

# Single-Type Semantics and Depiction Reports

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**Abstract.** We show that situated single-type semantics (see Liefke and Werning 2018) provides a compositional semantics for depiction reports (e.g. (1), (2)) that improves upon Montague-style semantics (see Moltmann 1997) and property-based semantics for such reports (see Zimmermann 2016; cf. 1993). In particular, situated single-type semantics predicts the absence of certain readings of depiction reports and blocks unwarranted monotonicity inferences between such reports. The semantics also makes a number of plausible predictions about the role of context in the interpretation of depiction complements.

**1. Introduction.** Depiction reports are readings of reports like (1) and (2) on which the complements of these reports describe the content of pictures or mental images (see Forbes 2006; Moltmann 2008; Zimmermann 2016).

- (1) Paul is painting  $[_{DP}a \text{ penguin}]$ .                      (2) Uli is imagining  $[_{DP}a \text{ unicorn}]$ .

Depiction reports pose a special challenge for the formal interpretation of natural language. This challenge is reflected in the inability of Montague-style semantics (see Montague 1970; cf. Moltmann 1997) and property-based semantics<sup>1</sup> (see Zimmermann 1993, 2016) to satisfy both of the following intuitive desiderata:

**Desideratum (i): account for the available readings.** *Explain the difference in available readings/truth-conditions between depiction reports with a (weak) indefinite object DP (e.g. (1)) and depiction reports with a strong quantificational object DP (e.g. (4)).*

This difference lies in the observation that reports like (1) are ambiguous between a referentially opaque/*de dicto*-reading – on which the DP receives a non-specific interpretation (see (3a)) – and a referentially transparent/*de re*-reading – on which the DP receives a specific interpretation (3b). In contrast, reports like (4) only have a *de re*-reading (see (4a)). For these reports, the *de dicto*-reading is not available (see Zimmermann 1993, p. 160 ff.).

- (3) a. Paul is painting some penguin, but no particular one.  
b. There is a particular penguin that Paul is painting.

- (4) Paul is painting  $[_{DP}every \text{ penguin}]$ .  
a. For each particular penguin in a given domain, Paul is painting it.

Since Montague semantics treats indefinite DPs analogously to quantificational DPs (i.e. as intensional generalized quantifiers), it is unable to account for the unavailability of the *de dicto*-reading of (4) (see (5)). In (5),  $\lambda j^s \lambda P^{(s, \langle e, t \rangle)} \forall x^e. penguin_j(x) \rightarrow P_j(x)$  is the quantifier-translation of the DP *all penguins*. This translation denotes a function from indices (or situations)  $j$  to the set of properties that all penguins in  $j$  have (i.e. to the set of properties  $P$  such that, for all individuals  $x$ , if  $x$  is a penguin in  $j$ , then  $x$  has  $P$  in  $j$ ).

- (5)  $paint_i(paul, \lambda j^s \lambda P^{(s, \langle e, t \rangle)} \forall x^e. penguin_j(x) \rightarrow P_j(x))$

**Desideratum (ii): predict the right inferences.** *Capture the intuitive inferences of depiction reports, esp. inferences (e.g. (6)) that use the upward monotonicity of the non-specific objects in these reports. At the same time, avoid predicting the validity of inferences to a common objective (e.g. (7)), where the object DP in (7a/b) has a non-specific reading (see (6b-i/ii)) and where something in (7c) is a quantifier over non-specific objects.*

- (6) a. i. Uli / ii. Ede is imagining  $[_{DP}some \text{ (non-specific) unicorn}]$ .  
⇒ b. i. Uli / ii. Ede is imagining  $[_{DP}some\text{-thing}]/[_{DP}some \text{ (non-specific) thing}]$ .  
(7) a. Uli is imagining  $[_{DP}something]$ .                      b. Ede is imagining  $[_{DP}something]$ .  
≠ c. Uli is imagining  $[_{DP}something \text{ that Ede is (also) imagining}]$ .  
(≡ Uli and Ede are imagining the same (non-specific) thing.)

<sup>1</sup>Zimmermann's (2006) revised property semantics, which interprets the non-specific DPs in depiction reports as existentially quantified sub-properties of the properties denoted by the DP's restrictor, meets both desiderata. However, since this semantics faces other serious problems, we will not consider it here.

Since Montague-style semantics and property-based semantics validate the inference from (6a-i/ii) to (6b-i/ii) (see (8) for the case of Montague-style semantics) – s.t. they assign the same (abstract) object to the two occurrences of *something* in (7a) & (7b) –, they wrongly predict the validity of (7) (see (9); cf. Zimmermann 2006, pp. 730–731). This prediction is based on the possibility of quantifying over the non-specific objects in (7a) & (7b) and on the observation that the quantifier  $\exists \mathcal{Q}^{\langle s, \langle \langle s, \langle e, t \rangle \rangle, t \rangle \rangle}$  in (9b) has the same witness for Uli’s as for Ede’s imagining. The validity of (6) (see (8)) relies on the monotonicity rule (8c). This rule uses the observation that  $\mathcal{Q}$  is less specific than  $\mathcal{P}^{\langle s, \langle \langle s, \langle e, t \rangle \rangle, t \rangle \rangle}$ , i.e.  $\mathcal{P} \subseteq \mathcal{Q}$ , given the empirical assumption that imagining or depicting a specific object (satisfying  $\mathcal{P}$ ) always involves imagining or depicting a less specific object (satisfying  $\mathcal{Q}$ ). For inspiration about how to motivate this rule, the reader is referred to (Zimmermann 2016, (106) on p. 758):

$$\begin{aligned}
 (8) \quad & \text{a. } (6a\text{-i}) = \textit{imagine}_i(\textit{uli}, \lambda j \lambda P \exists x. \textit{unicorn}_j(x) \wedge P_j(x)) \\
 & \text{b. } (\lambda j \lambda P \exists x. \textit{unicorn}_j(x) \wedge P_j(x)) \subseteq (\lambda j \lambda P \exists x. P_j(x)) \\
 & \text{c. } \frac{\forall \mathcal{P} \forall z^e. \textit{imagine}_i(z, \mathcal{P}) \rightarrow (\forall \mathcal{Q}. \mathcal{P} \subseteq \mathcal{Q} \rightarrow \textit{imagine}_i(z, \mathcal{Q}))}{\Rightarrow \text{d. } (6b\text{-i}) = \textit{imagine}_i(\textit{uli}, \lambda j \lambda P \exists x. P_j(x))} \\
 (9) \quad & \text{a. } \textit{imagine}_i(\textit{uli}, \lambda j \lambda P \exists x. P_j(x)) \quad \text{b. } \textit{imagine}_i(\textit{ede}, \lambda j \lambda P \exists x. P_j(x)) \\
 & \Rightarrow \text{c. } \exists \mathcal{Q}. \textit{imagine}_i(\textit{uli}, \mathcal{Q}) \wedge \textit{imagine}_i(\textit{ede}, \mathcal{Q})
 \end{aligned}$$

**2. Proposal & Background.** We propose to meet the above desiderata by replacing Montague- or property-style semantics for depiction reports by a situated single-type semantics (abbr. ‘STS’; see Liefke and Werning 2018, hereafter L & W). STS interprets sentences and referential DPs as (type- $\langle s, \langle s, t \rangle \rangle$ ) functions from contextually specified situations (CSSs) to sets of situations. In particular, STS interprets the DP *a penguin* as (10) (see L & W, pp. 660–663). Below,  $\sigma$  and  $\sigma'$  are variables over situations;  $\sqsubseteq$  is a partial ordering on the set of situations. We identify situations with informationally incomplete spatio-temporal world-parts. We assume that situations are obtained from a possible world by reducing the information about a particular spatio-temporal location in this world to the contextually salient information (see L & W, pp. 657–659). ‘ $\sigma' \sqsubseteq \sigma$ ’ asserts that  $\sigma$  contains all information that is contained in  $\sigma'$ , i.e. that  $\sigma$  is an (informational) extension of  $\sigma'$ .

$$(10) \quad \llbracket \text{a penguin} \rrbracket = \lambda \sigma'. \{ \sigma \mid \sigma' \sqsubseteq \sigma \ \& \ \text{some inhabitant of } \sigma \text{ is a penguin} \}$$

The above interpretation enables STS to explain the truth-evaluability of DP fragments (e.g. (11a); see L & W, pp. 656–667) and to capture semantic inclusion relations between DP fragments and sentences (e.g. the inclusion of (11a) in (11b); see L & W, pp. 670–674):

$$\begin{aligned}
 (11) \quad & \text{Paul \& Mary are doing a wildlife tour through New Zealand. After lying in wait for} \\
 & \text{indigenous animals for some time, Paul points at a rustling bush and whispers (a).} \\
 & \text{a. } \llbracket \text{DP A penguin} \rrbracket. \equiv \quad \text{b. } \llbracket \text{DP A penguin} \rrbracket \text{ is approaching from over there.}
 \end{aligned}$$

STS assumes that attitude complements (incl. depiction complements) are uniformly interpreted as situations (see L & W, pp. 664–665). Such situations are obtained from the complements’ interpretation at a contextually specified situation (i.e. from a set of situations) by a context-dependent choice function  $f$  (see von Heusinger 2013).  $f$  selects a situation from this set in dependence on a contextual parameter,  $c$ , for the described depicting event (below:  $c :=$  Paul painting in the CSS;  $c' :=$  Uli imagining in the CSS;  $c'' :=$  Ede imagining in the CSS). The interpretation of (1) at the CSS  $\sigma_0$  is given in (12):

$$\begin{aligned}
 (12) \quad & \{ \sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \ \text{in } \sigma, \text{ Paul paints } f_c(\{ \sigma' \mid \sigma' \in \llbracket \text{a penguin} \rrbracket(\sigma') \}) \} \\
 & = \{ \sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \ \text{in } \sigma, \text{ Paul paints } f_c(\{ \sigma' \mid \text{some inhabitant of } \sigma' \text{ is a penguin} \}) \}
 \end{aligned}$$

The interpretation of depiction complements as situations is supported by the possibility of modifying the matrix verb in reports like (1) through experiential modifiers like *vividly* or *in vivid/lifelike detail* (see Stephenson 2010, p. 156) and of rephrasing the complements of such reports as eventive *how*-complements. The latter possibility is corroborated by the observation that physical/mental images typically do not represent isolated properties (e.g. being a penguin), but informationally richer objects (see Zimmermann 2016, p. 433).

**3. Meeting Desideratum (ii): inferences.** We have assumed above that depiction verbs choose their argument-situation in dependence on a particular depicting event. This dependence blocks unwarranted inferences like (7) (see (13)). In particular, since Uli’s imagined situation in  $\sigma_0$  is typically different from Ede’s imagined situation in  $\sigma_0$  – and may even be part of a different world –, (7a) and (7b) do not imply (7c):

$$(13) \quad \begin{array}{l} \text{a. } (7a) = \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{ in } \sigma, \text{ Uli imagines } f_{c'}(\{\sigma' \mid \text{something inhabits } \sigma'\})\} \\ \text{b. } (7b) = \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{ in } \sigma, \text{ Ede imagines } f_{c''}(\{\sigma' \mid \text{something inhabits } \sigma'\})\} \\ \neq \text{c. } (7c) = \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{, for some } \sigma', \text{ Uli imagines } \sigma' \text{ in } \sigma \ \& \text{ Ede imagines } \sigma' \text{ in } \sigma\} \end{array}$$

The inference in (13) would only go through if  $f_{c'}$  and  $f_{c''}$  were identical choice functions. However, given the different parametrization of these functions (to Uli’s respectively to Ede’s imagining in  $\sigma_0$ ), this is usually not the case.

Since STS – like Montague- or property-semantics – assumes that non-specific objects of depiction verbs are upward-monotonic, it still captures inferences like (6a-i)  $\Rightarrow$  (6b-i). These inferences assume a ‘situational’ variant, (14c), of (8c). This is required by the fact that STS uses situations, not intensional quantifiers (see (8)), as the objects of imagining.

$$(14) \quad \begin{array}{l} \text{a. } (6a-i) = \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{ in } \sigma, \text{ Uli imagines } \\ \qquad \qquad \qquad f_{c'}(\{\sigma' \mid \text{some inhabitant of } \sigma' \text{ is a unicorn})\}\} \\ \text{b. } f_{c'}(\{\sigma' \mid \text{some inhabitant of } \sigma' \text{ is a unicorn})\} \sqsubseteq f_{c'}(\{\sigma' \mid \text{sth. inhabits } \sigma'\}) \\ \text{c. } \forall \sigma \forall z. z \text{ imagines } \sigma \rightarrow (\forall \sigma'. \sigma' \sqsubseteq \sigma \rightarrow z \text{ imagines } \sigma') \\ \Rightarrow \text{d. } (6b-i) = \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{ in } \sigma, \text{ Uli imagines } f_{c'}(\{\sigma' \mid \text{something inhabits } \sigma'\})\} \end{array}$$

**4. Meeting Desideratum (i): readings.** We have shown above that STS interprets (1) as (12) (copied in (15)). Notably, this interpretation leaves the truth-conditions of (1) underspecified. In particular, if the context,  $c$ , that constrains the function  $f$  in (15) contains a single penguin to whom Paul bears an acquaintance relation, (15) captures the (*de re*) truth-conditions of (3b). (Example of such a context: a special moment during Paul’s trip to New Zealand during which a particularly tame penguin allowed Paul to feed him.) If  $c$  is a context in which Paul is not acquainted with a penguin (example context: Paul is thinking of a good topic for his new painting), (15) captures the (*de dicto*) truth-conditions of (3a). The restriction of acquaintance to inhabitants of the same spatio-temporal world-part motivates the following conditions on the *de re*- and *de dicto*-truth of (1):

$$(15) \quad \begin{array}{l} \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{ in } \sigma, \text{ Paul paints } f_c(\{\sigma' \mid \sigma' \in \llbracket \text{a penguin} \rrbracket(\sigma')\})\} \\ = \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{ in } \sigma, \text{ Paul paints } f_c(\{\sigma' \mid \text{some inhabitant of } \sigma' \text{ is a penguin})\}\} \end{array}$$

$$(16) \quad \begin{array}{l} \text{a. } \textit{de re}: f_c(\{\sigma' \mid \sigma' \in \llbracket \text{a penguin} \rrbracket(\sigma')\}) \in \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{ Paul paints in } \sigma\} \\ \text{b. } \textit{de dicto}: f_c(\{\sigma' \mid \sigma' \in \llbracket \text{a penguin} \rrbracket(\sigma')\}) \notin \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \& \text{ Paul paints in } \sigma\} \end{array}$$

To explain the missing *de dicto*-reading of (4), we use the observation that strong quantifiers (incl. *every*) presuppose acquaintance with their restrictor set (above: the set of penguins in  $\sigma_0$ ; see Moltmann 1997, cf. Deal 2008). Since we assume that this presupposition is included in the pragmatic information that is part of  $c$ , this presupposition excludes that (4) is true under the *every penguin*-variant of the condition in (16b).

## References.

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