Variable-based Intensionality for Structured Propositions

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Abstract: I develop a variable-based theory of intensionality for advocates of Russellian, structured propositions, building on the semantic framework of Bryan Pickel (2019, *this journal*) by incorporating covert variables over possible worlds and equivalence functions in syntax. This account has stronger empirical coverage than a recent attempt by Harvey Lederman (2022) to develop a variable-based theory under Fregean assumptions. The upshot is to provide Russellians with their own compositional semantics for complex intensional phenomena, thereby strengthening the case for their framework being a viable alternative to possible world semantics.

1 Introduction

It's well-known that traditional scope-based theories of intensionality, such as Russell (1905), Montague (1973), Ladusaw (1977), Stowell (1993), and Ogihara (1996), struggle to account for the behavior of determiner phrases (DPs) in the context of attitude reports. The third reading of indefinites identified by Janet Fodor (1970) and the scope paradox identified by Bäuerle (1983), for example, show that simple scopal relations at the level of logical form (LF) fail to generate accessible readings of certain reports in context. These limitations led linguists working in the tradition of possible world semantics, such as Percus (2000), Schueler (2011), and Schwarz (2012), to develop variable-based theories of intensionality, which generate transparent interpretations of DPs not through scopal relations at LF but through the binding of covert possible world variables by λ-operators.

Not everyone is satisfied with the coarse-grained truth conditions provided by possible world semantics as developed in the tradition of Hintikka (1969). Some advocates of more finely-grained semantics, for example, take apparent hyperintensional distinctions in language to support a conception of propositions not as unstructured sets of possible worlds but as structured entities individuated by the identity and arrangement of constituents. The defensibility of these theories of structured propositions partly depends on whether they can also explain the data predicted successfully by possible world semantics, such as the third reading of indefinites and the scope paradox. On this score, however, there has not been as much progress as one would hope. It was not until two

decades after Percus (2000) presented the first variable-based theory of intensionality for possible world semantics that Lederman (2022) provided structured propositionalists with their own.

Lederman's theory operates under broadly Fregean assumptions concerning the nature of structured propositions, while the present work operates under Russellian assumptions instead. A few remarks about these competing frameworks are in order. Fregeans, following Frege (1892), maintain that ways of thinking, or *senses*, of objects, properties, and relations are the primary compositional semantic values of subsentential expressions (in context) and the constituents of structured propositions, or *thoughts*, semantically expressed by declarative sentences (in context).[1] Since Fregean semantics are motivated in part by the apparent failure to substitute co-referential expressions salve veritate in attitude reports, they track two levels of linguistic meaning, corresponding to sense and reference. Russellians, following Russell (1903), maintain instead that only objects, properties, and relations themselves are subsentential semantic values and propositional constituents. Since Russellian semantics are often motivated by the rejection of semantic properties that would, like senses, be fully transparent to speakers, they track only one level of linguistic meaning, corresponding to reference. Russellian semantics are therefore simpler than Fregean alternatives in this respect.

Unlike Fregeans, Russellians do not yet have their own variable-based theory of intensionality. This work corrects that state of affairs by developing one under the assumption of Russellian, structured propositions. Its formal implementation builds on the semantic framework of Pickel (2019, *this journal*) by incorporating covert variables over possible worlds and what I will call *equivalence functions* in syntax. The resulting theory accounts for a larger class of third readings than Lederman's, which I'll show depends on a problematic assumption unrelated to Fregeanism. While my theory posits truth conditions similar to those considered by others, such as Schwager (2011) and Sudo (2014), its novelty lies in compositionally deriving Russellian, structured propositions with these truth conditions on the basis of a respectable syntax.

This theory does not constitute an argument against Fregeanism, although more work would be required for Fregeans to take advantage of it. They can try, after all, to incorporate my Russellian semantics into the referential level of meaning in their own two-tiered framework. Whether – and, if so, how – that can be done satisfactorily falls outside the scope of this work; accommodating an additional level of meaning for senses introduces a significant degree of complexity, the theoretical justification for which lies not in the third reading or scope paradox but in cases of mistaken identity, i.e. Frege's puzzle. So, there is also a practical

[1] I will assume that propositions are the objects of psychological attitudes such as belief, the designations of 'that'-clauses in context, and the compositional semantic values of declarative sentences in context. For ease of exposition and when clarity does not demand otherwise, I will sometimes omit explicit reference to context and other parameters of relativization after they have been introduced.

motivation for proceeding with a simpler, Russellian framework: it is easier to consider the strategy exemplified by Lederman (2022), raise a counterexample to it, and present a stronger theory in abstraction from Fregean senses. In any case, this work expands the range of linguistic data explainable by structured approaches to propositions, and this strengthens the case for their being a viable alternative to possible world semantics.

Here is the plan for the paper. In §2, I cover the background of traditional scope-based theories of intensionality, the third reading of indefinites, and Hintikkan variable-based theories. The third reading of indefinites is the focus of the paper, with a solution to the scope paradox falling out of an account of the third reading. In §3, I introduce the theory of structured propositions and argue that its advocates should reject a popular sufficient condition on propositional constituency in order to accommodate a variable-based approach. In §4, I consider one strategy for doing so exemplified by Lederman (2022) and raise a counterexample to it; potential replies are considered and found to be lacking. In §5, I develop a stronger variable-based theory of intensionality for advocates of Russellian, structured propositions, providing them with an account of the third reading and scope paradox. I also extend the account to embedded constructions and address a concern surrounding the overgeneralization of transparent interpretations. I conclude in §6 by highlighting the importance of a proper semantic, as opposed to pragmatic, account of the intensional phenomena at issue.

2 Background

This section covers the background of traditional scope-based theories of intensionality, the third reading of indefinites, and Hintikkan variable-based theories. Consider the following belief report:

(1) Betty believes that every senator spies.

As is well-known since Quine (1956), reports in the form of (1) admit of readings that are true in different contexts, such as the following:

> Suspicious Senators
> Betty the reporter is suspicious of the government and thinks that maintaining a senatorial seat requires espionage. Despite not personally knowing any senators herself, she pens a story with the headline, 'EVERY SENATOR SPIES.'

> Suspicious Suits
> Betty the reporter thinks that anyone wealthy enough to wear an Italian suit engages in espionage. Walking home one night, she passes a convention center and sees all of its attendees wearing Italian suits. Unaware that

these are exactly the senators, she pens a story with the headline, 'EVERY CONVENTION-GOER SPIES.'

On the reading of (1) true in Suspicious Suits, the NP-complement 'senator' can be substituted with a co-extensional expression such as 'convention-goer' salve veritate, but this isn't the case on the reading of (1) true in Suspicious Senators. When a sentential operator O operates on a sentence S containing a DP with NP-complement φ, call the DP *transparent* with respect to O in context c just in case, for every expression φ^* co-extensional with φ in c, $\ulcorner OS \urcorner$ is true in c if and only if $\ulcorner OS[\varphi^*/\varphi] \urcorner$ is true in c.[2] Call a DP *opaque* just in case it is not transparent. Then 'every senator' is transparent with respect to the sentential operator 'Betty believes' in Suspicious Suits and opaque with respect to it in Suspicious Senators.

According to traditional scope-based theories of intensionality, such as Russell (1905), Montague (1973), Ladusaw (1977), Stowell (1993), and Ogihara (1996), whether a DP is transparent with respect to a sentential operator depends exclusively on the syntactic position of the DP relative to that of the operator at LF.[3] Such a view predicts the different readings of (1) by assigning it two possible logical forms, represented at the relevant degree of abstraction as follows:

(1a) *Betty-believe:* $\forall x(\textit{senator}(x) \rightarrow \textit{spy}(x))$ ← narrow scope
(1b) $\forall x(\textit{senator}(x) \rightarrow$ *Betty-believe:* $\textit{spy}(x))$ ← wide scope

The prediction is that a DP δ is transparent with respect to a sentential operator O just in case δ c-commands O at LF, as in the wide-scope reading (1b). Since May (1977), the predominate method for syntactically deriving such logical forms is through Quantifier Raising (QR), a form of movement by which the DP adjoins a higher sentential node, leaving behind a co-indexed trace at LF. While this view enjoys significant empirical coverage, a number of troubling counterexamples to it were identified in the latter half of the twentieth century.[4]

Consider, for example, the following context and belief report:

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[2] $\ulcorner S[\varphi^*/\varphi] \urcorner$ is the sentence that results from substituting every occurrence of φ in S with φ^*. Characterizing the readings of (1) in terms of opacity and transparency is an intentional departure from their traditional characterization in terms of "de dicto" and "de re" readings as in Quine (1956). The present work brackets questions surrounding the proper derivation of ascriptions of singular (or "de re") attitudes, which might be more faithfully represented by reports such as the following (cf. §2.5 of Hawthorne and Manley (2012)):

(i) Betty believes of every senator that he spies.

For a similar point, see footnote 2 of Lederman (2022). For more on the syntax and semantics of reports in the form of (i), see Rausch (2021).

[3] Traditional scope-based theories of intensionality contrast with non-traditional scope-based theories, such as the "split intensionality" of Keshet (2011). Whether structured propositionalists can develop a semantics inspired by non-traditional scope-based theories falls outside the scope of this work, which is focused instead on variable-based approaches.

[4] For overviews of this literature, see Keshet and Schwarz (2019) and §4 of Grano (2021).

Game Show

You're watching a live game show with Betty, who mistakenly thinks that you have no friends. She also holds the superstitious belief that green eyes cause good luck. Your two friends, Xavier and Yvette, are the only contestants on the show with green eyes. Seeing them, Betty remarks, "One of those green-eyed contestants will win."

(2) Betty believes that a friend of yours will win.

It's widely agreed that there's a true reading of (2) in Game Show, but as Janet Fodor (1970, 226-232) first observed, it does not result from the narrow- or wide-scope interpretation.[5] These interpretations result from logical forms such as the following:

(2a) *Betty-believe:* $\exists x(friend(x)$ & $win(x))$ ← narrow scope
(2b) $\exists x(friend(x)$ & *Betty-believe:* $win(x))$ ← wide scope

The narrow-scope reading (2a) is false in this context because it's not the case that Betty believes you have any friends, much less some that will win. The wide-scope reading (2b) is also false in this context because no friend of yours is such that Betty stands in the belief relation to the singular proposition that (s)he will win. Betty doesn't believe that Xavier will win, and she doesn't believe that Yvette will win. So, there's no witness to the existential quantifier in (2b). Call the reading on which (2) is true in Game Show *the third reading*. Since there don't appear to be any additional scopal interactions available at LF, traditional scope-based theories of intensionality incorrectly predict that the third reading is unavailable in this context.

The third reading seems to require a way of evaluating the NP-complement ('friend of yours') relative to the evaluation world of the matrix clause while keeping the force of existential quantification within the subordinate clause. This poses a difficulty for traditional scope-based theories because they take the entire DP to move outside of the subordinate clause at LF through QR.[6] Recognizing this limitation, variable-based theories of intensionality, such as Percus (2000), Schueler (2011), and Schwarz (2012), depart from scope-based explanations in

[5]For additional examples, see Ioup (1977) and Bonomi (1995).

[6]Sophisticated forms of syntactic movement that bypass this difficulty are considered in §8.3.2 of von Fintel and Heim (2011) and Appendix B of Lederman (2022). If one is willing to countenance what are generally considered to be ad hoc movement operations, these accounts can correctly predict the third reading's truth conditions for Hintikkans and structured propositionalists alike. However, such movements operations should be avoided if possible, or at the very least, their alternatives carefully considered. The choice between my approach and a movement-based alternative will depend on how one assesses the plausibility of my appeal to equivalence function variables compared to that of exotic forms of movement. In its favor, my view offers an explanation for the inaccessibility of transparent interpretations for some occurrences of predicates.

favor of a syntax involving possible world variables and λ-operators.[7] According to what von Fintel and Heim (2011) call *the standard solution*, verbs select for possible world variables and project co-indexed λ-operators to the heads of their immediate clauses, while nouns select for possible world variables that can be more freely co-indexed. The following is thereby permitted as a logical form for (2):

(3) λw_1 $believe_{Betty}(w_1)$: λw_2 $\exists x(friend(w_1)(x)$ & $win(w_2)(x))$

where variables $\ulcorner w_i \urcorner$ of semantic type s range over possible worlds.

On this view, a sentence is true in context c if its logical form in c maps the world of c to 1. So, (2) is true in Game Show if (3) maps the world of Game Show to 1. The compositional derivation demonstrating this is routine, with the attitudinal operator receiving a semantic value in c in the traditional manner following Hintikka (1969):[8]

$$[\![\textbf{\textit{believe}}_{\textbf{\textit{Betty}}}]\!]^c = \lambda w_s \lambda P_{st}(\text{every } w^* \text{ compatible with Betty's beliefs in } w \text{ is such that } P(w^*) = 1)$$

Given the standard λ-calculus and intended meanings for predicates and logical vocabulary, the resulting semantic interpretation of (3) is the intension defined on any world w as follows:

$[\![(3)]\!]^c(w) = 1$ if and only if the following condition is met:
for every world w^* compatible with Betty's beliefs in w,
there is an x such that x is your friend in w, and
x wins the game in w^*

Since this intension maps the world of Game Show to 1, the standard solution correctly predicts that (2) has a true reading in this context.

The DP is transparent in Game Show on this view because substituting the NP-complement ('friend of yours') with a co-extensional NP in the context results in the same intension defined above. Since intensions are functions from possible worlds to truth-values, and hence are themselves individuated extensionally in terms of set membership, the NP-complement can remain within the scope of the attitudinal operator without problematically requiring the attributee to conceptualize Xavier or Yvette as a friend of yours. In this way, the coarseness of grain typical of possible world semantics plays an essential role in the standard solution.

[7] The original implementation in Percus (2000) appeals to situation variables, but I'll conflate situations and possible worlds. I omit detailed consideration of the syntactic constraints Percus proposes to prevent the overgeneralization of transparent interpretations, although I discuss related overgeneralization worries in §5.3.

[8] I'll relativize the semantic value of an expression to a context c and variable assignment function determined by c, g_c. Variable assignment functions are rendered explicit when treating the semantics of quantification.

3 Structured propositions

This section introduces the theory of structured propositions and argues that its advocates should reject a popular sufficient condition on propositional constituency in order to accommodate a variable-based theory of intensionality. Despite its widespread use, the framework of possible world semantics remains controversial, particularly in its ability to account for apparent hyperintensional distinctions. Since the worlds in which Harris is president, for example, are exactly those in which Harris is president if and only if arithmetic is undecidable, the following belief reports are prima facie predicted incorrectly to be true in the same contexts:

(4) Betty believes that Harris is president.
(5) Betty believes that Harris is president if and only if arithmetic is undecidable.

Moved by this consideration among others, many have adopted the view that propositional attitude verbs semantically express relations between subjects and more finely-grained, structured propositions that are individuated by the identity and arrangement of constituents.[9] According to this view, the proposition reported as the object of Betty's belief in (4) is not identical with the one reported in (5), in part because only the latter contains the semantic values of 'arithmetic' and 'undecidable' as constituents. The view therefore entails that some distinct propositions have the same truth-value relative to every possible world, thereby capturing hyperintensional distinctions otherwise conflated prima facie by possible world semantics.

Structured propositionalists generally agree that there is some illuminating correspondence between propositional constituents and the semantic values of subsentential expressions in context. Salmon (1986a), for example, defends a semantics for Russellian, structured propositions on which

> [t]he information value. . .of a typical compound expression, if any, is a complex, ordered entity (e.g. a sequence) whose constituents are semantically correlated systematically with expressions making up the compound expression, typically the simple (noncompound) component expressions. (189, parentheticals in original)

Soames (1987) proposes a similar Russellian theory on which

> [t]he semantic content of a sentence. . .must encode at least as much structure as is determined by occurrences of its directly referential

[9] Soames (1987) provides an influential argument against propositions as sets of truth-supporting circumstances. For accounts of structured propositions, see Lewis (1972), Cresswell and von Stechow (1982), Zalta (1983, 1988), Cresswell (1985), Soames (1985, 1987, 1989), Salmon (1986a, 1986b, 1989a, 1989b), Menzel (1993), King (1995, 1996, 2007, 2009), and Bacon (2023). For defenses of possible world semantics, see Stalnaker (1984) and, more recently, Williamson (2024).

> singular terms (including free variables). (66-67, parenthetical in original)

Finally, King (2007) proposes a fact-based conception of structured propositions according to which

> if we picture a proposition in "tree form", the constituents of the proposition that is the fact are the components of the fact occurring at the terminal nodes of the propositional relation. (62)

For our purposes, the following sufficient condition on propositional constituency can be considered a consequence of such views:

> **Terminal Node Constituency:** For any sentence S, context c, proposition P, and thing x, if S designates P in c and x is the semantic value of a terminal node in the logical form of S in c, then x is a constituent of P.

Suppose, for example, that the sentence 'Serena smiles' designates in c the proposition that Serena smiles, that 'Serena' and 'smiles' are terminal nodes in the logical form of 'Serena smiles' in c, and that the semantic values of 'Serena' and 'smiles' in c are, respectively, Serena and the property of smiling. Then Terminal Node Constituency entails that Serena and the property of smiling are constituents of the proposition that Serena smiles.

It is not immediately obvious whether – and, if so, how – a structured propositionalist committed to Terminal Node Constituency can account for the third reading of indefinites by incorporating possible world variables into logical forms. In order to tease out one difficulty of doing so, suppose a structured propositionalist tried to approximate the standard solution in their own framework by crudely forcing the NP-complement ('friend of yours') in (2) to be evaluated relative to the world of the context of utterance. To this end, she might propose the following truth conditions for the third reading of (2) in c:[10]

> (2) is true in c if and only if Betty stands in the belief relation in w_c to the structured proposition that for some x, x is a friend of yours in w_c and x wins.

Providing a comprehensive syntax and compositional semantics for such a strategy need not detain us at this stage; the important supposition is that these truth conditions can be derived by incorporating a possible world variable as a terminal node of the 'that'-clause in (2) at LF. Then by Terminal Node Constituency, the proposition that for some x, x is a friend of yours in w_c and x wins thereby contains w_c itself as a constituent.

[10]The structured propositionalist will ultimately assign the third reading of (2) in c a structured proposition as its semantic value. For ease of exposition, I'll speak in terms of its truth conditions instead. The considerations of this section run orthogonal to the compositional derivation of structured propositions as the designations of clauses in context; the details of such derivations are taken up in detail in later sections.

The idea would be to argue that the instantiation conditions of the belief relation are loose enough for these truth conditions to be satisfied in Game Show, despite Betty's disposition to reject sentences such as 'A friend of yours in the actual world will win.' Including the world of the context in the specification of the object of Betty's reported belief secures its desired modal profile; its truth relative to any possible world partly depends on who your friends are in the actual world. If this strategy could be made to work, it would provide structured propositionalists with an account of the third reading at the cost of a less traditional account of the belief relation.[11]

Setting aside any difficulties involved in loosening the instantiation conditions of the belief relation in the required way, this proposal breaks down for an instructive reason upon consideration of third readings embedded in the consequents of counterfactual conditionals. Consider, for example, the following:

(6) If you were friendless, Betty would (still) believe that a friend of yours would win.

There's a true reading of this sentence in Game Show on which the NP-complement ('friend of yours') is evaluated with respect to the world of Game Show, w_{GS}, as opposed to that of the counterfactual scenario.[12] Let $w_\diamond$ be the possible world nearest to w_{GS} in which you have no friends. Then according to the crude proposal under consideration, supplemented with a standard semantics for counterfactual conditionals in the style of Stalnaker (1968) or Lewis (1973), the intended reading of (6) is true in Game Show just in case Betty stands in the belief relation in $w_\diamond$ to the structured proposition that a friend of yours in w_{GS} will win. By Terminal Node Constituency, the truth of this reading in Game Show entails that Betty stands in the belief relation in $w_\diamond$ to a proposition that contains w_{GS} as a constituent. This is problematic, however, because it's possible for Betty to have the belief reported by the intended reading without believing anything at all about the world of Game Show.[13] Moreover, if a relation of causal or epistemic acquaintance must obtain between believers and the constituents of their beliefs, as many structured propositionalists maintain, then it would be especially implausible for Betty to bear such a relation in one possible world to another.[14] So, there is a strong reason to think that this crude

[11]This strategy differs from an insistence that the opaque reading of (2) is true in Game Show because it appeals to lexically covert possible world variables in order to secure an object of Betty's reported belief with the desired modal profile.

[12]There's also a trivially false reading not at issue on which the NP-complement ('friend of yours') is evaluated with respect to the counterfactual scenario in which you have no friends. The example was selected to screen off such a reading, but if one has difficulty accessing the true reading of (6), the same point can be made with a sentence such as 'If you wore different socks, Betty would believe that a friend of yours would win,' although in this case I would need to stipulate that the NP-complement is evaluated with respect to the actual world.

[13]Soames (1998) deploys an analogous argument against rigidifying forms of descriptivism about proper names, although see Pickel (2012) for a reply.

[14]A variety of authors who endorse a special relation of causal or epistemic acquaintance on

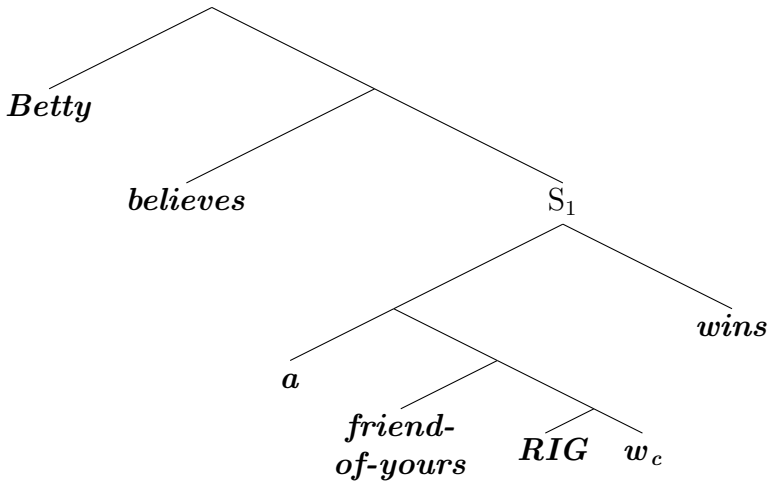
form of variable-based intensionality for structured propositions fails to capture an accessible reading of (6) in Game Show.

The moral of this strategy's shortcoming is that structured propositionalists should, if possible, avoid accounts of the third reading on which the attributee stands in the belief relation to a proposition with a constituent corresponding to a possible world variable. They should therefore take possible world variables to make semantic contributions without contributing propositional constituents, and this amounts to a rejection of Terminal Node Constituency. It remains an open question what the best way is to construct such a theory.

4 Against Rigidification

This section considers a strategy for rejecting Terminal Node Constituency exemplified by Lederman (2022), raises a counterexample to it, and finds potential replies to be lacking. The basic idea behind this strategy is that the third reading of (2) is true in Game Show because 'friend of yours' could just as well have been replaced with 'person identical with Xavier or Yvette' on the basis of the fact that exactly Xavier and Yvette satisfy the meaning of 'friend of yours' in the context. To see how this idea can be formally implemented, consider the following proposal for the logical form of the third reading of (2) in c:[15]

(7)



singular belief are included in Jeshion (2010), although see Hawthorne and Manley (2012) for a dissenting view.

[15]The syntax here is analogous to the first syntax tree in §3.2 of Lederman (2022), although note a slight typographic error there that displays [[***RIG*** $\boldsymbol{t}_{\boldsymbol{4}_w}$ ***winners***] ***lost***] as a sentential constituent instead of the intended [***two*** [***RIG*** $\boldsymbol{t}_{\boldsymbol{4}_w}$ ***winners***]]. My sketch ignores important complications arising from QR, the incorporation of the λ-calculus required for a systematic relativization of semantic values to possible worlds, and the constraint that semantic composition is driven by functional application with a few exceptions. While of great theoretical importance in a final account, these details are not relevant to the counterexample I'll raise.

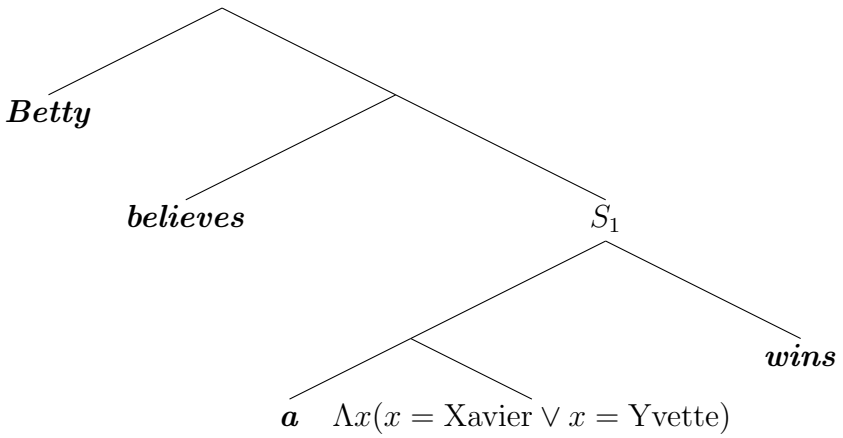
Since the interpretation of 'RIG' is our primary interest at this stage, I'll make a number of simplifying assumptions that I'll return to when constructing my own account in the next section. For now, I'll assume that 'believes' semantically expresses a binary relation between subjects and structured propositions, that 'friend-of-yours' semantically expresses the property of being a friend of yours, that 'wins' semantically expresses the property of winning the game, and that there is some compositional mechanism – perhaps driven by the interpretation of the determiner – for deriving a structured proposition as the semantic value of the subordinate clause, S_1.

We'll call an NP-complement *rigid* in a context just in case its interpretation in the context is satisfied by the same individuals relative to every possible world. Then the purpose of 'RIG' is to make the NP-complement in which it occurs rigid in context. It does so through a context-invariant semantic value, namely, the function, κ, that maps any possible world and property satisfied by some things in that world to the property of being identical with one of those things. Following Fine (2012), we'll introduce an operator $\ulcorner\Lambda x_i\urcorner$ that combines with open sentences to produce terms standing for properties; for example, '$\Lambda x(x$ is wise$)$' stands for the property of being wise. Then for any possible world w and property P:

$$\kappa(w)(P) = \Lambda x(x = a_1 \vee x = a_2 \vee \ldots \vee x = a_n)$$

where each a_i instantiates P in w.[16] Letting c be Game Show, κ – as the semantic value of 'RIG' – compositionally applies to w_c and the property of being your friend, yielding the following intermediate derivational stage:

(8)



Given our simplifying assumptions, S_1 designates the structured proposition that a thing identical with Xavier or Yvette will win, which contains the property of being identical with either Xavier or Yvette as a constituent. Since Betty stands

[16]The output of κ is analogous to what Lederman (2022) calls a "mere list." For simplicity, I'll ignore cases where the meaning of the noun is satisfied by an infinite number of things. Accommodating these cases requires redefining κ in terms of set theory or infinitary logic.

in the belief relation to this proposition in Game Show, the account correctly predicts the third reading of (2).

The rejection of Terminal Node Constituency is apparent, since the property of being your friend, κ, and w_c – the semantic values of the terminal nodes corresponding to 'friend-of-yours,' 'RIG,' and 'w_c' – cannot plausibly be taken to be constituents of the structured proposition designated by the subordinate clause, or the entire report, after the application of κ. These semantic values have been replaced in the compositional derivation with the property of being identical with Xavier or Yvette. This account entails, more generally, the following principle:

> **Rigidification**: If a transparent DP with NP-complement φ occurs in an attitude report true in context c and some things instantiate in w_c the property semantically expressed by φ in c, then the attributee of the report stands in the belief relation to a structured proposition that contains as a constituent the property of being identical with one of those things.

The system of Lederman (2022) adheres to Rigidification in its own terms.[17] But as Lederman himself points out, it isn't immediately obvious that the attributee of any third reading whatsoever stands in the belief relation to a proposition containing the required constituent:

> [O]ne might wonder whether in every case where such reports are available, the ascribee can be reasonably said to stand in the belief-relation to a relevant thought (*proposition*). In response to this concern, I note that a parallel assumption is also built into all competing treatments I am aware of. (1262, parenthetical mine)

Unfortunately for Lederman's account and the competing treatments he has in mind, the worry regarding Rigidification can be posed more forcefully in the form of a counterexample.

Consider, for example, the following context:

> BLINDFOLDS
> You're watching a live game show with Betty, who mistakenly thinks you have no friends. She also holds the superstitious belief that green eyes cause good luck. The three contestants are (i) Xavier, your friend with visible, green eyes, (ii) Yvette, your friend with blindfolded, green eyes, and (iii)

[17] Lederman (2022) characterizes it as follows:

> the proposal requires that, when a person's beliefs can truly be reported using a transparent attitude ascription, the person must stand in the belief-relation to a thought composed in part of a sense of a rigid property. For instance, I assumed that John stood in the belief-relation to a thought composed in part of the sense of the list "Ann, Bill, Carol and Dan". (1262)

> Zoe, a stranger with blindfolded, brown eyes. Seeing them, Betty remarks, "I don't know all of their eye colors, but I think a green-eyed contestant will win."

In this context, Betty knows that there's at least one green-eyed contestant, namely, Xavier, but she doesn't know who all the green-eyed contestants are due to their blindfolds. Still, she thinks that whoever the green-eyed contestants happen to be, one of them will win. As it turns out, your friends Xavier and Yvette are the green-eyed contestants. There's a reading of (2) that's true in Blindfolds, and it's a third reading for familiar reasons; Betty does not believe that you have any friends, much less some that will win, contra the narrow-scope interpretation, and no friend of yours is such that Betty stands in the belief relation to the singular proposition that (s)he will win, contra the wide-scope interpretation.

Theories committed to Rigidification predict this reading to be true in Blindfolds only if Betty stands in the belief relation to a proposition that contains the property of being Xavier or Yvette as a constituent, such as the proposition that a thing identical with Xavier or Yvette will win. The problem is that this is not plausible in this context, because Yvette and Zoe are indistinguishable contestants from Betty's point of view due to their blindfolds. There does not seem to be a principled reason for taking Betty to believe a proposition containing the property of being Xavier or Yvette instead of one containing the property of being Xavier or Zoe. A fortiori, there does not seem to be a principled reason for taking Betty to stand in the belief relation to the proposition that Xavier or Yvette will win instead of the proposition that Xavier or Zoe will win.[18] So, Rigidification theories prima facie predict incorrectly that there is no true reading of (2) in Blindfolds.

One might wonder whether a defender of Rigidification can respond by insisting that, appearances to the contrary notwithstanding, Betty does stand in the belief relation in Blindfolds to the proposition that Xavier or Yvette will win. While Betty might lack the disposition to assent to an utterance of the sentence, 'A person identical with *that contestant* or *that contestant* will win,' demonstrating Xavier and Yvette in succession, she might nevertheless reason after the blindfolds have been removed along these lines: "I didn't realize it at the time, but since I believed that a green-eyed contestant would win, and Xavier and Yvette were the green-eyed contestants, I did believe that one of them would win."

It's natural at this point to consider a further modification to the context, according to which Yvette and Zoe are placed behind curtains. This prevents Betty from entering into any relation of causal or epistemic acquaintance with Yvette, and as such renders it increasingly implausible that Betty stands in the belief relation to a proposition containing the property of being Xavier or Yvette as

[18] For ease of exposition, I will sometimes abbreviate ⌜the proposition that a thing identical with x or y will win⌝ as ⌜the proposition that x or y will win.⌝

a constituent. The requirement, however, that believers stand in any such relation of acquaintance to the constituents of their singular beliefs has been challenged, for instance by Hawthorne and Manley (2012). It would be ideal to resolve this counterexample without relying on controversial assumptions about the conditions of singular thought.

Here is a more theoretically neutral consideration. Insisting that in Blindfolds, Betty stands in the belief relation to the proposition that Xavier or Yvette will win is dialectically on a par with insisting that in Game Show, Betty stands in the belief relation to the proposition that a friend of yours will win. That is, one could just as easily insist that the interpretation of (2) with an opaque DP is true in Game Show, undermining the argument for there being a third reading in the first place. And if there is no third reading, then Rigidification is false. In neither context does Betty have the disposition to assent to the sentence expressing the belief in question, viz. 'A person identical with Xavier or Yvette will win' in Blindfolds and 'A friend of yours will win' in Game Show. Defenders of Rigidification who are willing to loosen the instantiation conditions of the belief relation in the former case but not the latter are guilty of special pleading unless they identify some relevant difference between the cases.

Here is a candidate for one such difference. To insist that in Game Show, Betty stands in the belief relation to the proposition that a friend of yours will win is to attribute inconsistent beliefs to her, because she also believes ex hypothesi that you have no friends. But one does not attribute inconsistent beliefs to Betty by insisting that in Blindfolds, she stands in the belief relation to the proposition that Xavier or Yvette will win.

This is a legitimate answer to the charge of special pleading, but the difference it relies on can be stipulated away. Consider an extended context, Blindsfolds$^+$, which is exactly the same as Blindfolds except for the following additions:

- Betty also believes you have no enemies.
- There is a fourth contestant, Zach, who has blindfolded, brown eyes.
- Zoe and Zach are your enemies.
- Betty also holds the superstitious belief that anyone born in March is lucky.
- Zoe and Zach are the only contestants born in March.
- Betty also utters, 'I'm not sure what their birthdays are, but I think someone born in March will win.'

Since Betty still stands in the belief relation to the proposition that a green-eyed contestant will win, the third reading of (2) remains true in the extended context. Our imagined defender of Rigidification will therefore continue to insist that Betty stands in the belief relation to the proposition that Xavier or Yvette will win. But now, since Betty also stands in the belief relation to the proposition that a contestant born in March will win, there is also a true third reading of the following report:

(9) Betty believes that an enemy of yours will win.

By parity of reasoning, the defender of Rigidification must insist that Betty also stands in the belief relation to the proposition that Zoe or Zach will win. This requires attributing inconsistent beliefs to Betty, namely, that a thing identical with Xavier or Yvette will win and that a thing identical with Zoe or Zach will win.[19] The argumentative burden falls back on defenders of Rigidification to identify a relevant difference between the cases in order to avoid the charge of special pleading. Until the charge can be answered satisfactorily, structured propositionalists would do well to consider alternative strategies.

5 A Russellian semantics for Equivalence

This section develops a stronger variable-based theory of intensionality under Russellian assumptions about the nature of structured propositions. To a first approximation, its motivating idea is that the third reading is true in Game Show because there is some way to replace the report's NP-complement ('friend of yours') with a co-extensional NP ('green-eyed contestant') that results in a report ('Betty believes that a green-eyed contestant will win') with a true, opaque interpretation. To state this more carefully, let NPs designate entities of semantic type τ, $[\![\cdot]\!]^c$ provide the compositional semantic values of expressions in c, and two entities of type τ be *extensionally equivalent* in possible world w just in case they are satisfied by exactly the same things in w. Then my account ultimately derives the following truth conditions:

> **Equivalence:** The third reading of $\ulcorner S$ believes that a ϕ Vs $\urcorner$ is true in c if and only if there is some P of type τ such that:
> (i) P is extensionally equivalent in w_c to $[\![\phi]\!]^c$, and
> (ii) $[\![S]\!]^c$ stands in the belief relation to the proposition designated by $\ulcorner$that a ϕ $Vs\urcorner$ in c under the assumption that $[\![\phi]\!]^c = P$.[20]

This is not a new idea. Fodor (1970) states that the unavailability of certain transparent interpretations is due to

> the absence of any appropriate identity statement that could serve as the basis for the speaker's substituting his own words for those of the person whose belief, want, etc., he is reporting. (288)

Inspired by Fodor, Schwager (2011) proposes a principle analogous to Equivalence, which Sudo (2014) extends to additional syntactic categories.[21]

[19] One can also assume that Betty believes that only one contestant will win, and that Xavier, Yvette, Zoe, and Zach are non-identical with each other. This renders the attributed beliefs logically inconsistent.

[20] I'm assuming that Vs does not contain any occurrence of ϕ. If it does, (ii) will need to be restricted so that only the occurrence of ϕ in $\ulcorner$a $\phi\urcorner$ is affected.

[21] Schwager (2011) presents "the Burj Dubai" case as evidence that the third reading is accessible in a context c in which the report's NP-complement has an empty extension,

While these accounts propose truth conditions for the third reading analogous to Equivalence, they do not compositionally derive them on the basis of a syntactic account, nor do they consistently deploy a semantic framework for Russellian, structured propositions.[22] As a result, they don't encounter the difficulty that Terminal Node Constituency poses for structured propositionalists pursuing a variable-based theory of intensionality. In contrast, I will compositionally derive structured propositions validating Equivalence on the basis of a syntactic account and while rejecting Terminal Node Constituency. The plan for this section is as follows. In §5.1, I introduce the basic semantic framework and show how it generates opaque DPs. In §5.2, I develop a Russellian variable-based theory of intensionality that explains the third reading of indefinites and the scope paradox. In §5.3, I offer a novel explanation of the inaccessibility of certain transparent interpretations of predicates through a syntactic system of feature checking, and I extend the account to embedded constructions.

5.1 The semantic framework

Structured propositionalists disagree about many aspects of their view, including the ontological category of propositions, their representational properties, and the means by which constituents are bound together into unified wholes. Abstracting away from these metaphysical distinctions, Russellian propositions can be represented as ordered n-tuples consisting of a property or relation R followed by $(n-1)$-many things, as in the following:

$$\langle R, x_1, x_2, \ldots, x_{n-1} \rangle$$

The proposition that John loves Mary, for example, can be represented by $\langle$LOVE, John, Mary$\rangle$. It contains the love relation, John, and Mary as constituents, arranged in such a way so as to be true just in case John and Mary instantiate (in that order) the loving relation. While this system of representation is arbitrary in many ways, the truth conditions for any structured proposition are determined by its constituents and their arrangement. A theory of propositional truth relative to possible worlds can be given as follows:

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thereby suggesting that the relevant entities of type τ must be extensionally equivalent not only in w_c but also in the possible world nearest to w_c in which they are both satisfied by at least one thing. What's more, as Schwager notes in Footnote 13, further complications arise when considering the possibility of different containment relations obtaining between the entities of type τ; this is why her more complicated principle ("Replacement Rule") features the subset relation instead of the identity relation. These insights can be incorporated into a suitably modified version of Equivalence but fall outside the scope of this work.

[22] The penultimate section of Schwager (2011) is self-reflectively titled, "What happened to syntax," and the truth conditions – see her (45) – deploy the structured semantics of Cresswell and von Stechow (1982) on one side of the biconditional but a possible world semantics on the other (in "condition c").

> **Propositional Truth:** For any possible world w, property or relation R, and things $x_1, x_2, \ldots x_n$, $\langle R, x_1, x_2, \ldots, x_n\rangle$ is true relative to w if and only if $x_1, x_2, \ldots, x_n$ instantiate R in that order in w.

In what follows, '$w \vDash \langle R, a_1, a_2, \ldots, a_n\rangle$' will mean that $\langle R, a_1, a_2, \ldots, a_n\rangle$ is true relative to w.

The primary role of a semantic theory, on this view, is to map sentence-context pairs to structured propositions, which have truth conditions in accordance with Propositional Truth. A sentence S is true in c relative to w just in case the correct semantic theory maps S and c to a structured proposition that is true relative to w. Such a mapping between sentence-context pairs and structured propositions must be determined compositionally in order to explain linguistic competence. To enable a variable-based theory of intensionality, it must also avoid the problem caused by Terminal Node Constituency by allowing subsentential expressions to make semantic contributions without corresponding to propositional constituents. Nearly any framework driven primarily by functional application meets these desiderata; compositionality is its raison d'être, and functions disappear from compositional derivations after applying to their arguments. As the previously considered implementation of Rigidification makes clear, functions can also operate on possible worlds and return arguments that do not themselves involve possible worlds in any way.

For this purpose, I will adopt the framework for Russellian, structured propositions developed by Pickel (2019), who builds, in turn, on Elbourne (2011). Consider the sentence 'John runs.' On this view, the semantic value of 'runs' maps the semantic value of 'John' via functional application to the structured proposition, $\langle$RUN, John$\rangle$. Since the semantic value of 'runs' is a function that is not a constituent of this proposition, this framework is inconsistent with Terminal Node Constituency. Before developing a variable-based theory under these assumptions, I will introduce the framework in more detail by deriving an opaque DP.

Only a standard type hierarchy with primitive types of e for individuals and t for structured propositions is required. Here are the semantic values for various lexical categories:

NPs
$[\![\textbf{\textit{Betty}}]\!]^c$ = Betty
$[\![\textbf{\textit{friend-of-yours}}]\!]^c = \lambda x\langle$FRIEND, $x\rangle$

VPs
$[\![\textbf{\textit{wins}}]\!]^c = \lambda x\langle$WIN, $x\rangle$
$[\![\textbf{\textit{believes}}]\!]^c = \lambda p_t \lambda x_e\langle$BEL, $x, p\rangle$

Determiner
$[\![\textbf{\textit{a}}]\!]^c = \lambda P_{et} \lambda Q_{et}\langle$SOME, $\lambda x\langle$CONJ, $P(x), Q(x)\rangle\rangle$

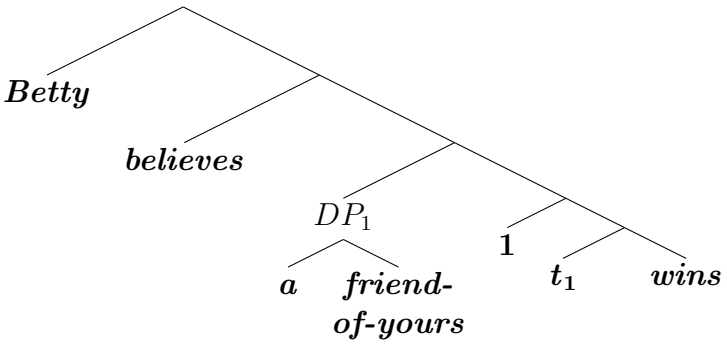
These lexical entries involve properties and relations defined in the following way, for any subject x, possible world w, propositional function g, and propositions p and q:

- x instantiates FRIEND (WIN) in w if and only if x is your friend (x wins the game) in w.
- x and p instantiate BEL in w if and only if x stands in the belief relation in w to p.
- g instantiates SOME in w if and only if for some y, $w \vDash g(y)$.
- p and q instantiate CONJ in w if and only if $w \vDash p$ and $w \vDash q$.

So far, this system is analogous to Pickel (2019), except that the instantiation relation has been relativized to possible worlds.

Now consider the opaque reading of (2), generated by a logical form after QR such as the following:

(10)



Over the course of syntactic movement, the numeral index is inserted in the customary way following Heim and Kratzer (1998). I depart from Pickel (2019) at this stage by adopting a generalized version of the canonical account of quantification, which will prove useful in the next subsection:

> VARIABLE PREDICATE ABSTRACTION
> Let α be a branching node with daughters β and γ, where β dominates only a numeral j co-indexed with a variable v of type ϕ. Then, for any context c, $[\![\alpha]\!]^c = \lambda v_\phi [\![\gamma]\!]^{c, g_c[v_j \mapsto v]}$.

Except in cases of Variable Predicate Abstraction, semantic composition proceeds by functional application:[23]

[23]If this raises concern about compositionality , see the recent iteration on the canonical account of quantification given by Glanzberg and King (2020), who refine and defend the appeal to semantic rules outside of functional application. The rule of Variable Predicate

Functional Application
If α is a branching node and $\{\beta, \gamma\}$ is the set of its daughters, then for any context c, α is in the domain of $[\![\cdot]\!]^c$ if both β and γ are, and $[\![\beta]\!]^c$ is a function whose domain contains $[\![\gamma]\!]^c$. In this case, $[\![\alpha]\!]^c = [\![\beta]\!]^c([\![\gamma]\!]^c)$.

The compositional derivation of (10) in c can start in the interior of the subordinate clause with an application of Variable Predicate Abstraction:[24]

$$[\![\text{ [} \mathbf{1} \text{ [} \boldsymbol{t_1} \textit{ wins} \text{]] }]\!]^c = \lambda x [\![\boldsymbol{t_1} \textit{ wins}]\!]^{c, g_c[t_1 \mapsto x]} = \lambda x \langle \textsc{win}, x \rangle$$

Through successive functional application, the semantic value of the determiner maps $\lambda x \langle \textsc{friend}, x \rangle$ and $\lambda x \langle \textsc{win}, x \rangle$ to the following structured proposition:

(11) $\langle \textsc{some}, \lambda x \langle \textsc{conj}, \lambda y \langle \textsc{friend}, y \rangle (x), \lambda y \langle \textsc{wins}, y \rangle (x) \rangle \rangle$

which by β-reduction is identical with the following:

(12) $\langle \textsc{some}, \lambda x \langle \textsc{conj}, \langle \textsc{friend}, x \rangle, \langle \textsc{wins}, x \rangle \rangle \rangle$

By Propositional Truth, (12) is true relative to possible world w just in case for some x, $\langle \textsc{friend}, x \rangle$ and $\langle \textsc{wins}, x \rangle$ are true in w, that is, just in case for some x, x instantiates FRIEND and WIN in w. It is the proposition, in other words, that some friend of yours wins. Through successive functional application, the semantic value of the attitude verb maps (12) and Betty to the semantic value of (10) in c:

(13) $\langle \textsc{bel}, \text{Betty}, \langle \textsc{some}, \lambda x \langle \textsc{conj}, \langle \textsc{friend}, x \rangle, \langle \textsc{wins}, x \rangle \rangle \rangle \rangle$

By Propositional Truth, this proposition is true relative to possible world w just in case Betty stands in the belief relation in w to (12).

Substituting 'friend-of-yours' in (10) with a co-extensional expression in context can change the truth-value of the report by changing the object of Betty's reported belief to a proposition with distinct constituents. The DP is therefore correctly predicted to be opaque with respect to the attitudinal operator. With the basic semantic framework behind us, we are now in a position to extend this fragment into a variable-based theory of intensionality that generates transparent DPs.

5.2 The third reading and scope paradox

Two more primitive semantic types are now required: s and F. Type s represents possible worlds in the familiar way; variables corresponding to type s

Abstraction can be seen as a version of their rule, "Variable IFA," that is modified to interpret numeral indices in the syntax.

[24] In this particular instance, QR and Variable Predicate Abstraction might seem superfluous because $[\![\text{ [} \mathbf{1} \text{ [} \boldsymbol{t_1} \textbf{ win} \text{]] }]\!]^c = [\![\textbf{wins}]\!]^c$, but movement by QR is still required for uncontroversially scopal ambiguities such as 'Everybody loves somebody.'

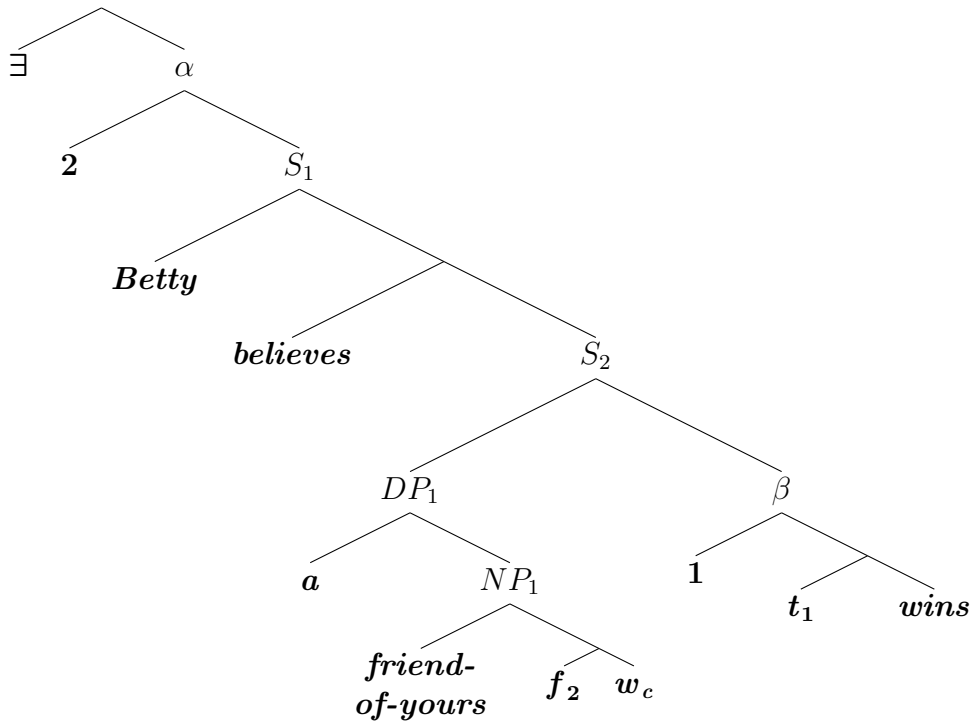
$(w_1, w_2, \ldots)$ range over the set of possible worlds, D_s. Type F represents what I call *equivalence functions*, which are intensional relations between co-extensional meanings of type et; a function f is an equivalence function just in case, for any possible world w and entity P of type et, f maps w and P to an entity Q of type et such that P and Q are, intuitively, satisfied by the same things in w. Variables corresponding to type F $(f_1, f_2, \ldots)$ range over the set of equivalence functions, D_F, defined as follows:

$$D_F = \{f \in (D_{et} \times D_{et})^{D_s} \mid \forall w_s \forall P_{et} \forall Q_{et}(f(w)(P) = Q \leftrightarrow \forall x_e(w \vDash P(x) \leftrightarrow w \vDash Q(x)))\}$$

I will assume that every context c comes equipped with its own world w_c and variable assignment function g_c defined on variables of types e, s, and F. Unbound possible world variables are interpreted by default as the world of the context of utterance.

The third reading of (2) in c results from a logical form such as the following, where various nodes have been labeled to ease the compositional derivation:

(14)



This logical form is similar to (7), except that 'RIG' has been replaced by an equivalence function variable existentially bound at the top of the matrix clause. The account bears a similarity to Reinhart (1997) and Winter (1997), who posit existentially quantified choice function variables to account for the exceptional

wide scope-taking of indefinites. The difference is that choice functions map meanings of type *et* to individuals, whereas equivalence functions map meanings of type *et* to other meanings of type *et*. Note that DP_1 has undergone movement by QR but remains clause-bound, respecting established island constraints on movement outside of finite clauses.[25]

The interpretation of the existential quantifier is provided by the following lexical entry:

Equivalence Function Quantifier
$[\![\exists]\!]^c = \lambda R_{<F,t>}\langle \textsc{some}, R\rangle$

The the compositional derivation of (14) in c can start with an application of Variable Predicate Abstraction for α:

$$[\![\alpha]\!]^c = \lambda f_F [\![S_1]\!]^{c,g_c[f_2 \mapsto f]}$$

To derive the interpretation of S_1 relative to c and $g_c[f_2 \mapsto f]$, begin with the corresponding interpretations of NP_1 after functional application:

$$[\![NP_1]\!]^{c,g_c[f_2 \mapsto f]} = f(w_c)(\lambda x\langle \textsc{friend}, x\rangle)$$

and β after Variable Predicate Abstraction:

$$[\![\beta]\!]^{c,g_c[f_2 \mapsto f]} = \lambda t\langle \textsc{win}, t\rangle$$

These are the inputs to the interpretation of the determiner, deriving S_2:

$$[\![S_2]\!]^{c,g_c[f_2 \mapsto f]} = \langle \textsc{some}, \lambda y\langle \textsc{conj}, [f(w_c)(\lambda x\langle \textsc{friend}, x\rangle)](y), \lambda t\langle \textsc{win}, t\rangle(y)\rangle\rangle$$

The interpretation of the attitude verb operates on this and Betty to derive the interpretation of S_1:

$$[\![S_1]\!]^{c,g_c[f_2 \mapsto f]} =$$
$$\langle \textsc{bel}, \text{Betty}, \langle \textsc{some}, \lambda y\langle \textsc{conj}, [f(w_c)(\lambda x\langle \textsc{friend}, x\rangle)](y), \langle \textsc{win}, y\rangle\rangle\rangle$$

The interpretation of α is therefore given by the following:

$$[\![\alpha]\!]^c = \lambda f_F\langle \textsc{bel}, \text{Betty}, \langle \textsc{some}, \lambda y\langle \textsc{conj}, [f(w_c)(\lambda x\langle \textsc{friend}, x\rangle)](y), \langle \textsc{win}, y\rangle\rangle\rangle$$

This is the input to the interpretation of the equivalence function quantifier, yielding the structured proposition designated by (14) in c:

15. $\langle \textsc{some}, \lambda f_F\langle \textsc{bel}, \text{Betty}, \langle \textsc{some}, \lambda y\langle \textsc{conj}, [f(w_c)(\lambda x\langle \textsc{friend}, x\rangle)](y), \langle \textsc{win}, y\rangle\rangle\rangle\rangle$

[25] See May (1977) and, more recently, Grano and Lasnik (2018).

This concludes the compositional derivation. Intuitively, (15) is true relative to the world of Game Show because, roughly, there is some equivalence function that maps the meaning of 'friend-of-yours' and the world of Game Show to the meaning of 'green-eyed contestant,' and under that mapping, the (false) proposition that Betty believes that a friend of yours will win becomes the (true) proposition that Betty believes that a green-eyed contestant will win.

More carefully, (15) has two constituents: SOME and a propositional function from equivalence functions to structured propositions. It is true relative to a world w' just in case this propositional function has a structured proposition in its range that is itself true relative to w'. Such is the case just in case there is some equivalence function that maps w_c and $\lambda x\langle \textsc{friend}, x\rangle$ to a predicate meaning, P_{et}, such that the following structured proposition is true relative to w':

15. $\langle \textsc{bel}, \text{Betty}, \langle \textsc{some}, \lambda y\langle \textsc{conj}, P(y), \langle \textsc{win}, y\rangle\rangle\rangle\rangle$

There is such an equivalence function in the context of Game Show; it maps $\lambda x\langle \textsc{friend}, x\rangle$ to $\lambda x\langle \textsc{green-eyed-contestant}, x\rangle$.[26] Since Betty does stand in the belief relation to the proposition that a green-eyed contestant will win, substituting $\lambda x\langle \textsc{friend}, x\rangle$ with $\lambda x\langle \textsc{green-eyed-contestant}, x\rangle$ results in the following true proposition:

16. $\langle \textsc{bel}, \text{Betty}, \langle \textsc{some}, \lambda y\langle \textsc{conj}, \langle \textsc{green-eyed-contestant}, y\rangle, \langle \textsc{win}, y\rangle\rangle\rangle\rangle$

So, the third reading is correctly predicted to be true in Game Show. More generally, the DP is correctly predicted to be transparent in this context because replacing 'friend of yours' with any co-extensional noun results in an existential generalization witnessed by some propositional function, namely, one that contains in its domain an equivalence function with $\lambda x\langle \textsc{green-eyed-contestant}, x\rangle$ in its range.

On this view, the third reading of (2) does not *specify* the object of Betty's belief in the sense that the 'that'-clause does not correspond to any node at LF that designates a proposition in context. Instead, the third reading requires Betty to stand in the belief relation to some proposition related by the substitution of co-extensional noun-meanings to the proposition reported by (2) under an opaque DP interpretation. Since the proposition satisfying this condition does not contain w_c as a constituent, counterfactual conditionals with third readings embedded in their consequents do not require subjects in merely possible worlds to have beliefs about the actual world.

This account derives other transparent interpretations of DPs in the same manner. Consider the scope paradox identified by Bäuerle (1983), for example, which can be illustrated by the following belief report provided by Keshet (2010):

[26] If one is worried about the conjunctive property GREEN-EYED-CONTESTANT, one can let P be the slightly more complex $\lambda x\langle \textsc{conj}, \langle \textsc{green-eyed}, x\rangle, \langle \textsc{contestant}, x\rangle\rangle$ instead.

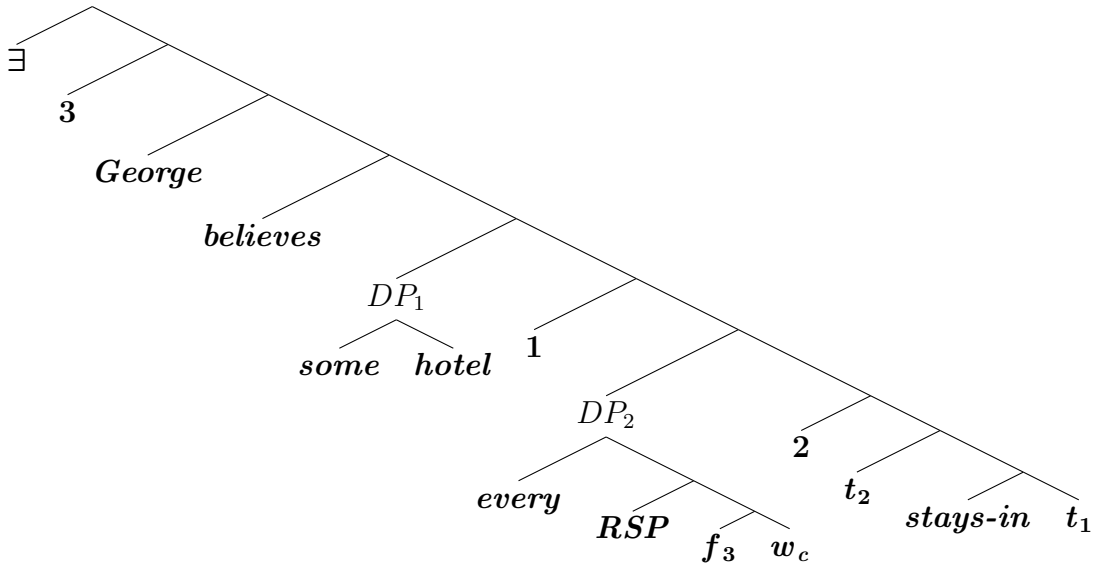
17. George thinks [every Red Sox player is staying in some five star hotel downtown].

This reports admits of a true reading in a context in which George mistakes the Red Sox players (RSP) for Yankee players and takes there to be one hotel in which they all stay. On this reading, 'every Red Sox player' is transparent,' 'some five star hotel downtown' is opaque, and the indefinite DP takes wide scope over the universal DP at LF. Traditional scope-based theories of intensionality therefore predict the following scopal relations at LF:

- 'every Red Sox player' > 'George thinks'
- 'George thinks' > 'some five star hotel downtown'
- 'some five star hotel downtown' > 'every Red Sox player'

But these relations are inconsistent, at least under the assumption of binary branching. The variable-based theory developed here generates the intended reading through a logical form such as the following:

(18)



The equivalence function machinery explains the transparency of 'every Red Sox player,' the lack of this machinery explains the opacity of 'some five star hotel downtown,' and clause-bound movement by QR explains the priority of the indefinite over the universal.

This account correctly predicts transparent interpretations of DPs when they are needed, from the third reading of indefinites to the scope paradox. One might reasonably worry, however, that it also incorrectly predicts transparency when it is not available. One might wonder, in addition, how the existential quantifier behaves in more complex constructions. I now turn to these considerations before concluding.

5.3 Overgeneralization and embedding

Returning to (14), consider the node immediately dominating the equivalence function and possible world variables: $[\boldsymbol{f}_2 \ \boldsymbol{w}_c]$. Because equivalence functions map possible worlds to relations between entities of type *et*, the interpretation of this node, without additional constraints, can interact compositionally with any entity of type *et*, including the meanings of verb phrases (VPs), via functional application. Consequently, this node could appear in problematic configurations—for instance, as a sister to the simple VP 'wins' or even the complex VP 'believes a friend of yours wins,' incorrectly predicting transparent interpretations for all verb phrases.

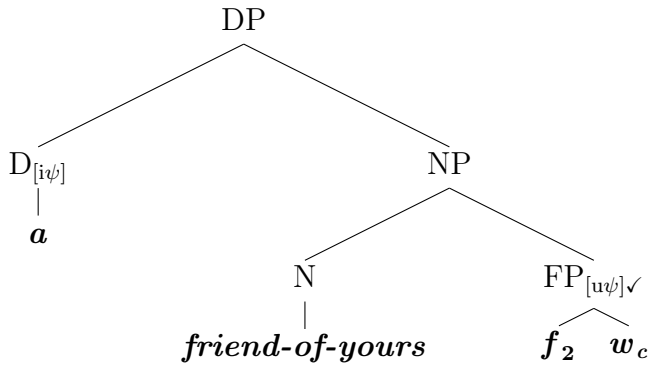
The threat of overgeneralization is not unique to my proposal. Percus (2000) addresses an analogous problem for the standard solution by proposing specific constraints on the binding of possible world variables, leading Schueler (2011) to develop a refined theory of binding and Schwarz (2012) to limit the syntactic locations of possible world variables. Schwager (2011), by contrast, insists on the accessibility of transparent interpretations for all predicate occurrences and gestures towards the need for a pragmatic explanation of their varying accessibility. The structured propositionalist could try to replicate any of these solutions to the problem of overgeneralization in their own terms. The account developed here is, as it stands, consistent with ad hoc binding constraints and pragmatic explanations of accessibility, but it would need substantial revisions to accommodate a refined theory of binding or a more restricted syntax for possible world variables. Since a full investigation into the viability of these options falls outside the scope of this work, I will propose an explanation in terms of a syntactic system of feature checking.

At the most basic level, feature checking posits that syntactic constituents carry interpretable and uninterpretable features. Uninterpretable features on a syntactic constituent must be checked off by a corresponding interpretable feature elsewhere in the syntax, otherwise the syntactic derivation of the sentence crashes. Early Minimalist frameworks, such as Chosmky (1993, 1995), imposed strict locality conditions on feature checking, typically characterized as Spec-head or head-head adjacency. Later developments, such as Chomsky (2000, 2001), relaxed these conditions, permitting feature checking across structural distances defined by c-command, provided locality conditions such as phases and intervention effects are respected.

Although standard Minimalist analyses typically assume downward probing, with higher uninterpretable probes searching for lower interpretable goals, my proposal adopts a reversed configuration in line with recent mechanisms, such as upward probing or Reverse Agree, explored in a growing literature exemplified by Neeleman and van de Koot (2002), Adger (2003), von Stechow (2003, 2004, 2005, 2009), Baker (2008), Haegeman and Lohndal (2010), Grønn and von Stechow (2011), Merchant (2011), Zeijlstra (2012), and Wurmbrand (2014). My proposal aligns broadly with these frameworks by suggesting that the

equivalence function variable engages in upwards feature checking with the determiner, as in the following logical form:

19.



The determiner, occupying a structurally higher position, carries an interpretable feature ([iψ]) that matches and checks an uninterpretable feature ([uψ]) on the phrase of the equivalence function. This mechanism constrains the syntactic distribution of the equivalence function phrase (FP), only permitting it to occur within a DP. The syntactic derivations of the worrisome cases of overgeneralization crash in the absence of feature checking.

I will now turn to the question of how the existential quantifier interacts with more complex constructions, such as sentential negation, doubly-embedded attitude reports, and counterfactual conditionals. For ease of exposition, I will adopt a loose system of abbreviation on which, for example, the logical form of the third reading of (2) in c, i.e. (14), can be abbreviated as follows:

20. $\exists f(\textit{Betty-believes:}\ \langle \textsc{some}, f(w_c)(\textsc{friend}), \textsc{wins}\rangle)$

Consider the following sentential negation and pair of abbreviated logical forms:

(21) It's not the case that Betty believes that a friend of yours will win.

(22) $\neg\exists f(\textit{Betty-believes:}\ \langle \textsc{some}, f(w)(\textsc{friend}), \textsc{wins}\rangle)$

(23) $\exists f\neg(\textit{Betty-believes:}\ \langle \textsc{some}, f(w)(\textsc{friend}), \textsc{wins}\rangle)$

While (22) provides an accessible reading of (21) as uttered by someone who disagrees with the third reading, (23) does not provide any accessible reading. Such a reading would be trivially true owing to the multitude of equivalence functions there are, the vast majority of which witness the existential quantifier in (23). This suggests that (sentential) logical operators cannot intervene between the existential quantifier and clause.

Now consider the following doubly-embedded attitude report and pair of abbreviated logical forms:[27]

[27]For ease of exposition, I only represent the propositional structure of the innermost subordinate clause in these abbreviated logical forms. In expanded logical forms, the complement of any propositional attitude verb syntactically reflects such structure.

(24) Serena thinks Betty believes a friend of yours will win.

(25) *Serena-thinks:* $\exists f$(*Betty-believes:* $\langle$SOME, $f(w_c)$(FRIEND), WINS$\rangle$)

(26) $\exists f$(*Serena-thinks:* (*Betty-believes:* $\langle$SOME, $f(w_c)$(FRIEND), WINS$\rangle$))

(25) provides an accessible reading of (24) as uttered by someone who takes Serena to agree with the third reading. Allow me a brief digression on this point. One might object to the plausibility of a subject's belief involving quantification over (propositional functions defined on) equivalence functions. The semantic framework itself, however, requires subjects to stand in the belief relation to structured propositions containing propositional functions defined on entities of type e. So, if propositional functions are objectionable constituents, the problem arises before the introduction of equivalence functions. Let's grant, then, that the account requires subjects' beliefs to be about (propositional functions defined on) equivalence functions in some sense. While semantic theories involve formal machinery unrecognizable by lay people, it's often possible to colloquially paraphrase the function of semantic machinery in a more accessible manner. Competent speakers of English might not be familiar with the mathematical representation of (propositional functions defined on) equivalence functions, for example, but they understand that there are ways of replacing one meaning for another in their interpretations of utterances.[28] Back to the main thread.

Does (26) provide an accessible interpretation in any context? Such a reading would be true in Game Show if Serena, who we may assume is ignorant of who your friends are, thinks that Betty stands in the belief relation to the proposition that a green-eyed contestant will win. I suspect there is such a reading corresponding to (26), although it is more difficult to access than (25). This can be explained by the increased distance between the quantifier and equivalence function variable. As long as the quantifier c-commands the equivalence function variable and a logical operator does not intervene, it can occur at the top of any clause.[29]

So far, I have only considered logical forms in which the possible world variable occurs unbound, allowing us to interpret it by default as the evaluation world of the context of utterance. The account must allow for this variable to be bound

[28]The objection is, of course, diffused by adopting an instrumentalist approach to semantic theorizing, but it seems to me that advocates of structured propositions should lean towards a form of scientific realism about semantics that vindicates both the existence of propositions and the relations subjects bear to them independently of our models. So, I prefer to meet the objection head-on.

[29]This includes the top of the matrix clause of a sentence with no propositional attitude verb, as in (i), and the top of the subordinate clause of an attitude report, as in (ii):

(i) $\exists f\langle$SOME, $f(w_c)$(FRIEND), WINS$\rangle$

(ii) *Betty-believes:* $\exists f\langle$SOME, $f(w_c)$(FRIEND), WINS$\rangle$

(i) redundantly generates transparency, and (ii) attributes belief in such redundantly transparent interpretations. I do not think that (ii) is any more problematic than (25). Finally, theories that posit existential quantification over choice functions admit of analogous cases.

from the outside in certain logical forms, however, in order to be interpreted as a merely possible (non-actual) world. This requires a treatment of modal operators as introducing quantifiers over possible worlds at LF. Consider, for example, the following counterfactual conditional (repeated from (6)):

(27) If you were friendless, Betty would (still) believe that a friend of yours would win.

Recall that there are two accessible readings of this sentence in Game Show. On the first, it is true because the NP-complement ('friend of yours') is evaluated relative to the world of Game Show. On the other, it is trivially false because the NP-complement is evaluated relative to the counterfactual scenario. The present account generates the true reading through an abbreviated logical form such as the following:

28. $[\forall w_1 : w_1 R_c w_c](w_1 \vDash [\![\textbf{you have no friends}]\!]^c \rightarrow$
$w_1 \vDash \langle \exists, \lambda f(\textit{Betty-believes:}\ \langle \textsc{some}, f(w_c)(\textsc{friend}), \textsc{wins}\rangle)\rangle$

where 'R_c' designates a contextually determined accessibility relation between worlds. The trivially false reading is generated by a logical form identical with (28), except the occurrence of 'w_c' adjacent to the equivalence function variable is replaced by an occurrence of 'w_1,' which is bound by the universal quantifier over possible worlds introduced by the modal operator. This account therefore extends to a variety of embedded constructions.

6 Concluding remarks

This section concludes the paper by highlighting the importance of a semantic, rather than pragmatic, account of the third reading. It is tempting to regard the complexity required by a semantic account of the third reading as providing evidence that the data would be more simply explained by a theory of pragmatics. Suppose, for example, one took inspiration from Blumberg and Lederman (2021) and proposed the following pragmatic principle:[30]

> **Revisionist Reporting:** An utterance of the form ⌜S believes that p⌝ is felicitous in context c just in case the referent of S in c stands in the belief relation to some proposition, Q, such that Q non-trivially entails the proposition designated by ⌜that p⌝ in c under shared conversational background assumptions.

This principle would seem to explain the felicity of uttering (2) in Game Show. Betty stands in the belief relation to the proposition that a green-eyed contestant will win, and under a shared background assumption, viz. that the green-eyed

[30] Blumberg and Lederman present their solution as a semantics for revisionist reporting but recognize in §3.1 that a pragmatic solution could be offered in a similar vein.

contestants are your friends, this proposition non-trivially entails that a friend of yours will win. If this explanation were correct, then the third reading of indefinites would be the result of a pragmatic process operating on reports with opaque DPs.

We should be wary of such pragmatic explanations, however, because there are true third readings of reports that would, if interpreted with opaque DPs, ascribe beliefs in necessarily false propositions. Consider, for example, the third reading of a report such as the following, under the assumption that your sworn enemy is not your friend:

29. Betty believes that a friend of yours is your sworn enemy.

Revisionist Reporting predicts that this report is felicitous in context just in case Betty stands in the belief relation to some proposition that non-trivially entails the proposition that a friend of yours is your sworn enemy. But no proposition non-trivially entails a necessarily false proposition. So, the pragmatic proposal cannot account for true third readings of reports such as (29). Indeed, it is difficult to imagine how any pragmatic account could provide an explanation of third readings that satisfactorily generalizes to this example. If there is such an account, it has yet to be provided. This consideration underscores the importance of developing a proper semantic account of the third reading and helps to justify the complexity required to do so through a variable-based theory of intensionality.

The Hintikkan framework of possible world semantics arguably remains the predominant approach to the semantics of propositional attitude verbs for practicing linguists, and it continues to exert considerable influence on contemporary philosophers of language and mind. For those who view structured propositions as preferable to unstructured sets of possible worlds, establishing a theory that handles intensional phenomena as effectively as possible worlds semantics is essential. Two decades after Percus (2000) presented the standard solution, Lederman (2022) provided structured propositionalists with the first detailed account of the third reading under the assumptions of Fregeanism and Rigidification. The present work has added to this momentum by deriving Equivalence under Russellian assumptions. Future work may vindicate the idea that Fregeans can do the same in their own terms. Structured propositionalists, more generally, still have a considerable amount of ground to cover in their war against the Hintikkan.[31] This war, like any other, will be won (or lost) one battle at a time.[32]

[31]Advances made under possible world semantics with no analogous development by structured propositionalists include Percus and Sauerland (2003) and Charlow and Sharvit (2014) on concept generators and the bound de re, Keshet (2011) on split intensionality, Schueler (2011) and Schwarz (2012) on refinements to the standard solution, Ninan (2012) on counterfactual attitude reports, and Stojnić (2019) on the role of propositions in epistemic modals.

[32]Thanks to [redacted].

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