Believe it or not: Perspectival replacement

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July 10, 2024
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1 Introduction

- In this talk I will consider a phenomenon recently addressed by Mayr and Schmitt (2024) at SALT.
- The phenomenon concerns non-de-dicto construals, e.g. de re construals, and how to treat them compositionally.
- A major contribution of Mayr and Schmitt (2024) is that they develop a uniform analysis of non-de-dicto construals based on the mechanism of *replacement* relative to a *question under discussion* (QUD; Carlson 1983, Grosz and Sidner 1986, Grosz et al. 1995, Roberts 1996, 2012a,b).

2 Background: Data

2.1 Mayr & Schmitt's key data

Context

- Joe and Bill went to a party. Ann and Eve were among the guests.
  - Bill knows both Ann and Eve well. He didn't see them together at the party. Still, he is convinced Eve and Ann are a couple.
  - Joe recognizes Eve, but does not recognize Ann. He saw them dancing with each other and thinks Eve and the person he saw her dancing with are lovers.

(1) Bill thinks/believes that Eve loves Ann. ✓*de dicto*

(2) Joe thinks/believes that Eve loves Ann. ✓*de re*

(3) Joe thinks/believes that Ann was at the party. ~~*de re*~~

(4) Only Bill thinks/believes that Eve loves Ann. $\bot$

(5) Only Joe thinks/believes that Eve loves Ann. $\bot$

(6) Exactly one guest thinks/believes that Eve loves Ann. $\bot$

(7) Two guests think/believe that Eve loves Ann. $\top$

Context

- Joe and Bill went to a party.
  - Bill has no idea if there were any linguists at the party, but Bill is convinced that Eve is in a relationship with a linguist.
  - Joe thought all guests were biologists. Except for three linguists called Ann, Bea, and Cate, this was the case. Joe doesn't know them or their names. He saw each of them dancing with Eve, who he knows. So he thinks Eve and one of them are lovers but is not sure which of them it is.
- There was discussion about Eve's relationship status. No other guest has an opinion about it.

(8) Bill thinks/believes that Eve loves a linguist. ✓*narrow-scope opaque/'de dicto'*

(9) Joe thinks/believes that Eve loves a linguist. ✓*narrow-scope transparent/'non-de dicto'*

(10) Joe thinks/believes that a linguist was at the party. ~~*narrow-scope transparent/'non-de dicto'*~~

(11) Only Bill thinks/believes that Eve loves a linguist. $\bot$

(12) Only Joe thinks/believes that Eve loves a linguist. $\bot$

(13) Exactly one guest thinks/believes that Eve loves a linguist. $\bot$

(14) Two guests think/believe that Eve loves a linguist. $\top$

2.2 Asudeh & Giorgolo's key data

(15) Hesperus is Phosphorus.

a. Kim believes that Hesperus is a planet. $\Diamond\top$ even if (15b) is $\bot$

b. Kim believes that Phosphorus is a planet. $\Diamond\top$ even if (15a) is $\bot$

(16) Kim doesn't believe that Hesperus is Phosphorus. *consistent/informative*

(17) a. Clark Kent went into the phone booth, and Superman came out. (Saul 1997: 102)

b. Clark Kent went into the phone booth, and Clark Kent came out. (Saul 1997: 102)

(18) a. #Bill shares a birthday with Spider-Man, but he doesn't share a birthday with Peter Parker. *contradiction*

b. #Doctor Octopus punched Spider-Man but he didn't punch Peter Parker. *contradiction*

c. #Doctor Octopus killed Spider-Man but he didn't kill Peter Parker. *contradiction*

d. Doctor Octopus murdered Spider-Man but he didn't murder Peter Parker. *consistent/informative*

(19) Mary Jane loves Peter Parker, but she doesn't love Spider-Man. *consistent/informative*

(20) Sandy is Sandy.

Context

- Kim suffers from Capgras Syndrome,[1] also known as the Capgras Delusion, a condition "in which a person holds a delusion that a friend, spouse, parent, or other close family member has been replaced by an identical-looking impostor."

(21) Kim doesn't believe Sandy is Sandy. *consistent/informative*

Context

- In 1897, Dr Edwin J. Goodwin presented a bill to the Indiana General Assembly for "[] introducing a new mathematical truth and offered as a contribution to education to be used only by the State of Indiana free of cost." He had copyrighted that $\pi = 3.2$ and offered this "new mathematical truth for free use to the State of Indiana" (but others would have to pay to use it).[2]

(22) Dr Goodwin doesn't believe that π is π. *consistent/informative*

Context

- Elena knows that seals are marine mammals. She doesn't know that dolphins are mammals, but knows that they are marine creatures. The speaker knows that both seals and dolphins are marine mammals. Flipper is a dolphin. Hoover is a seal.

(23) Elena loves dolphins, but she doesn't love marine mammals.
consistent/informative from Elena's perspective
contradiction from speaker's perspective

(24) Elena doesn't love any marine mammals, but she loves Flipper.
consistent/informative from Elena's perspective
contradiction from speaker's perspective

(25) Elena doesn't love any marine mammals, but she loves Hoover.
contradiction from Elena's perspective
contradiction from speaker's perspective

[1] https://en.wikipedia.org/wiki/Capgras_delusion
[2] https://en.wikipedia.org/wiki/Indiana_pi_bill

	Non-embedded ('simple')	Embedded
Same term	#Dr. Octopus punched Spider-Man but he didn't punch Spider-Man.	Kim doesn't believe Sandy is Sandy.
Distinct term	Mary Jane loves Peter Parker but she doesn't love Spider-Man. #Dr. Octopus killed Spider-Man but he didn't kill Peter Parker.	Kim doesn't believe Hesperus is Phosphorus.

Table 1: Same/distinct term × non-embedded/embedded (Asudeh and Giorgolo 2020: 70)

3 The LF enrichment approach to non-de-dicto construals

- Mayr and Schmitt (2024) present their analysis in the framework of Logical Form semantics.
  - This is not meant as a criticism: after all, LF semantics is currently the *lingua franca* of formal semantics.
- The key generalization that Mayr and Schmitt (2024) propose, which seems promising to me, is presented independently of the formalization, though.

(26) **QUD constraint** (Mayr and Schmitt 2024)
The proposition resulting from replacement must resolve the salient QUD (partition of logical space W [the set of worlds]) in the same way as the proposition without replacement (i.e., there is a partition cell that both entail).
  - Answer options to QUD must be relativized to what is available in the context (= common ground or intensional state introduced by higher operator).
  - Answers must be informative (i.e., add new information)

- Mayr and Schmitt (2024) also propose the following generalization, after considering some analytical alternatives (also in light of further data, which I've set aside to keep things relatively manageable):

(27) **Generalized non-de-dicto account** (Mayr and Schmitt 2024)
  - NDD construals are a by-product of compositional interpretation.
  - Special grammatical devices are not implicated in their generation.

- While these strike me more as desiderata than a generalization, they seem like eminently reasonable desiderata to me.
- Mayr & Schmitt's particular analytical proposal is that:
  - All expressions are assigned an ordinary, $[\![\ ]\!]^o$, and an alternative 'transparency' value, $[\![\ ]\!]^t$.
  - The interpretation function $\mathcal{F}$ maps expressions to pairs of the two values.
    - $\mathcal{F}$ is relativized to an assignment g, a context c, and the salient question under discussion Q.
  - t-value for terminals are determined relative to o-value by a context-sensitive 'salient-replacement-for' relation, $\sim_c$.

(28) $\mathcal{F}^{g,c,Q}(Ann) = \langle [\![Ann]\!]^o, [\![Ann]\!]^t \rangle = \langle \lambda w.\text{Ann}, f : f \sim_c \lambda w.\text{Ann} \rangle$
(Mayr and Schmitt 2024: (48))

(29) a. $[\![Ann]\!]^o = \lambda w.\text{Ann}$ (Mayr and Schmitt 2024: (49a))
b. $[\![Ann]\!]^t = \{\lambda w.\text{Ann}, \lambda w.\text{the person Eve danced with in } w, \ldots\}$ (Mayr and Schmitt 2024: (49a))

- In sum, the Mayr & Schmitt proposal is that LF be augmented such that every node has an *ordinary* value and a *transparency* value.
  - This considerably enriches LF.
  - This is not problematic in and of itself, but there have been many such enrichments proposed for LF semantics over the years.
  - While I'm unaware of any attempt to do this systematically, taking all these enrichments on board at once would create a highly complex (and probably somewhat unpredictable) system.
- **Question:** Can we capture Mayr & Schmitt's insights without this kind of enrichment?

4 The monadic approach to perspectives

- As observed in §2. Asudeh and Giorgolo (2016, 2020) consider failure of substitution in a variety of embeddings under *believe*.
- We developed a compositional semantics based on a *monad* that maps certain lexical functions to an enriched monadic space, while allowing other lexical items to contribute standard, non-monadic meanings.
- We contrasted the approach with an LF-enrichment alternative.
- Here I will first present the LF alternative (§4.1), which might be particularly useful to prime the audience's intuitions of how the system works.
  - Next, I present how the Asudeh & Giorgolo approach fairs with the perspectival data it was designed for (§4.2), again to give a sense of the system's workings.
  - In §5, I subsequently present a sketch of how a similar system might account for the Mayr & Schmitt facts without LF enrichment.

4.1 An LF enrichment alternative

- In order to capture perspectival reference, we need to introduce indices for perspectives (*perspectival indices*).
  - In other words, an expression α would minimally need to bear both an assignment function (as is standard) and a perspective index.
- We also need to revise the functional application and abstraction rules (e.g., Heim and Kratzer 1998: 105) such that they take perspective indices into account.
  - Our particular approach is highly lexicalist, such that changes in perspective are determined by the lexicon.
  - Therefore, the perspective indices should simply be left untouched by the revised rules.

(30) **Revised Application Rule**
Let α be a branching node with daughters β and γ. Then for any assignment function g and perspective index i, $[\![\alpha]\!]^{g,i} = [\![\beta]\!]^{g,i}([\![\gamma]\!]^{g,i})$ or $[\![\alpha]\!]^{g,i} = [\![\gamma]\!]^{g,i}([\![\beta]\!]^{g,i})$, as determined by the semantic types of β and γ. (Asudeh and Giorgolo 2020: 71)

(31) **Revised Predicate Abstraction Rule**
Let α be a branching node with daughters β and γ, where β dominates only a numerical index j. Then, for any variable assignment g and perspective index i, $[\![\alpha]\!]^{g,i} = \lambda x. [\![\gamma]\!]^{g^{x/j},i}$, where $g^{x/j}$ is the same assignment function as g except that it maps x to j. (Asudeh and Giorgolo 2020: 71)

- In the resulting system, all expressions are interpreted with respect to a perspective index, but the indices are not always used for determining the denotation of an expression.

- For a non-controversial name, like *Mary Jane* or *Peter Parker*, we thus obtain:

(32) $[\![\textit{Mary Jane}]\!]^{g,i} = mj_\sigma$

(33) $[\![\textit{Peter Parker}]\!]^{g,i} = pp_\sigma$

- The subscripted σ is the speaker index.
  - A denotation such as mj_σ is the constant mj relativized to the speaker's perspective index.
  - There is no other perspective index in play, since we are considering the case where the speaker understands the name to be non-controversial.
- In contrast, for a controversial name (i.e., one whose interpretation is contentious between different speakers), the final denotation is based on the perspective index passed to the interpretation step.
  - So a name like *Spider-Man* will have a denotation that depends on the perspective index.
- For a speaker who is aware of Spider-Man's secret identity, the denotation of *Spider-Man* is the same as that of *Peter Parker*.
- For Mary-Jane, at the point before she knows that Peter is Spider-Man, *Spider-Man* denotes a different entity.

(34) $$[\![\textit{Spider-Man}]\!]^{g,i} = \begin{cases} pp_\sigma & \text{if } i = \sigma \\ sm_{\texttt{mj}} & \text{if } i = \texttt{mj} \\ \vdots & \vdots \end{cases}$$

- The denotation for the perspectival verb *love* requires a direct manipulation of the perspective indices which are part of the interpretational meta-language.
  - In particular, we want to be able to force the perspective index of the expression in the object position to be the perspective of (the denotation of) the subject of the verb.
  - Given that we can manipulate the perspective indices only at the level of the meta-language, the denotation for *love* needs to include as an argument the expression in the object position, rather than the denotation of the object itself (κ is a function that maps entities to perspective indices).

    (35) $[\![\textit{loves DP}]\!]^{g,i} = \lambda s.love([\![\textit{DP}]\!]^{g,\kappa(s)})(s)$

- In contrast, for the non-perspectival verb *punch*, which does not involve a potential switch in perspective, we provide a denotation that operates entirely at the level of the meaning language:

(36) $[\![\textit{punch}]\!]^{g,i} = \lambda o.\lambda s.punch(o)(s)$

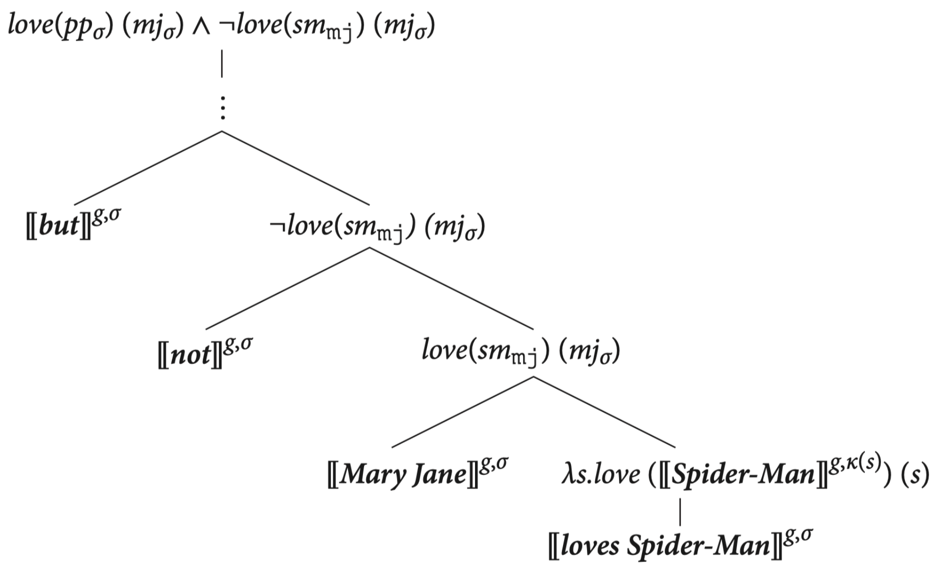
- Equipped with this mini lexicon, we can sketch a preliminary analysis of an example like the following from above:

(37) Mary Jane loves Peter Parker, but she doesn't love Spider-Man.

- Let's assume that the speaker is aware of Spider-Man's secret identity (Peter Parker), but Mary Jane is not.
  - There are two relevant readings of this example.
    1. There is a consistent reading, in which the controversial term *Spider-Man* is interpreted from Mary Jane's perspective index, while the uncontroversial term *Peter Parker* is interpreted from the speaker's index (which maps to the same thing as Mary Jane's perspective index, since the name is uncontroversial).
    2. There is also a contradictory reading, in which both *Spider-Man* and *Peter Parker* are interpreted from the enlightened speaker's perspective.
  - The two readings correspond to two different scopal relationships between the object term and the perspectival verb *loves*.

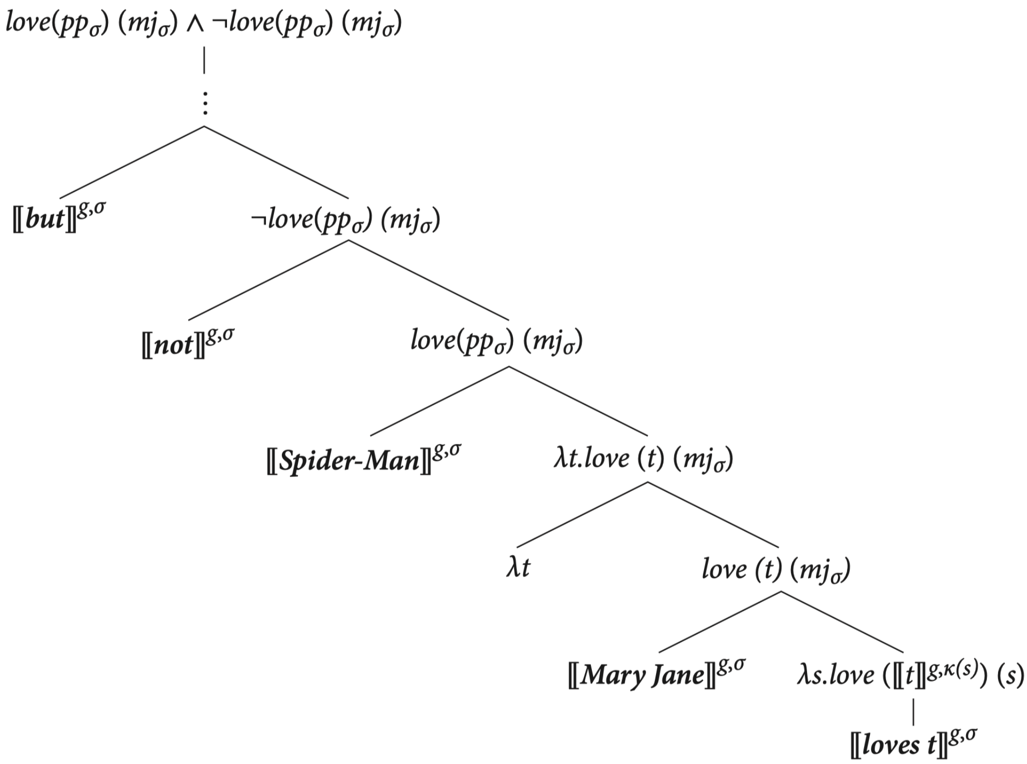
- Given the application and abstraction rules in (30) and (31) above, the consistent reading gets the LF in (38), where *Spider-Man* is evaluated in the scope of the verb *loves* and therefore is interpreted from the perspective of Mary Jane.

(38)



- The contradictory reading gets the LF in (39), where *Spider-Man* is instead interpreted from the perspective of the speaker, who, according to our assumptions, knows Spider-Man's secret identity.

(39)



4.1.1 Evaluation of the LF approach

- The LF approach just sketched seems adequate to capturing the phenomenon, but it suffers from a number of theoretical and conceptual flaws.

  1. In the LF approach, the lexicon must be generalized to the worst case: everything must be festooned with indices, but they are only sometimes utilized.
     - In contrast, the monadic approach only treats relevant items as perspectival and does not generalize to the worst case.
     - The process is entirely governed by the compositional logic, instead of being a generalized lifting of the lexicon.
  2. The LF approach required complicating the rules for application (and abstraction).
     - In contrast, the monadic approach introduces perspective indices in the derivation and their propagation is controlled by the specific part of the logic that deals with monads, together with specific lexical specifications, such as the ones for verbs like *love* or *believe*.
  3. The LF approach requires syncategorematicity, since perspectival verbs need to interpret their objects relative to their subject's perspective index (at least on one reading). "Syncategorematic" is another way of saying "not fully compositional."
     - In contrast, the monadic approach allows us to treat the relevant expressions categorematically, i.e. fully compositionally.
     - The LF approach could deal with things categorematically, in principle, but this would require lifting everything in the lexicon to be functions from perspectives to extensions.
       - In other words, there is a tension between categorematicity of perspectival expressions and lexical parsimony.
  4. The monadic approach is much more *general*: we can reuse the same compositional mechanism to account for a variety of semantic phenomena (Asudeh and Giorgolo 2020).

- In other words, the monadic approach makes more evident a general pattern of enhanced composition that is otherwise hard-wired in the LF system by generalized type lifts and alternative composition rules.

4.2 A monad for perspectives

4.2.1 What is a monad?

- Monads are a concept from category theory (among others, Awodey 2010), so before answering this question, let's consider the notion of a category.

- Categories, like sets, are useful in mathematics, because they can be used as a general framework to study mathematical structures (Awodey 2010).

- **Intuition:** The basic concept of category theory is functions and compositions of functions. The collections that these functions map between are then the derived concepts.
  - **Contrast:** In set theory, the basic concept is the collection (of elements). Relations and functions are then defined in terms of these collections.
  - Another way of getting at the intuition is demonstrated by this simple diagram:

    (40) $A \to B$

    - In set theory, where A and B are sets, the emphasis is on the nature of A and B.
    - In category theory, where A and B are categories, the emphasis is on the nature of the arrow.

- **Intuition:** A category is a way to describe a complex ensemble of objects in terms of how these objects interact.

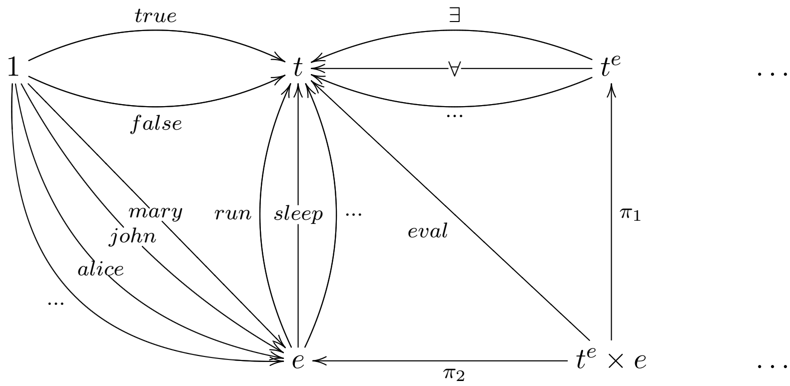


Figure 1: A (very small) portion of the category of linguistic meanings (Asudeh and Giorgolo 2020: 24)

- A small fragment of the category of linguistic meanings is shown in Figure 1.
- The arrows in category theory are functors.
  - **Endofunctor:** A functor that maps between the same category.
- A monad is an endofunctor that is equipped with two natural transformations that encode the notions of *embedding* and *joining/composing/combining* (Kuhnle 2013, Asudeh and Giorgolo 2020).
- We can define a monad as follows (Asudeh and Giorgolo 2020: 31): a monad for a category **C** is a triple $\langle M, \eta, \star \rangle$, where M is an endofunctor of **C** and η is the unit for the endofunctor.
  - **Intuition:** The unit for an operation returns the other argument unmodified.
    - The unit for $+$ is 0.
    - The unit for $\times$ is 1.
- $\star$ is the *bind* operation: it takes an arrow $A \to M(B)$ and maps it to an arrow $M(A) \to M(B)$.
- A monad $\langle M, \eta, \star \rangle$ requires η and $\star$ to satisfy the following three laws:

$$m \star \eta = m \quad (41)$$
$$\eta(x) \star f = f(x) \quad (42)$$
$$(m \star f) \star g = m \star (\lambda x. f(x) \star g) \quad (43)$$

  - The first two laws say that η behaves as a kind of unit if we consider $\star$ to be multiplication-like.
  - The last law requires that $\star$ be associative.

4.2.2 Applying the idea to perspectives

- In our formalization (Asudeh and Giorgolo 2020: 75ff.), we represent the functor M as $\Diamond$.
  - **Intuition:** $\Diamond$ maps each linguistic type to a new type that corresponds to the original type with an added perspective index parameter.
    - It is a sort of type constructor: it takes a type as input and returns a different type as output.
- Strictly speaking, though, we are not introducing a new base type.
  - $\Diamond$ has two components, since it must deal with its input type and the associated arrow
    1. $\Diamond$ maps any type τ to $i \to \tau$, where i is a perspective index.
    2. $\Diamond$ maps any function $f : \tau \to \delta$ to a function $f' : (i \to \tau) \to i \to \delta$.
    3. This basically corresponds to function composition:

$$\Diamond(f) = \lambda g.\lambda i.f(g(i)) \quad (44)$$

- The unit for the perspective monad, η, just adds a vacuous parameter to the unit's argument, meaning that the value will not be dependent on the argument:

$$\eta(x) = \lambda i.x \quad (45)$$

- The *bind* of the monad, $\star$, is defined as follows:

$$a \star f = \lambda i.f(a(i))(i) \quad (46)$$

  - $\star$ takes care of passing the outer argument to the monadic computations that are combined with it.
    - The definition for bind is similar to the *Revised Application Rule* given in (30) in §4.1.
    - A crucial difference is that now the interpretation indices are part of the language used to represent meanings, whereas in §4.1 they were part of the meta-language used to interpret the expressions.
- In order to keep things manageable (too late?), I won't show any further details of the compositional system or the proofs of the relevant readings; see Asudeh and Giorgolo (2020: 76–87) for further details.

WORD	DENOTATION	TYPE
Kim	k_σ	e
Dr. Octopus	o_σ	e
Mary Jane	mj_σ	e
Peter Parker	pp_σ	e
not	$\lambda p.\neg p$	$t \to t$
but	$\lambda p.\lambda q.p \wedge q$	$t \to t \to t$
is	$\lambda x.\lambda y.x = y$	$e \to e \to t$
punch	$\lambda o.\lambda s.punch(o)(s)$	$e \to e \to t$

WORD	DENOTATION	TYPE
love	$\lambda o.\lambda s.love(o(\kappa(s)))(s)$	$\Diamond e \to e \to t$
believe	$\lambda c.\lambda s.B(c(\kappa(s)))(s)$	$\Diamond t \to e \to t$
Hesperus	$\lambda i.\begin{cases} es_{\mathtt{k}} & \text{if } i = \mathtt{k} \\ v_\sigma & \text{if } i = \sigma \\ \ldots \end{cases}$	$\Diamond e$
Phosphorus	$\lambda i.\begin{cases} ms_{\mathtt{k}} & \text{if } i = \mathtt{k} \\ v_\sigma & \text{if } i = \sigma \\ \ldots \end{cases}$	$\Diamond e$
Spider-Man	$\lambda i.\begin{cases} sm_{\mathtt{o}} & \text{if } i = \mathtt{o} \\ sm_{\mathtt{mj}} & \text{if } i = \mathtt{mj} \\ pp_\sigma & \text{if } i = \sigma \\ \ldots \end{cases}$	$\Diamond e$
Sandy	$\lambda i.\begin{cases} impostor_{\mathtt{k}} & \text{if } i = \mathtt{k} \\ s_\sigma & \text{if } i = \sigma \\ \ldots \end{cases}$	$\Diamond e$

Table 2: Speaker's lexicon[3]

- The final ingredient of the analysis is the lexicon, a fragment of which is shown in Table 2.
  - Notice that the perspectival lexical items are monadic or take a monadic argument: their types include a $\Diamond$ type.
  - Notice also that the logical vocabulary (*not*, *but*, *is*) just has simple/non-perspectival types, since we assume that logical vocabulary should not be perspectival (cf. their non-intensional nature).
- The system derives the following readings for a representative sample of the data in §2.2:

(47) Mary Jane loves Peter Parker but she doesn't love Spider-Man.

1. $love(pp_\sigma)(mj_\sigma) \wedge \neg love(sm_{\mathtt{mj}})(mj_\sigma)$ *consistent/informative*
2. $love(pp_\sigma)(mj_\sigma) \wedge \neg love(pp_\sigma)(mj_\sigma)$ *contradiction*

(48) #Doctor Octopus punched Spider-Man but he didn't punch Spider-Man.

1. $punch(pp_\sigma)(o_\sigma) \wedge \neg punch(pp_\sigma)(o_\sigma)$ *contradiction*

(49) Kim doesn't believe Hesperus is Phosphorus.

1. $\neg B(es_{\mathtt{k}} = ms_{\mathtt{k}})(k_\sigma)$ *consistent/informative*
2. $\neg B(v_\sigma = ms_{\mathtt{k}})(k_\sigma)$ *consistent/informative*
3. $\neg B(es_{\mathtt{k}} = v_\sigma)(k_\sigma)$ *consistent/informative*
4. $\neg B(v_\sigma = v_\sigma)(k_\sigma)$ *contradiction*

(50) Kim doesn't believe Sandy is Sandy.

1. $\neg B(s_\sigma = impostor_{\mathtt{k}})(k_\sigma)$ *consistent/informative*
2. $\neg B(s_\sigma = impostor_\sigma)(k_\sigma)$ *contradiction*

[3] κ is a function that maps entities to perspective indices.

5 A monad for non-de-dicto construals?

- I now present an informal sketch of how a monadic system might account for the Mayr & Schmitt facts without LF enrichment.

- A monadic alternative for the Mayr & Schmitt phenomena suggests itself based on our work on conventional implicature in a monadic setting (Giorgolo and Asudeh 2012, Asudeh and Giorgolo 2020).

  - Without getting into the details, a proposition is mapped by a monad to a pair, where the first member of the pair is its at-issue meaning and the second member is a set containing the conventional implicature(s).
  - Importantly, the set of conventional implicatures in the pair is propagated forwards/upwards in the derivation, thus capturing their projective behaviour (Potts 2005).

- Similarly, we can define a monad, $\langle \overset{\blacktriangle}{\triangledown}, \eta, \star \rangle$, such that $\overset{\blacktriangle}{\triangledown}$ is a functor that maps ordinary meanings (Mayr & Schmitt's $[\![\ ]\!]^{o}$) to their transparent values (Mayr & Schmitt's $[\![\ ]\!]^{t}$).

  - The postulated monad, $\overset{\blacktriangle}{\triangledown}$, is also similar to the perspective monad, $\Diamond$, except it does not deal with mapping from ordinary values to perspectival values, but rather with mapping ordinary values to transparent values.[4]
  - Thus, the LF can be stated in terms of the ordinary values and the transparent values computed 'on the fly,' if and when required.
  - I believe this captures the heart of the Mayr & Schmitt proposal without LF enrichment.
  - It is not entirely clear to me if and how transparent values should propagate, but that can also be handled, based on our analysis of conventional implicature.

- The QUD and QUD-update can itself be modelled monadically, too.

  - Let us treat the common ground C not as a *set* of propositions but as a *pointed set*.
  - A pointed set is some set A paired with a distinguished member of A: $\langle A, a \in A \rangle$.
  - There is a category of pointed sets (Awodey 2010).
  - If the common ground is a pointed set, then its point (distinguished member) is the QUD.
  - QUD-update can then be modelled as a functor that maps one common ground pointed set to another, with a new distinguished point, the new QUD.

6 Conclusion

- Mayr & Schmitt recently presented an analysis of non-de-dicto construals that shows a lot of promise and captures an important generalization (the QUD constraint in (26) above).

- A possible downside of their proposal is that it enriches LF, complicating the system and arguably generalizing to the worst case, since everything is assigned both an ordinary and transparent value.

- The monadic alternative sketched above keeps the system *modular* (in the sense of computer science, not philosophy of mind).

- The monadic alternative may also shed interesting new light on QUDs and QUD-update.

- Of course, these remarks are merely suggestive, and much work would need to be done to properly formalize them.

- Nevertheless, there has been substantial work done on monad semantics at this point (see Asudeh and Giorgolo 2020 for citations and references), so this seems like a promising avenue for future research.

[4]The symbol we choose is not important, but $\overset{\blacktriangle}{\triangledown}$ is meant to be suggestive of an ordinary value, $\blacktriangle$, associated with a transparent value, $\triangledown$.

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