attitude holder we can check whether there is an individual z' who the attitude holder is uniquely acquainted with in that world by virtue of $\mathfrak{R}$. This "checking" is analogous to Percus & Sauerland's suitability condition on acquaintance-based concept generators. In *de re* readings, z' is taken to be the content of a nominal phrase whose matrix referent is z.

1.3   De Se Interpretation

Another phenomenon pertinent to any discussion of attitude complements is the existence of *de se* readings (Lewis 1979, Chierchia 1989; see Landau 2013, pg. 32-34 for background). A nominal phrase is read *de se* when it refers to the individual whom the attitude holder identifies as. Both the *de se* reading, in which the subject of the embedded clause refers to the amnesiac's concept of himself, and the *de re* reading, in which the subject of the embedded clause refers to the individual on TV who happens to actually be the amnesiac, are available in (8a); but in (8b), only the *de se* reading is felicitous.

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of proper names, and endorses the following statement of Hughes (2004): "that proper names are rigid, and that identity statements involving only proper names are accordingly necessarily true or necessarily false," is "as close to uncontroversial as any interesting views in analytic philosophy". Matushansky (2008), however, argues convincingly that proper names are semantically definite descriptions. These questions are not crucial to our analysis, however: permitting names to have multiple referents does not solve the problem (1) poses to theories of opaque reference, but we will assume rigid designation of proper names throughout for ease of exposition.

[5] What constitutes (vivid) acquaintance is discussed in the philosophical literature, and is perhaps best taken as primitive. See Hasan & Fumerton (2017) for discussion, and Santorio (2014) fn. 5 for related concerns.

[6] Historically, acquaintance relations have been considered part of a special rule governing interpretation of traces of nominal phrases which have moved out of the embedded clause (Cresswell & Maxwell 1982), but Charlow & Sharvit (2014) present an important flaw in such accounts. [Discuss later?]

(8)   *Context: The amnesiac is a soldier who, watching an old awards ceremony he had participated in on television but not recognizing himself, hopes that the man he is watching on TV (who happens to be the amnesiac himself!) will receive a medal.*

    a.   The amnesiac hopes he will get a medal. (*de re/ de se*)

    b.   The amnesiac hopes to get a medal. (**de re/ de se*)

The way the contrast in (8) is accounted for is by stipulating that the subject PRO of subject-control complements must be read *de se* (Chierchia 1989, *inter alia*).[7]

The individual whom an attitude holder identifies as is called the *doxastic counterpart* of the attitude holder. Unless otherwise specified, we will take the term *doxastic counterpart* to refer the attitude holder's conception of himself under any attitude predicate.

Semantically, we can view *de se* readings as a special case of *de re* because the attitude holder is identified as the doxastic center by the acquaintance relation of self-identification. As to how this identification is made mandatory and is derived compositionally, we use as our starting point the analysis of Landau (2015), which accounts for *de se* readings in attitude verbs by positing that a concept generator that uses only the acquaintance relation of self-identification and takes as argument an empty pronoun bound by the attitude holder is projected above and saturates the predicative embedded clause. This account shall be briefly reviewed and modified later in §6.2.

We maintain in §2 a distinction between the attitude holder and the doxastic center, but for ease of exposition this distinction is later ignored in all cases where the context implies that the attitude holder and the doxastic center are identical.

1.4   Outlook

Using the concepts developed above, we can more precisely state why (1b) is problematic for theories of opaque reference.

(1)   *Context: Obi-Wan Kenobi has told Luke Skywalker that the evil Darth Vader betrayed and murdered his father. Unbeknownst to Luke, Darth Vader is his father.*

    a.   Luke thinks Darth Vader killed his father.

    b.   # Luke thinks [Darth Vader]$_i$ killed himself$_i$.

Suppose following philosophical consensus (LaPorte 2016) that names are *rigid designators*; which is to say the content of the nominal phrase *Darth Vader* is always a particular indi-

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[7]In object-control, PRO refers to the individual whom the attitude holder identifies the addressee as: this reading is called *de te*.

vidual d regardless of where it appears.[8] Then *Darth Vader* refers to d, which means that $g(i) = d$ where g is the *assignment function* that maps syntactic indices to entities; consequently, the DP projected over *himself*, which is bound by *Darth Vader*, also refers to d. But pronouns are not rigid designators, as demonstrated below.

(9)   *Context: John believes that he is actually Napoleon and that John does not exist.*
      Only John wants Mary to read about his conquest of France.

In (9), *his* is a phonological reduction of the pronoun *he* and the possessive morpheme *'s* which occupies the head of the DP embedding *he*. In the ordinary meaning of the sentence,[9] the content of *he* is an individual (Napoleon) with whom the referent John of its binder is acquainted by virtue of self-identification, but who is distinct from John. This proves that pronouns can be interpreted *de re* and have a content distinct from their binder. We expect anaphors to pattern similarly to pronouns insofar as the intensional referent of both is the value the assignment function assigns to their index. To test this claim, substitute for (1) similar sentences with bound pronouns like (10) below: the same problem arises.

(10) *Context: Obi-Wan Kenobi has told Leia that the evil Darth Vader, who has no family*
      of his own, betrayed her father and stole his lightsaber. Unbeknownst to Leia, Darth
      Vader is her father.
      a. Leia thinks Darth Vader killed everyone who was related to her father.
      b. # Leia thinks [Darth Vader]$_i$ killed everyone who was related to [him]$_i$.
         (We ignore the reading of accidental coreference in which him *is not bound.)*

For those skeptical of the arguments above, they are developed more rigorously in §4 after the requisite formalism has been introduced. In §5 we present our solution for ruling out (1b). We finally compare our solution with the framework of Santorio (2014) in §6.1 and account for unexpected binding theory effects in §6.2.

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[8]As later demonstrated, this assumption is actually not necessary for our argument, but makes exposition much easier. Refer to fn. 3 above for a discussion of names as rigid designators.

[9]Sentences which contain focusing adverbs like *only* have two meanings: an ordinary meaning which is the affirmative content of the utterance, and a focus meaning which is the negative content of the utterance (Rooth 1992). In (9), the ordinary meaning of the sentence is "John wants Mary to read about his [John's] conquest of France" and the focus meaning of the sentence is "Bill does not want Mary to read about his conquest of France and Ted does not want Mary to read about his conquest of France and..." which expresses a quantification over the *focus alternatives* to John. The reason we use a focusing adverb in (9) is to preclude a reading in which *his* accidentally corefers with *John* to John, without actually being bound.

2 Formalism

2.1 Basic Framework

We assume a compositional type-theoretic semantics in which if σ and τ are semantic types, then $\langle \sigma, \tau \rangle$ or equivalently $\sigma\tau$ is a semantic type that denotes functions from expressions of type σ to expressions of type τ. e denotes the type of individuals, s the type of possible worlds, t the type of truth values, and κ is the type of contexts or intensional indices. As tense is not directly relevant to the phenomena discussed in this paper, time arguments are omitted from our semantic denotations. Propositions are considered to be functions from possible worlds to truth values, or type κt.

An assignment $g : \mathbb{N} \to D_e$ maps indices to elements of the domain D_e of discourse, which is necessary to account for the behavior of anaphors (§2.4) and other bound variables. A context c a tuple of AUTHOR, ADDRESSEE, and world coordinates. We use the notations $\text{AUTH}(c)$, $\text{ADDR}(c)$ and $w(c)$ to denote the coordinates of a context.

The global context c contains information regarding the matrix speech act and does not change in the course of an utterance's evaluation unless modified by shifty operators (as described by Anand and Nevins 2004). For example, the English first-person pronoun I, has the denotation $[\![\text{I}]\!]^{i,c,g} = \text{AUTH}(c)$, whose value is only dependent on the global context; consequently, I always refers to the speaker of the matrix speech act. The local context i (sometimes called an intensional index) is identical in the matrix clause to the global context, but is shifted by attitude predicates as illustrated in §2.2.

A linguistic constituent L is evaluated as $[\![\text{L}]\!]^{i,c,g}$, relative to a global context, a local context, and an assignment. If α and β are sister nodes and the function $\lambda i'.[\![\beta]\!]^{i',c,g}$ is in the domain of $[\![\alpha]\!]^{i,c,g}$, then by a rule of *intensional functional application* (von Fintel & Heim 2011, Ch. 1) the denotation of their parent node is given by $[\![\alpha \ \beta]\!]^{i,c,g} = [\![\alpha]\!]^{i,c,g}(\lambda i'.[\![\beta]\!]^{i',c,g})$.

The *iota operator* ι is the semantic content of an overt or covert definite article, and is defined such that $y = \iota x.p_{et}(x)$ iff y is the unique individual such that $p(y)$.

2.2 Attitude Verbs

$\text{DOX}(x,i)$ denotes a set of doxastic alternative contexts i' such that x self-identifies as $\text{AUTH}(i')$ in $w(i)$ and $w(i')$ is compatible with the beliefs which x holds in $w(i)$.[10] $\text{BOUL}(x,i)$

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[10]The derivation of this set is complex, involving a BEST operator, a modal base, and an ordering source. See Kratzer (1981) and Portner (2009).

denotes a set of bouletic alternative contexts i' such that x self-identifies as $\text{AUTH}(i')$ in $w(i)$ and $w(i')$ is compatible with the beliefs and desires which x holds in $w(i)$.

A denotation for the attitude verb *think* is given in (31) below, which is used in (12) to write out the denotational meaning of the sentence that was introduced in (4). For readability, we use the notation P_w to indicate that a predicate P is evaluated with respect to the subscripted world w.

(11) $[\![\text{think}]\!]^{i,c,g} = \lambda p_{\kappa t}\lambda x_e.\forall i' \in \text{DOX}(x,i)\,[\,p(i')\,]$

(12) a. $[\![\text{Darth Vader}]\!]^{i,c,g} = d$ and $[\![\text{Luke}]\!]^{i,c,g} = l$

  b. $[\![\text{Luke thinks Darth Vader is evil.}]\!]^{i,c,g} = \forall i' \in \text{DOX}(l,i)\,\big[\text{evil}_{w(i')}(d)\big]$

A full derivation of (12) is provided below.

(13) a. $[\![\text{is evil}]\!]^{i,c,g} = \lambda y_e.\text{evil}_{w(i)}(y)$

  b. $[\![\text{Darth Vader is evil}]\!]^{i,c,g} = \text{evil}_{w(i)}(d)$

  c. $[\![\text{thinks Darth Vader is evil}]\!]^{i,c,g} = [\![\text{think}]\!]^{i,c,g}(\lambda i'.\text{evil}_{w(i')}(d))$
$$= \lambda x_e.\forall i' \in \text{DOX}(x,i)\,\big[\text{evil}_{w(i')}(d)\big]$$

  d. $[\![\text{Luke thinks Darth Vader is evil.}]\!]^{i,c,g} = \forall i' \in \text{DOX}(l,i)\,\big[\text{evil}_{w(i')}(d)\big]$

2.3 Acquaintance Relations

An acquaintance relation $\mathfrak{R}_w$ holds of a subject and an object in a possible world w. If there is a unique $y \in D_e$ such that $x\mathfrak{R}_w y$, we write $\mathfrak{R}_w(x) = y$.

Denotations for the sentences of (7) in terms of existential quantification over acquaintance relations are given in (14) below, though these shall be reformulated when we review Percus & Sauerland (2003) and Charlow & Sharvit (2014) in §3. The meanings which these denotations ascribe to (7) should be taken as ultimately correct: in clarifying in §5 the nature of the substitution that replaces *Ortcutt* with $\mathfrak{R}_{w(i')}$ we derive different formulas which ultimately have an identical sense.

(7) a. Ralph (r) believes that Ortcutt (o) is a spy.

  b. Ralph believes that Ortcutt is not a spy.

(14) a. $[\![\text{(7a)}]\!]^{i,c,g} = \forall i' \in \text{DOX}(r,i), \exists\mathfrak{R}\,\big[r\mathfrak{R}_{w(i)}o \wedge \text{spy}_{w(i')}(\mathfrak{R}_{w(i')}(\text{AUTH}(i')))\big]$

  b. $[\![\text{(7b)}]\!]^{i,c,g} = \forall i' \in \text{DOX}(r,i), \exists\mathfrak{R}\,\big[r\mathfrak{R}_{w(i)}o \wedge \neg\text{spy}_{w(i')}(\mathfrak{R}_{w(i')}(\text{AUTH}(i')))\big]$

By the above denotations, (7a) receives a true reading because the nuclear scope of its existential quantification is satisfied by the acquaintance relation $\mathfrak{G}$ of having glimpsed one

under questionable circumstances; (7b) receives a true reading because the nuclear scope of its existential quantification is satisfied by the acquaintance relation $\mathfrak{V}$ of vaguely knowing one to be a pillar of the community.

2.4   Anaphora

Anaphors obtain their reference from *indices* that can be bound by other nominal phrases, through the process illustrated in the derivation (15) below.

(15)   Mary$_6$ (m) likes herself$_6$.

    a. $[\![\text{herself}_6]\!]^{i,c,g} = g(6)$, **presupposed:** $\female(g(6))$

    b. $[\![\text{likes}]\!]^{i,c,g} = \lambda y_e \lambda x_e.\text{likes}_{w(i)}(x, y)$

    c. $[\![\text{likes herself}_6]\!]^{i,c,g} = \lambda x_e.\text{likes}_{w(i)}(x, g(6))$, **presupposed:** $\female(g(6))$

    d. $[\![\text{Mary}]\!]^{i,c,g} = m$

    e. $[\![\text{Mary 6 } t_6 \text{ likes herself}_6]\!]^{i,c,g} = \text{likes}_{w(i)}(g[6 \to m](6), g[6 \to m](6))$

$$= \text{likes}_{w(i)}(m, m), \textbf{ presupposed: } \female(m)$$

Here and elsewhere in the paper presuppositional content of a denotation is either given within the specification of a function's argument after a colon, or given after the main body of a denotation. In the derivation above, we use the following rule (adapted from Heim & Kratzer 1998) to interpret traces and indices.

(16)   **Interpretation of Traces and Indices**
For any node α_n bearing index n, $[\![\alpha_n]\!]^{i,c,g} = g(n)$. Otherwise, $[\![\text{n } \beta]\!]^{i,c,g} = [\![\beta]\!]^{i,c,g[n \to x]}$ where $g[n \to x]$ is the assignment such that $g[n \to x](x) = x$ and $g[n \to x](y) = g(y)$ if $y \neq x$.

The trace t_6 and index 6 are said to be created by vacuous movement of *Mary*, but the particular syntactic mechanism by which predication between a binder and a lambda abstract over the index of its bindee is achieved is not important for this paper.

3   Review of Percus & Sauerland (2003)

Percus & Sauerland (2003) account for *de re* readings by treating attitude predicates as expressing quantification over concept generators.[11]

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[11]Charlow & Sharvit (2014) rework Percus & Sauerland's existential quantification to a universal quantification over a contextually determined set of sequences of concept generators. This does not impact our discussion, so we maintain the simpler framework of existential quantification.

(17)   **Concept Generator Formalism**

    a. An *individual-concept* is a map from possible worlds to entities. $\mathfrak{R}$ assigns an individual-concept χ to x iff $\chi(w) = \mathfrak{R}_w(x)$ for any possible world w.

    b. A *concept generator* G is a map from entities to individual-concepts.

    c. A *relation generator* $\mathcal{R}$ is a map from entities z to acquaintance relations $\mathcal{R}(z)$.

    d. A concept generator G is an *acquaintance-based concept generator* for attitude holder x in a context c iff there exists a relation generator $\mathcal{R}^G$ such that for every $z \in \mathrm{dom}(G)$, $\mathcal{R}^G(z)$ assigns $G(z)$ to z.

In this system, variables of type $\langle e, se \rangle$ representing acquaintance-based concept generators for the attitude holder are projected over embedded nominal phrases read *de re*, and are bound by an existential quantification expressed by the attitude predicate. Denotations of this form for the sentences of (7) are given in (18) below, where r is Ralph, o is Ortcutt, and G is a variable ranging over acquaintance-based concept generators for r in c.

(7)   a. Ralph (r) believes that Ortcutt (o) is a spy.

      b. Ralph believes that Ortcutt is not a spy.

(18)   a. $[\![(7a)]\!]^{i,c,g} = \forall i' \in \mathrm{DOX}(r,i), \exists G \left[\mathrm{spy}_{w(i')}(G_{w(i')}(o)) \right]$

      b. $[\![(7b)]\!]^{i,c,g} = \forall i' \in \mathrm{DOX}(r,i), \exists G \left[\neg\mathrm{spy}_{w(i')}(G_{w(i')}(o)) \right]$

Using the above denotations, (7a) receives a true reading because the nuclear scope of its existential quantification is satisfied by any concept generator G such that the acquaintance relation $\mathfrak{G}$ of having glimpsed one under questionable circumstances assigns $G(o)$ to o. Likewise, (7b) receives a true reading because the nuclear scope of its existential quantification is satisfied by any concept generator G such that the acquaintance relation $\mathfrak{V}$ of vaguely knowing one to be a pillar of the community assigns $G(o)$ to o. We can describe these readings as $\mathcal{R}^G(o) = \mathfrak{G}$ and $\mathcal{R}^G(o) = \mathfrak{V}$, respectively.

4   Coindexed Nominals

4.1   The Problem

We now have enough background to return to the main problem of the paper. Consider (1a).

(1a)   *Context: Obi-Wan Kenobi has told Luke Skywalker that Darth Vader betrayed and murdered his father. Unbeknownst to Luke, Darth Vader* is *his father.*
      Luke thought Darth Vader killed his father.

We offer the following two possible denotations of (1a), which both have true readings. The nuclear scope of existential quantification in the *de re* parse (19b) is satisfied by any concept generator G such that the acquaintance relation $\mathfrak{F}$ of being one's father assigns $G(d)$ to d.

(19)   a. $[\![(1a)]\!]^{i,c,g} = \forall i' \in \text{DOX}(l,i) \left[\text{killed}_{w(i')}(d, (\iota x.\text{father}_{w(i')}(x,l)))\right]$ (*de dicto*)

  b. $[\![(1a)]\!]^{i,c,g} = \forall i' \in \text{DOX}(l,i), \exists G \left[\text{killed}_{w(i')}(d, G_{w(i')}(\iota x.\text{father}_{w(i)}(x,l)))\right]$ (*de re*)

Importantly, since $\iota x.\text{father}_{w(i')}(x,l) = d$ it is clear that all that is necessary for felicity to obtain using the acquaintance $\mathfrak{F}$ is that the content of the argument of G be Darth Vader. (20) below contains possible paraphrases and parses for (1b).

(20)   *Context: Luke has been told Darth Vader killed his father.* Luke thinks [Darth Vader]$_j$ killed [himself]$_j$.

  a. Grammatical Parse (*de dicto*)

    i. *In worlds compatible with Luke's beliefs, Darth Vader killed himself.*

    ii. $\forall i' \in \text{DOX}(l,w(i)) \left[\text{killed}_{w(i')}(g(j), g(j))\right]$ where $g(j) = d$

  b. Ungrammatical Parse (*de re*)

    i. **In worlds compatible with Luke's beliefs, Darth Vader killed an individual who in that belief world likewise bore to Luke the acquaintance relation $\mathfrak{F}$ of being one's father.*

    ii. **$\forall i' \in \text{DOX}(l,w(i)), \exists G \left[\text{killed}_{w(i')}(g(j), G_{w(i')}(g(j)))\right]$ where $g(j) = d$

The ungrammatical parse (20b) receives a true reading when the relation generator $\mathcal{R}^G$ associated with G is such that $\mathcal{R}^G(d) = \mathfrak{F}$.

(21)   Luke thinks [Darth Vader]$_6$ killed [himself]$_6$. (*de dicto*)

  a. $[\![\text{Darth Vader}]\!]^{i,c,g} = d$ and $[\![\text{Luke}]\!]^{i,c,g} = l$

  b. $[\![\text{himself}_6]\!]^{i,c,g} = g(6)$

  c. $[\![\text{killed}]\!]^{i,c,g} = \lambda y_e \lambda x_e.\text{killed}_{w(i)}(x,y)$

  d. $[\![\text{killed himself}_6]\!]^{i,c,g} = \lambda x_e.\text{killed}_{w(i)}(x,g(6))$

  e. $[\![\text{Darth Vader 6 } t_6 \text{ killed himself}_6]\!]^{i,c,g} =$
      $\lambda x_e.\text{killed}_{w(i)}(g[6 \to d](6), g[6 \to d](6)) = \text{killed}_{w(i)}(d,d)$

  f. $[\![\text{thinks Darth Vader 6 } t_6 \text{ killed himself}_6]\!]^{i,c,g} = \lambda x_e.\forall i' \in \text{DOX}(x,i) \left[\text{killed}_{w(i')}(d,d)\right]$

  g. $[\![\text{Luke thinks Darth Vader 6 } t_6 \text{ killed himself}_6.]\!]^{i,c,g} =$
      $\forall i' \in \text{DOX}(l,i) \left[\text{killed}_{w(i')}(d,d)\right]$

(22)   Luke thinks [Darth Vader]$_6$ killed [himself]$_6$. (*de re*)

  a. $[\![\text{Darth Vader}]\!]^{i,c,g} = d$ and $[\![\text{Luke}]\!]^{i,c,g} = l$

b. $[\![\text{himself}_6]\!]^{i,c,g} = g(6)$

c. $[\![\text{G}_7\ \text{himself}_6]\!]^{i,c,g} = G_{7,w(i)}(g(6))$

d. $[\![\text{killed}]\!]^{i,c,g} = \lambda y_e \lambda x_e.\text{killed}_{w(i)}(x,y)$

e. $[\![\text{killed G}_7\ \text{himself}_6]\!]^{i,c,g} = \lambda x_e.\text{killed}_{w(i)}(x, G_{7,w(i)}(g(6)))$

f. $[\![\text{Darth Vader 6 t}_6\ \text{killed G}_{7,w(i)}\ \text{himself}_6]\!]^{i,c,g} =$
   $\lambda x_e.\text{killed}_{w(i)}(g[6 \to d](6), g[6 \to d](6)) = \text{killed}_{w(i)}(d, G_{7,w(i)}(d))$

g. $[\![\text{thinks Darth Vader 6 t}_6\ \text{killed himself}_6]\!]^{i,c,g} =$
   $\lambda x_e.\forall i' \in \text{DOX}(x,i), \exists G_7 \left[\text{killed}_{w(i')}(d, G_{7,w(i')}(d))\right]$

h. $[\![\text{Luke thinks Darth Vader 6 t}_6\ \text{killed himself}_6.]\!]^{i,c,g} =$
   $\forall i' \in \text{DOX}(l,i), \exists G_7 \left[\text{killed}_{w(i')}(d, G_{7,w(i')}(d))\right]$

Where G_7 is such that $\mathcal{R}^{G_7}(d) = \mathfrak{F}$, the nuclear scope $\text{killed}_{w(i')}(d, G_{7,w(i')}(d))$ is equivalent to $\text{killed}_{w(i')}(d, \mathfrak{F}_{w(i')}(d))$. Because $\mathfrak{F}_{w(i')}(d) = (\iota x.\text{father}_{w(i')}(x,l))$, this yields a reading identical to (1a). This reading does not exist, so the derivation in (22) needs to be ruled out.

4.2   Mandatory Projection of Concept Generators

One way to rule out (22) would be to make projection of concept generators over nominal phrases in attitude complements mandatory. If this were the case, then both the subject and object of *kill* in (1b) would have the same content $[\![\text{Darth Vader}]\!]^{i,c,g} = [\![\text{himself}_6]\!]^{i,c,g} = G_w(i')(d)$, where G is a concept generator for Luke in $w(i)$ bound by existential quantification. However, the data below will demonstrate that this modification seems unlikely to work.

(23)   *Context: Sally works at the cash register at a bookshop. John has just bought some books, and would like to thank her for processing his order. However, he has misidentified Sally as Mary, who happens to look similar to Sally and who is in John's linguistics class.*

   a. John wants to thank Mary. (*de dicto*)

   b. John doesn't want to thank Mary. (*de re?*)

In (23b), there is only one individual who John is acquainted with in his belief worlds as he is with *Mary* in the actual world, but John *does* want to thank this individual. So if the negation in (23b) applies to the predicate *thank* as is standardly taken to be the case in such structures, the only possible analysis is one in which the content of *Mary* is an individual with whom John is not acquainted with in his belief worlds as he is with *Mary* in the actual world. As acquaintance-based concept generators are defined by relation generators which associate individuals with one another on the basis of acquaintance, such an individual cannot be the content of a nominal phrase which contains a concept generator.

A perhaps clearer example is given in (24) below. Again, there is no individual corresponding to the speaker in the addressee's belief worlds at the past time of the matrix clause. Therefore, projection of a concept generator in the extended nominal projection of I is illicit.

(24)   You didn't think I had secretly masterminded the attacks. (After all, you had no idea who I was.)   (Orin Percus, p.c.)

A full account of (23b) and (24) is left for future research, but we believe they adequately show that an analysis in which projection of concept generators in mandatory will not be empirically feasible.

5   The Solution

That present theories of *de re* become inadequate in the context of coindexed nominals implies that indexation may be an important component of *de re* interpretation. In following this heuristic, we develop below a formalism that accounts for *de re* interpretation by shifting assignment functions and a modified indexation rule.

(25)   **Local Assignments**
A linguistic constituent L is evaluated as $[\![L]\!]^{i,c}$, relative to a local context and a global context. A context i has an assignment coordinate denoted by $\gamma(i)$, and the values of indices used in the trace and indexation rule are determined by the assignment of the local context.

(26)   **Constraint on Indexation**
If α is a nominal phrase evaluated with respect to a global context c and a local context i, then α can bear the index n iff either $\gamma(i)(n) = [\![\alpha]\!]^{i,c,g}$ or $\gamma(c)(n) = [\![\alpha]\!]^{i,c,g}$.

(27)   **Relativized Assignment Function**
An assignment $g^x_{i \to i'}$ for i' relativized to x and i is an assignment such that for any index n, either $g^x_{i \to i'}(n) = \gamma(i)(n)$ or $g^x_{i \to i'}(n) = \mathfrak{R}_{w(i')}(\text{AUTH}(i'))$, where $\mathfrak{R}$ is an acquaintance relation such that $x\mathfrak{R}_{w(i)}\gamma(i)$.

(28)   **Shifted Assignment Functions** (First Version)
Redefine the set of doxastic alternatives $\text{DOX}(x, i)$ for an attitude holder x in a local context i to be a set of local contexts i' such that $w(i')$ is compatible with the beliefs of x in $w(i)$, such that x self-identifies in $w(i)$ as $\text{AUTH}(i')$, and such that $\gamma(i')$ is an assignment for i' relativized to x and i.

The constraint on indexation above is less strict than the standard model in which a referential nominal phrases can only bear an index whose value (as given by the assignment) is

the referent of the nominal phrase. Together with the rule for interpretation of traces and indices, this means that a DP can have a well-defined referent in the absence of an index, but a different referent when given an index.

This is made clear in the analysis of (7) given below: our denotations have changed slightly, but the meaning ultimately remains the same.

(7)   a.   Ralph believes that Ortcutt$_6$ is a spy.

b.   Ralph believes that Ortcutt$_6$ is not a spy.

(29)   a. $[\![(7a)]\!]^{i,c} = \forall i' \in \text{DOX}(r,i) \left[\text{spy}_{w(i')}(\gamma(i')(6)) \right]$

b. $[\![(7a)]\!]^{i,c} = \forall i' \in \text{DOX}(r,i) \left[\neg\text{spy}_{w(i')}(\gamma(i')(6)) \right]$

In the above, the constraint on indexation is satisfied by $\gamma(c)(6) = o$. (7a) receives a true reading when $\mathfrak{G}_{w(i')}(r) = \gamma(i')(6)$ for all $i' \in \text{DOX}(x,i)$, and (7b) receives a true reading when $\mathfrak{V}_{w(i')}(r) = \gamma(i')(6)$ for all $i' \in \text{DOX}(x,i)$, where $\mathfrak{G}$ is the acquaintance relation of having glimpsed one under questionable circumstances and $\mathfrak{V}$ is the acquaintance relation of vaguely knowing one to be a pillar of the community.

However, under a context-insensitive formulation of the set of doxastic alternatives, it is impossible that $\mathfrak{G}_{w(i')}(r) = \gamma(i')(6)$ and $\mathfrak{V}_{w(i')}(r) = \gamma(i')(6)$ for all $i' \in \text{DOX}(x,i)$, because the definition of relativized assignment function permits 6 to be assigned to either $\mathfrak{G}_{w(i')}(r)$ or to $\mathfrak{V}_{w(i')}(r)$. One option is to have a sufficiently expansive understanding of the context-sensitivity of doxastic alternatives that in (7a), for example, all local contexts which assign 6 to $\mathfrak{V}_{w(i')}(r)$ are considered to not be salient enough to qualify as elements of the domain of quantification. Another option which is more explicit in its predictions is to reformulate the shifting of assignment functions in such a way that we return to a bipartite modal quantification. Recall that under the framework of Percus & Sauerland (2003), a universal quantification over local contexts was followed by an existential quantification over concept generators. This is the approach we pursue below.

(30)   **Shifted Assignment Functions** (Final Version)
An attitude predicate with attitude holder x evaluated in a local context i quantifies universally over new local contexts $i' \in \text{DOX}(x,i)$, and then existentially over assignment functions for i' relativized to x in i. The local assignment $\gamma(i')$ is shifted by the existential quantification, but not by the universal quantification.

This is made concrete in the modified denotation of *think* given below. The notation $i[\gamma \to g]$ means a context i' such that i' is identical to i in all coordinates except that $\gamma(i) = g$.

(31) $[\![\text{think}]\!]^{i,c} = \lambda p_{\kappa t} \lambda x_e . \forall i' \in \text{DOX}(x,i), \exists g^x_{i \to i'} \left[p(i'[\gamma \to g^x_{i \to i'}]) \right]$

The meaning of *think* given above yields our final denotations for (7), which are provided in (32). In each local context i' of the universal quantification, $\gamma(i)[6 \to \mathfrak{V}_{w(i')}(r)])$ is an assignment function for i' relativized to x in i, and $\gamma(i)[6 \to \mathfrak{V}_{w(i')}(r)](6)$ is $\mathfrak{V}_{w(i')}(r)$, who is a spy. Therefore, (7a) receives a true interpretation, which is likewise the case for (7b).

(32)   a. $[\![(7a)]\!]^{i,c} = \forall i' \in \mathrm{DOX}(r,i), \exists g^r_{i \to i'} \left[\mathrm{spy}_{w(i')}(g^r_{i \to i'}(6)) \right]$

      b. $[\![(7a)]\!]^{i,c} = \forall i' \in \mathrm{DOX}(r,i), \exists g^r_{i \to i'} \left[\neg\mathrm{spy}_{w(i')}(g^r_{i \to i'}(6)) \right]$

The mechanism of assignment function shifting given in (30) does not involve projection of concept generators, so there is no means by which the content of *himself* can differ from the content of its coclausal binder in (1b). Rather, (1b) has a single possible denotation, which is given by the derivation below.

(33)   Luke thinks [Darth Vader]$_6$ killed [himself]$_6$.

      a. $[\![\mathrm{Darth\ Vader}]\!]^{i,c,g} = d$ and $[\![\mathrm{Luke}]\!]^{i,c,g} = l$

      b. $[\![\mathrm{himself}_6]\!]^{i,c} = g(6)$

      c. $[\![\mathrm{killed}]\!]^{i,c} = \lambda y_e \lambda x_e.\mathrm{killed}_{w(i)}(x,y)$

      d. $[\![\mathrm{killed\ himself}_6]\!]^{i,c} = \lambda x_e.\mathrm{killed}_{w(i)}(x, g(6))$

      e. $[\![\mathrm{Darth\ Vader\ 6\ t}_6\ \mathrm{killed\ himself}_6]\!]^{i,c} =$
          $\lambda x_e.\mathrm{killed}_{w(i)}(g[6 \to d](6), g[6 \to d](6)) = \mathrm{killed}_{w(i)}(d,d)$

      f. $[\![\mathrm{thinks\ Darth\ Vader\ 6\ t}_6\ \mathrm{killed\ himself}_6]\!]^{i,c} =$
          $\lambda x_e.\forall i' \in \mathrm{DOX}(x,i), \exists g^x_{i \to i'} \left[\mathrm{killed}_{w(i')}(d,d) \right]$

      g. $[\![\mathrm{Luke\ thinks\ Darth\ Vader\ 6\ t}_6\ \mathrm{killed\ himself}_6.]\!]^{i,c} =$
          $\forall i' \in \mathrm{DOX}(l,i), \exists g^l_{i \to i'} \left[\mathrm{killed}_{w(i')}(d,d) \right]$

What if *Darth Vader* is given a different index after it is moved? *Darth Vader* and *himself* must still be read with the same content because the content of *Darth Vader* simply saturates the lambda abstract over the index of *himself*. The final meaning of such a construction is given in (5) below.

(34) $[\![\mathrm{Luke\ thinks\ [Darth\ Vader]}_7\ 6\ \mathrm{t}_6\ \mathrm{killed\ himself}_6.]\!]^{i,c} =$
      $\forall i' \in \mathrm{DOX}(l,i), \exists g^l_{i \to i'} \left[\mathrm{killed}_{w(i')}(g^l_{i \to i'}(7), g^l_{i \to i'}(7)) \right].$

6   Discussion

6.1   Comparison with Santorio (2014)

It should be noted that the framework developed above bears broad similarities to the proposal detailed by Santorio (2014). Santorio gives nominals two indices, a lower index and a raised index. The lower index is valued by the regular assignment function as an entity, but the raised index is valued as a concept generator by a different assignment function shifted by modal quantification. The concept generators to which raised indices refer are applied to the nominal phrases which bear them. This account correctly predicts the infelicity of (1b) as raised indices are taken to be bound by anaphoric binding just as lower indices are. However, we view our account as superior insofar as it retains the empirical advantages of Santorio's raised indices, because it involves fewer semantic primitives (we use no concept generators and only one type of index).

Santorio (2014) points out several other flaws of using projection of concept generators over nominal phrases to account for *de re* readings, including that concept generator projections must be largely invisible to binding phenomena. Our account retains the advantages of Santorio's in accounting for these facts.

6.2   Unexplained BT Effects

In (1b), an anaphor is unable to be bound by an overt subject distinct from the attitude holder which has a different *de re* reading than it. However, it is clear that an anaphor can be bound by PRO and yet not be read *de se*, as in (35) below.

(35)   *Context: Palin does not know who she is, nor that she is a vice-presidential candidate in the upcoming election.*
       McCain convinced Palin$_i$ PRO$_i$ to vote for herself$_i$.

Unexpected BT effects are well-known and have been discussed by Heim (1994), Sharvit(2011), Charlow (2010), among others. Landau (2018) argues that these are in fact predicted by a theory which treats *de se* as a special case of *de re*, and thus provides support for such an account. However, assuming we are correct that a *de re* anaphor is not in fact able to receive readings distinct from a coclausal binder, the asymmetry between these and *de se* anaphors becomes once again very puzzling.

Under our account, the only way in which *herself* could be read *de re* as opposed to *de se* is if it bears a different index from its binder PRO or if it is evaluated with respect to

a different assignment than PRO is. The first option would violate Binding Theory in an unprincipled manner, so the second possibility is the one that we will entertain below.

Suppose following Landau (2015) that PRO represents a simple variable bound by a lambda abstract saturated by a higher unpronounced nominal phrase whose referent is given by the AUTH coordinate of the embedded local context.[12] Under such a structure, *herself* in (35) is actually bound by this higher nominal, and not by the bound variable PRO which is in the embedded subject position (see discussion in Landau 2016). In order for our theory to produce the *de re* reading of *herself*, it would need to be the case that assignment function shifting occurs beneath the higher nominal but above the subject position; in order to still account for *de re* readings of overt embedded subjects which are distinct from the attitude holder, assignment function shifting needs to occur above the position of the embedded subject. Therefore, the locus of assignment function shifting needs to be somewhere within the exploded CP* domain between the embedded TP and the projection of the unpronounced indexical.

Such a framework becomes extremely plausible once the nature of the unpronounced indexical is further considered. Hill (2007) argues that a *Speech Act Projection* (SaP) constitutes the uppermost part of the CP* domain. Spec, SaP contains a nominal phrase which the Sa^0 head presupposes to be the author of the local context, $\text{AUTH}(i')$. Hill shows that such a projection accounts for crosslinguistic vocative phenomena, and Tang (2014) applies SaP to account for a Cantonese discourse particle.

If Landau's unpronounced indexical is simply the specifier of SaP projection, the more stipulative elements of Landau's (2015) account are reduced to those of an independently justified proposal. Since SaP is already associated with perspectival shifting, it is a natural step to locate the existential quantification over assignment functions developed above within the Sa^0 head, rather than as part of the lexical meaning of the attitude verb. This analysis then correctly predicts the grammaticality of (35).

[Insert Derivation Here]

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[12]For now we describe this nominal phrase as the unpronounced indexical of the embedded clause in order to avoid theoretical commitments about its status.

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