EVIDENCE FOR SINGLE-TYPE SEMANTICS – AN ALTERNATIVE TO e/t-BASED DUAL-TYPE SEMANTICS

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Abstract. Partee (2006) conjectures a formal semantics for natural language (hereafter, *single-type semantics*) that interprets CPs and referential DPs in *the same* semantic type: properties of situations. Partee's semantics contrasts with Montague semantics and its recent contenders (dubbed *dual-* or *multi-type semantics*) which assume distinct basic types for the semantic values of referential DPs (i.e. individuals) and CPs (i.e. propositions, truth-values, or sets of assignment functions). Partee's conjecture is motivated by results in event semantics and discourse representation theory, which support the indirect uni-directional shiftability between propositions and individuals. However, none of these results supports the *identity* of the types for individuals and propositions. Our paper improves upon the strength and scope of Partee's support for single-type semantics. In particular, it identifies a number of new arguments for the adoption of single-type semantics which display this semantics' greater unificatory and explanatory power. These arguments are based on the ability of single-type semantics to provide a uniform account of the distributional similarities between DPs and CPs, to explain the truth-evaluability of DP fragments, and to capture semantic inclusion relations between CPs and referential DPs. To further support single-type semantics, we defend it against a number of objections.

1. Introduction

The semantics of natural language presupposes a rich ontology (see Bach 1986a). For example, to provide an interpretation for English, we require the existence of individuals (denoted by, e.g., *Bill*), propositions (*Bill walks*), properties of individuals (*walk*), relations between individuals (*find*), and many other types of objects. Classical type-logical semantics for natural language (e.g. Montague 1970a) tame this zoo of objects by assuming only *two* basic types of objects, viz. individuals and propositions, and constructing all other objects from these primitives via semantic rules like function space formation. As a result of this constructibility, type-logical semantics can explain the compositionality of natural language interpretation and can account for the productivity and systematicity of linguistic understanding.[1]

The semantic distinction between individuals and propositions is inherited from Church's Simple Theory of Types (see Church 1940) and is adopted in classical Montague semantics (see Montague 1970a, 1973; Gallin 1975), situation semantics (see Barwise and Perry 1983; Muskens 1995), property theory (see Thomason 1980; Chierchia and Turner 1988), dynamic semantics (see Groenendijk and Stokhof 1989, 1991), and discourse representation theory (see Kamp 1981; Heim 1982). However, the philosophy behind Church's type theory, i.e.

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[1]For a critical evaluation of the arguments from productivity and systematicity, the reader is referred to Werning (2005).

Frege's philosophy of language, assumes an even more parsimonious ontology. In particular, Frege divides the semantic values of linguistic expressions into 'saturated' *objects* [*Gegenstände*], which can only serve as semantic arguments, and 'unsaturated' *concepts* [*Begriffe*], which serve as semantic argument-takers. Since Frege further classifies the semantic values of declarative sentences, i.e. truth-values, as *Gegenstände* (see Frege 1891), he clusters individuals and truth-values into a *single* basic type of object.

Montague's semantics for natural language aims to provide a direct formalization of Frege's linguistic ontology (see Montague 1970a, p. 217). However, already Montague himself diverges from Frege's foundational set-up by assuming distinct basic types for individuals (i.e. *entities*, type e) and propositions[2] (or *truth-values*, type t).

The success of Montague semantics and its recent variants has given the e/t-distinction the appeal of an *a priori* necessity. However, the question arises whether this distinction is really *required* for an adequate modelling and explanation of linguistic phenomena, or whether it is merely a convenient feature which enables an easy accommodation of these phenomena. Moreover, it may turn out that a semantics based on a single basic type is explanatorily more powerful than a semantics based on the types e and t.

In a 2006 paper on the foundations of natural language semantics, Barbara Partee provides a short informal argument for the adoption of a single basic type. Her argument is based on Carstairs-McCarthy's (1999) claim that the distinction between CPs and referential DPs is a contingent property of natural language syntax, and on the assumption of a correspondence between syntactic categories and semantic types (see Partee 2006, p. 37). Partee's suggestion about the linguistic type system is summarized below:

Proposition 1 (Single-Type Hypothesis)**.** *The e/t-distinction is inessential for the construction of a rich semantic ontology for natural language. Rich linguistic fragments can be adequately modelled through the use of one basic type of object.*

Partee's assumption of a single basic type corresponds to Frege's adoption of a uniform type for semantic arguments: just as Frege suggests a classification of the semantic values of declarative sentences (i.e. truth-values) in the interpretive domain of referential DPs (i.e. *Gegenstände*), Partee suggests the classification of propositions as a particular kind of individuals. Just as Partee conjectures the possibility of interpreting natural language in a single-base-type semantics, Frege suggests the possibility of interpreting natural language in an only-*Gegenstands*-based semantics.

Frege's/Partee's view of the linguistic type system contrasts with Montague's implicit assumption that any formal semantics for natural language requires distinct types for individuals and propositions. This assumption is captured below:

[2]For reasons of generality, we will hereafter not commit to a particular propositional domain. The type t may thus be associated with truth-values, sets of possible worlds or of world-time pairs, sets of situations, sets of assignment functions, semantically primitive propositions, or other viable candidates for the semantic values of declarative sentences. On all domain choices, the set of propositions forms an algebraic structure (at least a Heyting prealgebra; see Pollard 2008). The set of individuals is usually not assumed to be structured in this way. Because of the possible absence of an algebraic structure on individuals, we do not identify type-e objects with facts or events. To capture the divide between the types e and t, we assume that the sets of individuals and propositions do not overlap.

Proposition 2 (Dual-Type Hypothesis)**.** *The e/t-distinction is essential for the construction of a rich semantic ontology for natural language. Any adequate model for a rich linguistic fragment requires (at least) two distinct basic types of objects.*

We will hereafter refer to any formal semantics for natural language which is based on Proposition 1 as a *single-type semantics*, and refer to any formal semantics which is based on Proposition 2 as a *dual-type semantics*.[3]

Since Partee's single-type semantics conjoins Montague's types for individuals and propositions into a single basic type, it counts as basic-type objects both the semantic values of referential DPs (e.g. *Bill*, *the man*; which are traditionally interpreted in the type e) and the values of declarative sentences or complement phrases (e.g. *Bill walks*, *that Bill walks*; which are traditionally interpreted in the type t). For convenience, we will hereafter dub the single basic type 'o'.[4]

From type-o objects, the semantic values of all other linguistic expressions are obtained by the type-forming rule (CT) from Church (1940) (cf. Montague 1970b, pp. 227–228). This rule asserts that the type for functions from objects of one type to objects of another (possibly, the same) type is itself a type:

(CT) *If α and β are types, then $\langle \alpha, \beta \rangle$ is the type for functions from objects of type α to objects of type β.*

From Montague's basic types e and t, this type-forming rule obtains the types for functions from individuals to propositions (i.e. for first-order properties of individuals), $\langle e, t \rangle$, and for functions from individuals to functions from individuals to propositions, $\langle e, \langle e, t \rangle \rangle$ (i.e. for curried binary relations between individuals). Objects of these types serve as the semantic values of common nouns or intransitive verbs (e.g. *man*, *walk*) and as the values of extensional transitive verbs (e.g. *find*), respectively.

By applying the rule (CT) to the basic type o, single-type semantics obtains the types for functions from basic single-type objects to basic single-type objects, $\langle o, o \rangle$, and for functions from basic single-type objects to functions from basic single-type objects to basic single-type objects, $\langle o, \langle o, o \rangle \rangle$. Since the type o is neutral between Montague's types e and t, we can identify the classes of linguistic expressions which are associated with a particular single-type type by replacing 'e' and 't' by 'o' in the familiar Montagovian types of a linguistic expression. Thus, the type $\langle o, o \rangle$ serves as the single-type type of common nouns and intransitive verbs. The type $\langle o, \langle o, o \rangle \rangle$ serves as the type of extensional transitive verbs.

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[3]Since such semantics still assume a hierarchy over the basic type (or types), they should more adequately be described as '*single-* (or *dual-*) *base-type semantics*', or as *hierarchical* (as opposed to *flat*) *single-* (or *dual-*)*type semantics*. Flat single-type semantics will be discussed in Sect. 2.4.

[4]The type o can be analyzed either as a primitive (i.e. non-decomposable) type (e.g. e or t) or as a decomposable complex type (e.g. $\langle e, t \rangle$). The single-type semantics from Partee (2006) and Liefke (2014) both analyze o as a complex type. In the present paper, we adopt Partee and Liefke's move. In particular, we will follow Liefke (2014, Ch. 8) in analyzing o as the type for functions from situations to (characteristic functions of) sets of situations, $\langle s, \langle s, t \rangle \rangle$ (see our Sect. 4.2).

Partee (2006) supports[5] the introduction of a single basic type with reference to the semantic similarity of CPs and referential DPs. This similarity follows from the similarity of the standard dual-type values of CPs (i.e. propositions) and indefinite event-denoting DPs (i.e. events), and of event-denoting DPs and concrete, referential DPs (i.e. individuals). These similarities are reflected in the easy shiftability between objects of the above types. They question the strict type-difference between the semantic values of the above kinds of expressions.

In particular, Partee supports the semantic similarity of CPs and event-denoting DPs with reference to the event-semantic analysis[6] of declarative sentences (e.g. the analysis of (1a) and (2a) as (1b) and (2b)) and the event-type results of sentential nominalization (e.g. the nominalization of (1a) and (2a) as (1c) and (2c)) (cf. Davidson 1967; Kratzer 1996; Parsons 1985). She supports the similarity between concrete and event-denoting DPs with reference to the possibility of interpreting the same DP as an individual or an event in different linguistic contexts (cf. Bach 1986b; Krifka 1989; Partee 1991). For example, since the verb *last* requires an event-type subject, the DP *the thunderstorm* is interpreted as an event in (3a). Since *fly through* requires a concrete, individual-type object, the DP is interpreted as an individual in (3b).[7]

(1) a. Jones buttered the toast.
    b. There is a (past) event of Jones buttering the toast.
    c. Jones' buttering the toast

(2) a. You saw a snake yesterday.
    b. There is/was an event of you seeing a snake that happened yesterday.
    c. your seeing a snake yesterday

(3) a. [$_{\text{DP}}$The thunderstorm] lasted from early to mid-afternoon.
    b. The pilot flew his plane through [$_{\text{DP}}$the thunderstorm].

Examples (1) and (2) are taken from Partee (2007, p. 3) (cf. Davidson 1967) and from Partee (2006, p. 39) (cf. Carstairs-McCarthy 1999, p. 23), respectively. Example (3) is inspired by the discussion from Partee (2007, p. 4).

Note that Partee's examples do not support the *neutralization* of the distinction between individuals and propositions, or the *identification* of the semantic types for CPs and referential DPs that has been suggested in Proposition 1. Instead, they only support the semantic *similarity* of CPs and individual-denoting

[5]Partee does not intend to formulate a strong, coherent argument for single-type semantics. Rather, she only aims to "offer some preliminary sketchy notes" to show "that it might be possible to put together several lines of recent research to come up with a defense of the conceptual possibility of getting along without the *e*-*t* distinction [...]" (2006, p. 38).

[6]This analysis interprets sentences as existentially quantified event descriptions.

[7]The semantic similarity between concrete and event-denoting DPs is further supported by the observation that certain expressions take both concrete and event-denoting DPs as their complements, and allow the coordination of these different kinds of DPs in their complements. This observation is illustrated below. There, v is the type for events:

($\star$) a. [$_{e\text{-DP}}$Pat] annoyed Mary.
    b. [$_{v\text{-DP}}$Pat's permanent whining] annoyed Mary.
    c. [[$_{e\text{-DP}}$Pat] and [$_{v\text{-DP}}$her permanent whining]] annoyed Mary.

DPs (via the semantic similarity of CPs with event-denoting DPs and of event-denoting DPs with individual-denoting DPs). As a result, Partee's examples provide comparatively weak support for single-type semantics. This support is further weakened by its focus on linguistic phenomena (e.g. sentential nominalization; see (1), (2)) that exemplify a shift from propositions to events, and by the by-and-large absence of phenomena that exemplify a shift in the other direction.[8] As a result, Partee's support is not only *indirect* (via the semantic comparison to events), but also *uni-directional*.

This paper improves upon the strength and scope of Partee's support for single-type semantics. In particular, it identifies a number of new arguments for the adoption of single-type semantics that display this semantics' greater unificatory and explanatory power. These arguments are based on the ability of single-type semantics to provide a uniform account of the distributional similarities between DPs and CPs (see *the uniformity argument*; Sect. 2), to give a simple explanation of the truth-evaluability of syntactically isolated referential DPs (see *the assertoricity argument*; Sect. 4), and to give an explanation of the semantic relations between CPs and referential DPs (see *entailment arguments*; Sect. 6). The uniformity argument provides support for any kind of single-type semantics, regardless of its particular analysis of the type o. The assertoricity and entailment arguments provide support for our particular brand of single-type semantics, i.e. *situated single-type semantics*, which analyzes o as the type for functions from contextually specified situations to sets of situations, $\langle s, \langle s, t\rangle\rangle$.

Admittedly, there are also a number of phenomena that can be used to argue against single-type semantics. These are phenomena which can be modelled in dual-type semantics, but which seem to resist an easy modelling in single-type semantics. They include the distributional differences between DPs and CPs, and the semantic difference between CPs and their DP nominalizations of the form *the proposition* $[_{\text{CP}}\textit{that}\ldots]$. The latter difference is exemplified by the fact (dubbed the *substitution problem* by Moltmann (2003, 2013)) that many DP/CP-neutral contexts do not allow a meaningful substitution of CPs by their propositional nominalizations. Section 3 identifies different strategies for explaining distributional DP/CP differences. Section 5 shows that, since CPs are not semantically equivalent with their propositional nominalizations in situated single-type semantics, this semantics avoids the substitution problem. The paper closes with a summary of our results and with pointers to future work.

2. The Uniformity Argument for Single-Type Semantics

We have noted above that single-type semantics interprets CPs and referential DPs in the same semantic type. As a result, it provides a simple, uniform account of the distributional similarities between DPs and CPs. These similarities include the ability of CPs and referential DPs to serve as complements of the same verbs, to be used in specificational constructions, and to provide anaphoric antecedents. The former is exemplified by different kinds of DP/CP-neutral constructions (see Sect. 2.1). The latter two are exemplified by different kinds of DP/CP-aligning constructions (see Sect. 2.2).

[8] Partee (2007, p. 4) herself admits that "it is not so easy to 'propositionalize' an arbitrary entity".

2.1. **DP/CP-Neutral Constructions.** DP/CP-neutral constructions are constructions that allow for the alternation of CPs with referential DPs as the subject or object of certain verbs, and as the arguments of adjectives and prepositions. We present different DP/CP-neutral constructions below, starting with expressions that accept both DP and CP *objects*. DP-biased expressions, which only accept referential DPs (but not CPs) as their subject or object complements, will be discussed in Section 3.

2.1.1. *Constructions with DP/CP-Neutral Objects.* Many transitive verbs are neutral between taking a CP or a referential DP as their object complement (see Kim 2008, pp. 121–122; Sag et al. 2003, pp. 341–342). For example, the verb *remember* can combine both with a DP (e.g. with the name *Bill*; in (4a)) and with a CP (e.g. with the phrase *that Bill was waiting for her [i.e. Pat]*; in (4b)). The observed DP/CP neutrality generalizes to factive intentional verbs, including epistemic verbs (e.g. *know*, *prove*, *notice*; see (5)) and (arguably factive) perception verbs (e.g. *see*, *hear*, *feel*; see (6)). It is further exhibited by quasi-perceptual intentional verbs (e.g. *imagine*, *hallucinate*; see (7)), by emotional and evaluative verbs (e.g. *fear*, *hate*, *desire*; see (8); *respect*, *admire*, *disdain*; see (9)), and by causative verbs (e.g. *enable*, *allow*, *prevent*; see (10)).

(4) a. Pat remembered [$_{\text{DP}}$Bill].
b. Pat remembered [$_{\text{CP}}$that Bill was waiting for her].

(5) a. Mary noticed [$_{\text{DP}}$the problem].
b. Mary noticed [$_{\text{CP}}$that Pat did not like Bill].

(6) a. Mary saw [$_{\text{DP}}$Bill].
b. Mary saw [$_{\text{CP}}$that Bill was waiting at the front exit].

(7) a. Bill imagined [$_{\text{DP}}$Pat's embrace].
b. Bill imagined [$_{\text{CP}}$that Pat would hug him].

(8) a. Pat fears [$_{\text{DP}}$Bill].
b. Pat fears [$_{\text{CP}}$that Bill may try to kiss her].

(9) a. Mary respects [$_{\text{DP}}$Pat].
b. Mary respects [$_{\text{CP}}$that Pat wishes to avoid Bill].

(10) a. Mary prevented [$_{\text{DP}}$another mental breakdown].
b. Mary prevented [$_{\text{CP}}$that Pat experienced another mental breakdown].

Notably, DP/CP complement-neutrality is also exhibited by verbs that take a prepositional (rather than a direct) object complement. Such verbs include volition verbs (e.g. *hope*, *wish*, *care*; see (11)), *say*-verbs (e.g. *complain*, *remark*, *grumble*; see (12)), and cognition verbs (e.g. *marvel*, *wonder*, *reason*; see (13)).

(11) a. Bill hoped for [$_{\text{DP}}$Pat's sympathy].
b. Bill hoped [$_{\text{CP}}$that Pat would change her mind about him].

(12) a. Mary complained about [$_{\text{DP}}$Pat].
b. Mary complained [$_{\text{CP}}$that Pat did not try to understand Bill].

(13) a. Bill marveled at [$_{\text{DP}}$Pat].
b. Bill marveled [$_{\text{CP}}$that Pat was the prettiest girl he had ever met].

2.1.2. *Constructions with DP/CP-Neutral Subjects.* The DP/CP neutrality of verbal object complements is supplemented by the neutrality of many expressions between taking a CP or a referential DP in subject position (see Sag et al. 2003, p. 339; Levin 1989, pp. 38, 76–77; Alrenga 2005; Lohndal 2014). These expressions include emotional and non-emotional causative verbs (e.g. *frighten*, *anger*, *please*; see (14); *destroy*, *foster*, *explain*; see (15)), emotional judgement verbs (e.g. *suck*, *stink*, *rule*; see (16)), emotional evaluation adjectives (e.g. *pleasant*, *lucky*, *unfortunate*; see (17)), and cognitive-assessment adjectives (e.g. *interesting*, *amazing*, *strange*; see (18)).

(14) a. [$_{DP}$Bill's behavior] frightens Pat.
b. [$_{CP}$That Bill's behavior is getting increasingly unpredictable] frightens Pat.

(15) a. [$_{DP}$Bill] destroyed his friendship with John.
b. [$_{CP}$That Bill suspected John of courting Pat] destroyed his friendship with John.

(16) a. [$_{DP}$Today's weather] sucks.
b. [$_{CP}$That today's weather is not improving] sucks.

(17) a. [$_{DP}$The crash] was unfortunate.
b. [$_{CP}$That the crash was so disastrous] was unfortunate.

(18) a. [$_{DP}$Bill] is strange.
b. [$_{CP}$That Bill is obsessed with Pat] is strange.

2.1.3. *Constructions with DP/CP-Neutral Arguments of Prepositions.* DP/CP-neutrality is further[9] exhibited by prepositional phrases in languages like German, Dutch, and French. These phrases result from combining a preposition (e.g. German *vor*, *durch* [Engl.: 'of', 'through']) with a DP, or from combining a pro-preposition (e.g. *da*vor, *da*durch [Engl.: 'PRO-of', 'PRO-through']) with a CP. The first possibility is exemplified by the German phrases *vor Bill* [Engl.: 'of Bill'] and *durch einen Pfeiler* [Engl.: 'through a beam'] in (19a) and (20a). The second possibility is exemplified by the German phrases *davor, dass Bill sie küssen könnte* [Engl.: 'PRO-of that Bill her kiss could', i.e. 'of Bill kissing her'] and *dadurch, dass er einen Pfeiler aufstellte* [Engl.: 'PRO-through that he a beam put up', i.e. 'by (him) putting up a beam'] in (19b) and (20b).

(19) a. Pat hat Angst [$_{PP}$vor [$_{DP}$Bill]].
[*gloss:* Pat has fear of Bill.]
[*translation:* Pat is afraid of Bill.]
b. Pat hat Angst [$_{PP}$*da*vor, [$_{CP}$dass Bill sie küssen könnte]].
[*gloss:* Pat has fear PRO-of that Bill her kiss could.]
[*translation:* Pat is afraid of Bill kissing her.]

(20) a. Peter stützte das Dach [$_{PP}$durch [$_{DP}$einen Pfeiler]].
[*gloss/trans:* Peter supported the roof through a beam.]

[9]Another interesting DP/CP similarity regards the case-marking of CPs in languages like Spanish, Persian, and Japanese (see Contreras 1985; Massam 1985; Plann 1986; Tsai 1993; Luján 1999; Öhl and Lotfi 2008). Luján (1996) even argues for the universality of case-marking of CPs. We leave the evidential relevance of CP case-marking for single-type semantics as a topic for future research.

b. Peter stützte das Dach [$_{\text{PP}}$ *da*durch, [$_{\text{CP}}$dass er einen Pfeiler aufstellte]].
[*gloss:* Peter supported the roof PRO-through that he a beam put up.]
[*translation:* Peter supported the roof by putting up a beam.]

2.2. **DP/CP-Aligning Constructions.** Constructions aligning DPs with CPs include coordinations, specificational constructions, and cases of proposition anaphora.

2.2.1. *Coordination.* Coordination can link DPs as well as CPs (see (21), (22)), and can even link DPs *with* CPs (see (23)–(25)). Traditionally, coordination has been assumed to be restricted to members of the same syntactic category, which receive an interpretation in the same semantic type (see Chomsky 1957, p. 36). However, Sag et al. (1985) have identified a particular type of coordination (called the *coordination of unlike categories*, or the *coordination of unlikes*; see Bayer 1996) which links members of *distinct* syntactic categories, including determiner and complement phrases (see Sag et al. 1985, pp. 165–167; Bayer 1996, pp. 584–585, 598–599). The coordination of CPs and referential DPs is exemplified by the results of conjoining the DP- and the CP-complement of the different occurrences of the matrix verbs from (4), (6), and (8) (in (23)–(25)).

(21) Pat fears [[$_{\text{DP}}$Bill] and [$_{\text{DP}}$his impulsiveness]].

(22) Pat fears [[$_{\text{CP}}$that Bill may try to kiss her] and [$_{\text{CP}}$that she will not be able to evade him]].

(23) Pat remembered [[$_{\text{DP}}$Bill] and [$_{\text{CP}}$that he was waiting for her]].

(24) Mary saw [[$_{\text{DP}}$Bill] and [$_{\text{CP}}$that he was waiting at the front exit]].

(25) Pat fears [[$_{\text{DP}}$Bill] and [$_{\text{CP}}$that he may try to kiss her]].

The above discussion has focused on the coordination of DPs and CPs in sentential *object* position. Notably, DPs can also be coordinated with CPs in *subject* position.[10] Such coordinations are exemplified by the results of conjoining the DP- and the CP-complement of the different occurrences of the verbs from (14), (16), and (17) (in (26)–(28)). The possibility of coordinating unlike sentential subjects is also acknowledged by Bayer (1996, p. 608; see (29)).

[10]An anonymous reviewer for SALT 2016 has pointed out that, while it is in principle always possible to coordinate an object-position DP with a CP, sentences with *subject*-position DP/CP-coordinations are sometimes deviant, as evidenced by (†c). The reviewer interprets this fact as disqualifying (26) to (29) as support for single-type semantics.

(†) a. [$_{\text{DP}}$Windows 10] sucks.
b. [$_{\text{CP}}$That Qatar is hosting the 2022 FIFA World Cup] sucks.
c. $^{??}$[[$_{\text{DP}}$Windows 10] and [$_{\text{CP}}$that Qatar is hosting the 2022 FIFA World Cup]] suck.

We do not share the reviewer's conclusion. Instead, we suggest to explain the deviance of (†c) through the disjointness of the relevant world-parts [or *referential anchors*] w.r.t. which the coordinated subjects are evaluated – here: my computer (which runs Windows 10) and (the relevant part of) Qatar. This explanation is supported by the non-deviance of the similar sentence (‡), in which the referential anchors of the coordinated subjects are *not* disjoint:

(‡) [[$_{\text{DP}}$Windows 10] and [$_{\text{CP}}$that I spent $120 on it]] suck.

The notion of a referential anchor, and relations between referential anchors, will be discussed in some detail in Sect. 4.1.

(26) [[$_{DP}$Bill's behavior] and [$_{CP}$that it is getting increasingly unpredictable]] frightens Pat.

(27) [[$_{DP}$Today's weather] and [$_{CP}$that it is not improving]] sucks.

(28) [[$_{DP}$The crash] and [$_{CP}$that it was so disastrous]] was unfortunate.

(29) [[$_{CP}$That Himmler appointed Heydrich] and [$_{DP}$the implications thereof]] frightened many observers.

2.2.2. *Equatives and Specification.* The possibility of aligning DPs with CPs is further exhibited by CP equatives and by specifications. CP equatives are sentences of the form of (31) to (33), which equate the referents of the two expressions flanking *to be* (see Stowell 1981; Potts 2002). They differ from typical equatives (e.g. (30)), whose arguments are both determiner phrases, by taking as their arguments a DP *and a CP*.

(30) [$_{DP}$The problem] was [$_{DP}$Pat's dislike of Bill].

(31) [$_{DP}$The problem] was [$_{CP}$that Pat did not like Bill].

(32) [$_{DP}$Mary's guess] was [$_{CP}$that Bill had been having feelings for Pat for quite a while].

(33) [$_{CP}$That Bill may try to kiss her] was [$_{DP}$Pat's biggest fear].

Specifications are constructions of the form of (34) to (36) in which an adverb (paradigmatically, the adverb *namely*) specifies a verb's complement through a second complement. In contrast to the most common kind of specifications, in which the specifying and the specified complement are both members of the same syntactic category (see (34)), CP-involving specifications delegate the specification of the DP complement *to a CP*. This possibility is witnessed by (35) and (36).

(34) Mary noticed [$_{DP}$the problem], namely [$_{DP}$Pat's dislike of Bill].

(35) Mary noticed [$_{DP}$the problem], namely [$_{CP}$that Pat did not like Bill].

(36) [$_{DP}$Pat's situation], namely [$_{CP}$that she was being followed by a lunatic] worried Mary.

Note that, while DP/CP coordinations only suggest that the aligned expressions are interpreted *in the same type*, CP equatives and specifications demand that these expressions be interpreted *as the same object* (i.e. that they are co-referential). Equatives and specifications thus provide stronger support for single-type semantics than coordination.

The co-referentiality of aligned CPs and referential DPs is further exemplified by proposition anaphora:

2.2.3. *Proposition Anaphora.* Anaphoric relations most commonly hold between pronouns and their antecedent *DPs*. However, anaphoric relations can also hold between pronouns and their antecedent *CPs* (see Charlow 2012). In Asher (1993, Ch. 6.4) and Elbourne (2013, Sect. 10.8), such cases of anaphora are called *proposition anaphora*, or *anaphora to propositions*. Proposition anaphora is exemplified by (37) to (39). In particular, in (37), the pronoun *it* is used to refer to the semantic value of the CP *that Bill has feelings for Pat*, thus suggesting the co-referentiality of the two expressions.

(37) Mary believes [$_{CP}$that Bill has feelings for Pat]^{i}. John is certain of [$_{PRO}$it]$_{i}$.

(38) If Mary tells Pat $[_{\text{CP}}$that Bill is waiting at the front exit$]^i$, she must be sure of $[_{\text{PRO}}$it$]_i$.

(39) $[_{\text{CP}}$That Pat was so evasive$]^i$ bothered Bill. $[_{\text{PRO}}$It$]_i$ upset him very much.

This completes our presentation of the distributional similarities between CPs and referential DPs. We next show how these similarities are accommodated in dual-type semantics. We will see that this accommodation requires the use of *different* non-standard tools and mechanisms, which prevents a uniform account of DP/CP similarities in dual-type semantics.

2.3. **Dual-Type Accounts of DP/CP Similarities.** Dual-type semantics explain the similarities between CPs and referential DPs through the combination of four strategies: (i) polysemy, (ii) type-shifting, (iii) ellipsis, and (iv) covert syntactic operators. These strategies are briefly described below.

(i) *Polysemy:* Assume that expressions which take complements of different syntactic categories are lexically ambiguous;

(ii) *Type-shifting:* Assume an operation at the level of compositional interpretation that shifts propositions to individuals (or to generalized quantifiers over individuals);

(iii) *Ellipsis:* Assume an elided determiner with a full NP layer that selects for a CP and yields a DP;

(iv) *Covert syntactic operators:* Assume a context-sensitive phonologically null functional head that selects for a CP and yields a DP.

Strategy (i) is realized by the distinction between differently-typed meanings of the matrix expression (see Sag et al. 2003, pp. 341–342; Pietroski 2000; Forbes 2018) and by the identification (through disambiguation) of this expression's 'right' meaning in the relevant linguistic context. Strategy (ii) is realized by the nominalization operator $^\cap$ (see Chierchia and Turner 1988; Potts 2002). This operator takes as arguments elements of type t (i.e. propositions) and produces as values elements of type e (i.e. individuals). Strategy (iii) is realized by prefacing a CP with an elided DP like *the proposition* or *the fact* (see Elbourne 2013; Kiparsky and Kiparsky 1970). Strategy (iv) prefaces a CP with the covert definite determiner Δ (see Kastner 2015; cf. Adger and Quer 2001; Takahashi 2010). In the complement of presuppositional verbs like *remember* and *deny*, this determiner combines with a CP to form a definite DP.

The above shows that Strategies (i) to (iv) operate at different levels of interpretation: while Strategy (i) operates at the level of the *lexicon*, Strategy (ii) operates at the level of compositional *semantic* interpretation. Strategies (iii) and (iv) apply – with different degrees of (c)overtness – at the level of *syntax*.

In virtue of the above, the expression *that Bill was waiting for her [i.e. Pat]* from (4b) will be analyzed as a CP by Strategies (i) and (ii), and as a DP by Strategies (iii) and (iv). The result of this analysis will be interpreted as a proposition by Strategy (i) and as an individual by Strategies (ii) to (iv). The different analyses of sentence (4b) are given in (4b)$'$ to (4b)$''''$, where the crucial ingredient is printed in boldface. In (4b)$'$, 'remember$_2$' is the disambiguated term, expressed by the verb *remember*, that selects for CP complements. The semantic nature of Strategy (ii) demands that the syntactic structure from (4b) be replaced by its logical form in (4b)$''$. In (4b)$''$, types are given in subscript.

(4) b.′ Pat **remembered$_2$** [$_{\text{CP}}$that Bill was waiting for her].

b.″ $remember_{\langle e,\langle e,t\rangle\rangle}\left(^{\cap}(waitfor_{\langle e,\langle e,t\rangle\rangle}(pat_e)(bill_e))_t\right)_{\boldsymbol{e}}(pat_e)$

b.‴ Pat remembered [$_{\text{DP}}$**the fact** [$_{\text{CP}}$that Bill was waiting for her]].

b.⁗ Pat remembered [$_{\text{DP}}\boldsymbol{\Delta}$ [$_{\text{CP}}$that Bill was waiting for her]].

Notably, Strategies (i) to (iv) were not initially intended to accommodate *all* of the above DP/CP similarities. In particular, Strategy (i) was designed to account for the DP/CP complement-neutrality of certain verbs; Strategy (ii) was designed to account for nominalizations. Strategies (iii) and (iv) were conceived of as ways of accounting for proposition anaphora, respectively of explaining the selection requirements of presuppositional verbs. The different empirical targets of these strategies have an effect on their ability to accommodate the various DP/CP-similarities, as we will see below:

We have suggested above that Strategy (i) associates the occurrences of the verb *remember* from (4a) and (4b) with disambiguated terms of the type $\langle \boldsymbol{e}, \langle e,t\rangle\rangle$ and $\langle \boldsymbol{t}, \langle e,t\rangle\rangle$, respectively (and similarly for the occurrences of each of the matrix expressions from (5) to (18)). As a result, this strategy succeeds in modelling the pairs of sentences from (4) to (18). A similar observation holds for the different occurrences of the prepositions from (19) and (20) (typed $\langle \boldsymbol{e}, \langle\langle e,t\rangle, \langle e,t\rangle\rangle\rangle$ and $\langle \boldsymbol{t}, \langle\langle e,t\rangle, \langle e,t\rangle\rangle\rangle$), such that Strategy (i) also models the pairs of sentences from (19) and (20). Since some variants of this strategy assume the lexical ambiguity of the pronoun *it*, this strategy also accommodates proposition anaphora. The strategy fails for embedded DP/CP coordinations and for DP/CP specifications, which would require multiple type-assignments to *the same* lexical entry.

In contrast to the above, Strategy (ii) explains DP/CP-complement neutrality through the adoption of the nominalization operator $^{\cap}$, or *nom* (see Partee 1987). Depending on the preferred ontology for the types e and t, this operator is analyzed as, e.g.,

- the function from a proposition φ to the individual correlate of the constant function $\lambda x_e.\,\varphi$ (see Chierchia 1984; cf. Chierchia and Turner 1988)[11];
- the function from a set of possible worlds φ to the plural individual composed of all and only the worlds in φ (see Potts 2002, p. 69);
- the function from a proposition φ (treated as a member of the domain of individuals) to the property of all of φ's properties (see Turner 1983);
- the function from a proposition to its associated Landmannian *peg* (see Hegarty 2005; cf. Landmann 1984).

The use of the nominalization operator is triggered by the occurrence of a type-mismatch between a predicate and its intuitive argument (in (4b): by a mismatch between the type of the first argument of *remember*, i.e. e, and the type of the CP *that Bill was waiting for her*, i.e. t). By resolving this mismatch, the nominalization operator enables a modelling of the pairs of sentences from (4) to (18)

[11]Chierchia and Turner do not address the nominalization of propositions. However, since their nominalization operator maps properties of individuals (type $\langle e,t\rangle$) to their individual correlates (type e) – and since propositions φ can be coded as constant properties ($\lambda x_e.\,\varphi$) –, Chierchia and Turner's framework strongly suggests this treatment.

and from (19) to (20). Since embedded DP/CP coordinations[12], DP/CP specifications, and CP equatives also display a type-mismatch, the nominalization operator further models the constructions from Sections 2.2.1 and 2.2.2. Because sentences containing anaphoric CP antecedents (e.g. (37)–(39)) typically do not display a type-mismatch, Strategy (ii) is, however, unable to accommodate cases of proposition anaphora.

Strategy (iii) constitutes a syntactic alternative to Strategy (ii) that is independent of the observation of a type-mismatch. In particular, this strategy analyzes anaphoric occurrences of the pronoun *it* as an optional reduction of the DP *the proposition* or *the fact* (see Elbourne 2013; cf. Kiparsky and Kiparsky 1970) (see the analysis of (37) as (37)′). As a result, this strategy enables a largely analogous treatment of anaphora with DPs and with CPs.

(37)′ Mary believes [$_{\text{CP}}$that Bill has feelings for Pat]. John is certain of [$_{\text{DP}}$*this proposition*]/[$_{\text{DP}}$*the proposition* [$_{\text{CP}}$that Bill has feelings for Pat]].

Strategy (iii) is challenged by the difficulty of finding a meaning-preserving DP for some CPs in certain linguistic contexts. For the sentences from (6b), (20b), and (32), this difficulty is illustrated below:

(6) b′. ?? Mary saw [$_{\text{DP}}$*the proposition* [$_{\text{CP}}$that Bill was waiting at the front exit]].

b″. ?? Mary saw [$_{\text{DP}}$*the fact* [$_{\text{CP}}$that Bill was waiting at the front exit]].

(20) b′. ?? Peter stützte das Dach durch [$_{\text{DP}}$*die Proposition*, [$_{\text{CP}}$dass er einen Pfeiler aufstellte]].

[*gloss:* Peter supported the roof through *the proposition* that he a beam put up.]

[*translation:* Peter supported the roof through *the proposition* that he put up a beam.]

b″. ?? Peter stützte das Dach durch [$_{\text{DP}}$*die Tatsache*, [$_{\text{CP}}$dass er einen Pfeiler aufstellte]].

[*gloss:* Peter supported the roof through *the fact* that he a beam put up.]

[*translation:* Peter supported the roof through *the fact* that he put up a beam.]

(32) b′. ?? [$_{\text{DP}}$Mary's guess] was [$_{\text{DP}}$*the proposition* [$_{\text{CP}}$that Bill had been having feelings for Pat for quite a while]].

b″. ?? [$_{\text{DP}}$Mary's guess] was [$_{\text{DP}}$*the fact* [$_{\text{CP}}$that Bill had been having feelings for Pat for quite a while]].

In particular, Peter did not support the roof through *the fact* that he put up a beam (see (20b)″), but through *a beam* (see (20a)). Similarly, Mary did not see *the fact* that Bill was waiting at the front exit (see (6b)′) (or *the proposition* that he was waiting at this exit; see (6b)″), but *Bill* (as he was waiting at this exit). For the DP/CP complement-neutral verbs *imagine* and *conclude*, an analogous observation is made by Moltmann (2013, p. 128). The difficulty of finding

[12]Since coordination is typically restricted to expressions of the same *conjoinable* type (i.e. to a type of the form $\langle \alpha_1, \langle \ldots, \langle \alpha_n, t \rangle \rangle \rangle$; see Partee and Rooth 1983), the accommodation of DP/CP coordinations requires a shift to *generalized quantifiers* over individuals (type $\langle \langle e, t \rangle, t \rangle$).

a suitable DP for some CPs also influences the ability of Strategy (iii) to accommodate embedded DP/CP coordinations. The semantic difference between CPs and their DP nominalizations will receive a detailed discussion in Section 5.

Strategy (iv) is a sophisticated variant of Strategy (iii) that restricts the DP-type interpretation of apparent CPs to the complements of presuppositional verbs like *remember* and *deny*. Since – with the exception of quasi-perceptual verbs like *imagine* – all of the matrix verbs from Section 2.1.1 are presuppositional, Strategy (iv) succeeds in modelling the majority of DP/CP object-neutral constructions and of DP/CP coordinations and specifications that occur in these constructions. Since the determiner Δ also combines with apparent CP *subjects* (see Kastner 2015; cf. Ross 1967; Takahashi 2010; Hartman 2012), Strategy (iv) further accommodates expressions that are neutral between taking a DP or a CP *subject*. However, since the use of the determiner Δ is restricted to presuppositional contexts, this strategy fails to accommodate the DP/CP-neutrality of prepositions as well as proposition anaphora.

The merits and problems of the different explanation strategies for the observed DP/CP similarities are summarized in Table 1. In the table, '✓!!', '(✓)', and '(✗)' abbreviate the need for *a particular variant of* a strategy, the ability to uniformly accommodate *certain subclasses of* a similarity, and the *restriction to few special cases* of a similarity, respectively.

	O comp.	S comp.	P comp.	Coor.	Spec.	Anaph.
Strategy (i)	✓	✓	✓	✗	✗	✓!!
Strategy (ii)	✓	✓	✓	✓!!	✓	✗
Strategy (iii)	(✗)	(✗)	(✗)	(✗)	(✗)	✓
Strategy (iv)	(✓)	✓	✗	(✓)	(✓)	✗
Single-Type	✓	✓	✓	✓	✓	✓

Table 1. Merits and problems of the explanation strategies for DP/CP similarities.

Table 1 shows that none of the above strategies is able to accommodate *all* of the observed DP/CP similarities from Sections 2.1 and 2.2. A general account of these similarities will consequently need to combine different strategies, thus losing its uniformity. In contrast, single-type semantics interprets CPs and referential DPs in the *same* semantic type. As a result, it uniformly captures the distributional similarities between DPs and CPs.[13]

[13]The ability of single-type semantics to directly accommodate all distributional DP/CP similarities obviates the use of Strategies (i) to (iv). However, Kastner (2015) has shown that the DP-analysis of presuppositional clauses (see Strategy (iv)) also explains several phenomena at the syntax-semantics interface, including these clauses' particular extraction and fronting behavior. As a result, it seems desirable to integrate Strategy (iv) with single-type semantics. We expect that single-type semantics allows for such an integration. This is due to the fact that none of the ingredients of Kastner's account (i.e. Heim's file-change semantics, Honcoop's account of presuppositional islands, and Adger and Quer's analysis of unselected embedded questions) relies on a particular interpretation of DPs and CPs, and that the syntactic distinction between CPs and DPs – which is presupposed in Kastner's explanation – is not questioned by single-type semantics. A detailed demonstration of the integrability of Strategy (iv) into single-type semantics is left as a project for future work.

We close this section by sketching an overgeneralization argument against single-type semantics and by defending the proposed semantics against this argument. Further arguments against single-type semantics will be presented and refuted in Sections 3 and 5.

2.4. **The Scope of the Uniformity Argument.** Sections 2.1 and 2.2 have supported the neutralization of the e/t-distinction with reference to a number of distributional similarities between CPs and referential DPs. A critic of our approach might object that the arguments from DP/CP object-neutrality and from coordination generalize to other classes of expressions, including adjective and prepositional phrases. For example, as is evidenced by (40) and (41), *be* and *become* are neutral between taking a DP, an AP, and a PP or, respectively, a DP and an AP as their complement (see Sag et al. 1985; Bayer 1996). This neutrality enables the coordination of DPs, APs, and PPs in the complement of *be* (see (42)) and the coordination of DPs and APs in the complement of *become* (see (43)).

(40) a. Bill is [$_{\text{DP}}$a desperate soul].
b. Bill is [$_{\text{AP}}$relentless].
c. Bill is [$_{\text{PP}}$in need of psychological attention].

(41) a. Pat has become [$_{\text{DP}}$a business shark].
b. Pat has become [$_{\text{AP}}$reckless].

(42) Bill is [[$_{\text{DP}}$a desperate soul] and [$_{\text{AP}}$relentless]]./
[$_{\text{PP}}$in need of psychological attention]].

(43) Pat has become [[$_{\text{DP}}$a business shark] and [$_{\text{AP}}$reckless]].

If the described generalization were to hold, it would weaken the uniformity argument for single-type semantics by questioning two constituent parts of this argument. More drastically, this generalization could be interpreted as suggesting an extension of the uniformity argument to other kinds of expressions aside from DPs and CPs. This extension would recommend a neutralization of the distinction between the basic types (i.e. e, t) and certain complex types (here: the type of APs and PPs, $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$). This neutralization would, in turn, collapse parts of Montague's type hierarchy analogously to the untyped lambda calculus (see Church 1985; Barendregt 1984; Scott 1980) and would result in a 'flat' single-type semantics that also assigns the type o to APs and PPs.

However, the above generalization is not convincing. This is due to the fact (i) that DP/AP- (or DP/AP/PP-)neutrality is restricted to the complements of copulative verbs and (ii) that the occurrences of the bracketed DPs in (40) to (43) are non-referential (s.t. they are not interpreted in the type e in dual-type semantics). The examples (40) to (43) do, thus, not support a neutralization of the distinction between the types e and $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$.

The non-referentiality of the DP-occurrences in (40) to (43) (see (ii)) is supported by the observation that these occurrences are unable to serve as the antecedents of anaphoric pronouns (note the ungrammaticality of (44) and (45)). This contrasts with the referential occurrences of DPs from Sections 2.1 and 2.2, which *can* serve as the antecedents of such pronouns (see the grammaticality of (46) and (47)).

(44) *Bill is [$_{\text{DP}}$a desperate soul]^i. [$_{\text{PRO}}$It]$_i$ would do anything to win Pat.

(45) *Pat has become $[_{DP}$a business shark$]^i$. Nothing can shy $[_{PRO}$it$]_i$ away from profit.

(46) Pat remembered $[_{DP}$Bill$]^i$. $[_{PRO}$He$]_i$ had been waiting at the front exit each day over the past week.

(47) Mary noticed $[[_{DP}$the problem$]^i$ and $[_{CP}$that $[_{PRO}$it$]_i$ was not easy to solve]].

This ends our presentation – and our first defense – of the uniformity argument for single-type semantics. We will see in the next section how single-type semantics answers a number of arguments that are based on distributional differences between CPs and referential DPs.

3. Selection Arguments against Single-Type Semantics

Distributional differences between CPs and DPs are exemplified by linguistic contexts which do *not* allow the grammatical substitution of a referential DP by a CP. Such contexts include the complements of verbs like *pinch* and *elude*, as well as some cases of coordination. Since these contexts only select for a referential DP (and not for a CP), we hereafter refer to members of the presented class of arguments as *selection arguments*.

This section details different selection arguments against single-type semantics and develops two single-type responses to these arguments. Below, we first present some distributional differences between DPs and CPs, which form the basis of the different selection arguments (in Sect. 3.1). We then identify different strategies for refuting these arguments (in Sect. 3.2).

3.1. DP-Biased Constructions.

Expressions which only accept a referential DP complement include activity verbs (e.g. *pinch*, *devour*, *elude*) and, in some languages (e.g. English), prepositions in prepositional adjuncts (i.e. PPs that do not occupy a verb's theme-role and, hence, do not constitute a prepositional object). The restriction of activity verbs to DP object and subject complements is illustrated by the ungrammaticality of the constructions in (48b) to (50b).

(48) a. Bill pinched $[_{DP}$Pat$]$.
b. *Bill pinched $[_{CP}$that Pat was unable to evade him$]$.

(49) a. Pat eluded $[_{DP}$Bill$]$.
b. *Pat eluded $[_{CP}$that Bill was following her every move$]$.

(50) a. $[_{DP}$Bill$]$ pinched Pat.
b. *$[_{CP}$That Bill was waiting for Pat$]$ pinched Pat.

The restriction of English[14] prepositional adjuncts to DPs is illustrated by the ungrammaticality of the construction in (51b).

(51) a. Peter supported the roof through $[_{DP}$a beam$]$.
b. *Peter supported the roof through $[_{CP}$that he put up a beam$]$.

As a result of their DP-complement bias, the matrix expressions from (48) to (50) do not accept DP/CP-coordinations in their complements. This fact is evidenced by (52) and (53).

[14]Other languages (e.g. German) *do* allow the alternation of DPs with CPs in prepositional adjuncts under certain conditions (see (19b), (20b)). We leave the detailed discussion of DP/CP-alternation in prepositional adjuncts for another occasion.

(52) *Pat eluded [[$_{\text{DP}}$Bill] and [$_{\text{CP}}$that he was following her every move]].

(53) *[[$_{\text{DP}}$Bill] and [$_{\text{CP}}$that he was waiting for Pat]] pinched Pat.

Notably, at least in English, there do not seem to be any verbs that only select for a CP (and not for a DP). Verbs like *hope* and *complain*, in which the CP cannot be directly replaced by a DP on the surface, still exhibit an alternation between CP complements and DPs figuring as a prepositional object (see Sect. 2.1.1).

Selection arguments against single-type semantics exploit the ability of dual-type semantics to straightforwardly explain the above DP/CP-differences, and the alleged inability of single-type semantics to explain these differences. This ability (or alleged inability) is supposed to be due to an approximate correspondence between syntactic categories and semantic types in dual-type semantics and to the absence of such a correspondence in single-type semantics.

Traditional dual-type semantics explain the ungrammaticality of (48b) and (49b) with reference to a mismatch between the type of the object complement of activity verbs, i.e. e, and the standard type of CPs, i.e. t, such that the semantic values of activity verbs do *not* accept the values of CPs as their arguments. As a result of this mismatch, pairs of DP object-biased verbs and CPs are excluded from the domain of the syntactic merge operation. This also holds for pairs of DP subject-biased verbs and for DP/CP coordinations. The ungrammaticality of (50b), (51b), (52), and (53) thus has an analogous explanation.

Since single-type semantics interprets CPs and referential DPs in the *same* type (s.t. the single-type type of activity verbs, $\langle \boldsymbol{o}, \langle o, o\rangle\rangle$, does not distinguish between the types of CP- and DP-complements), one might object that this semantics is, thus, unable to explain the ungrammaticality that results from combining a DP-biased verb or preposition with a CP (see (48b)–(51b)) or from combining a DP-biased verb with a DP/CP coordination (see (52), (53)). These alleged explanatory failures could then be construed as arguments against single-type semantics.

3.2. **Answering the Selection Arguments.** Single-type semantics has at its disposal several strategies for explaining the above-observed DP/CP differences. These strategies use the semantic selection properties of the matrix verb (Strategy 1) and the verb's syntactic subcategorization properties (Strategy 2).

Strategy 1. Strategy 1 aims to explain the ungrammaticality of (48b) to (51b) and (52) to (53) in analogy to the deviance of expressions like (54b) and (55b) to (55d), viz. through a violation of the lexical restrictions on the verbs' arguments: just as the verb *murder* demands that its subject be a person, such that it cannot be soundly combined with the designator of an impersonal individual (in (54b): with the DP *the fox tapeworm*), the verb *pinch* demands a concrete object and a concrete, animate subject. Hence, this verb cannot be soundly combined with the designator of an abstract entity in object position (e.g. with the DP *the problem*; see (55b)) or of an abstract or inanimate entity in subject position (e.g. with the DP *the problem* or *the door*; see (55c), (55d)).

(54) a. [$_{\text{DP}}$The mafia boss] murdered the mayor.

b. #[$_{\text{DP}}$The fox tapeworm] murdered the mayor.

(55) a. [$_{\text{DP}}$Bill] pinched [$_{\text{DP}}$Pat].

b. #Bill pinched [$_{DP}$the problem].
c. #[$_{DP}$The problem] pinched Pat.
d. #[$_{DP}$The door] pinched Pat.

Strategy 2. Strategy 2 provides a purely syntactic explanation of the ungrammaticality of (48b) to (51b) and (52) to (53) along the lines of Montague (1973) (see also Montague 1970a; Lewis 1970),[15] which is independent of the semantic interpretation of the matrix expression in these examples. This strategy is based on recent attempts at explaining the restriction of English *it*-extraposition in object position (see Kim and Sag 2005; Kim 2008; Sag et al. 2003). The strategy classifies verbs into DP object complement-biased, CP object complement-biased, and DP/CP object complement-neutral verbs. By classifying *pinch* and *elude* as members of the first class, this strategy explains the above ungrammaticalities. A generalization of this strategy to subject complements explains the ungrammaticality of (50b) and (53). Since this strategy does not reduce syntactic (i.e. subcategorization) to semantic (i.e. lexical selection) properties (vs. Strategy 1), it also entails that the above sentences are ungrammatical, rather than only semantically deviant.

This ends our support of single-type semantics through distributional DP/CP similarities, and our defense of this semantics against arguments from distributional DP/CP differences. We next turn to a different class of arguments for single-type semantics, whose members exploit the particular semantic properties of referential DPs. These arguments include the assertoricity argument for single-type semantics (which uses the ability of single-type semantics to explain the truth-evaluability of free-standing referential DPs) and entailment arguments for single-type semantics (which use the ability of this semantics to explain the obtaining of semantic inclusion relations between referential DPs and CPs). We will show that the explanation of these properties in single-type semantics is simpler and more natural than the explanation of these properties in dual-type semantics.

4. The Assertoricity Argument for Single-Type Semantics

The assertoricity argument for single-type semantics addresses the semantic contribution of non-sentential utterances or *fragments*. Fragments are utterances of free-standing DPs[16] like (56a) which are used to express a contextually salient proposition about the DPs' type-e referent (in the context from (56): the proposition (56b)) (see Stainton 2006; Merchant 2008; Progovac 2013). For convenience, we hereafter refer to such fragments as *DP fragments*.

The example fragments from (56a) to (60a) are inspired by Stainton (2006) (see Merchant 2008). Their propositional content is paraphrased in (56b) to (60b):

[15]Montague (1973) interprets intransitive verbs (category t/e) and common nouns (category $t/\!/e$) in the type for functions from individuals to propositions, $\langle e,t\rangle$ (or for functions from world-time pairs to sets of individuals, $\langle s,\langle e,t\rangle\rangle$). Distributional differences between these categories are exclusively explained through syntax. Montague does not regard this delegation of explanatory power as a defect of his framework. To the contrary: he attributes "the fact that Ajdukiewicz's proposals have not previously led to a successful syntax" to "the failure to pursue the possibility of syntactically splitting categories originally conceived in semantic terms" (*ibid.*, p. 249, fn. 4).

[16]These are proper sentence-constituents which do not have a linguistic antecedent.

(56) Barbara Partee is arriving at a linguistics conference. A participant turns to her colleague, gestures towards Barbara, and says (a).
   a. [$_{DP}$The keynote speaker].
   b. [$_{DP}$The keynote speaker] is arriving.

(57) Someone is trying to recognize a tune. Another person leans in on him/her and whispers (a).
   a. [$_{DP}$The Moon Lullaby].
   b. This is [$_{DP}$the Moon Lullaby].

(58) Pat and Mary are sitting at the promenade joking about who would be a good match for Bill. Mary signals at a pretty passer-by and says (a).
   a. [$_{DP}$She].
   b. [$_{DP}$She] would be a good match for Bill.

(59) Meera is putting jam on her toast. As she scoops out the jam, she observes, "chunks of strawberries". Anita nods and says (a).
   a. [$_{DP}$Rob's mom].
   b. [$_{DP}$Rob's mom] is responsible for the strawberry chunks in the jam.

(60) Bob is at a linguistics meeting, talking with Andy. There are some empty seats around the table. Bob points at one of them and says (a).
   a. [$_{DP}$An editor of *Natural Language Semantics*].
   b. This seat is reserved for [$_{DP}$an editor of *Natural Language Semantics*].

In virtue of their propositional interpretation, DP fragments have intuitive truth- and falsity-conditions (see Stainton 2006, pp. 8, 56). Thus, in the communicative context from (56), the utterance of (56a) is intuitively true if (56b) is true, and false if (56b) is false.

Dual-type semantics explain the truth-evaluability of DP fragments through non-standard mechanisms like ellipsis (see Merchant 2005) or flexible DP-typing (see Progovac 2013). Single-type semantics explains this truth-evaluability *without* resort to such special mechanisms. To make this possible, it analyzes o as the type for functions from contextually specified situations (type s)[17] to sets of situations (called *situated propositions*, type $\langle s,t\rangle$). This analysis is motivated by the inability of simpler single-type semantics to give the right truth-conditions for DP fragments and to correctly describe their semantic relation to certain CPs.[18] The ability of single-type semantics to explain the truth-evaluability of DP fragments is, thus, specific to our particular brand of single-type semantics. This contrasts with the simpler, uniform accommodation of the phenomena from Section 2, which is achieved by *any* single-type semantics. Since our particular single-type semantics interprets expressions with reference to a contextually specified situation, we describe this semantics as *situated single-type semantics*.

[17]The type s is typically associated with possible worlds or world-time pairs (see Montague 1970a, 1970b, 1973). To emphasize the similar role of situations and worlds (both function as contextual/evaluative parameters) – and to avoid the introduction of a new basic type –, we generalize s to *partial* possible worlds, or to (possible) *situations*. This generalization follows the use of the type s in Muskens (1995).

[18]The analysis of o as the type $\langle s,\langle s,t\rangle\rangle$ is motivated in detail in Liefke (2014, Ch. 4). This chapter also shows why neither the type s nor the type $\langle s,t\rangle$ qualify as single-type candidates.

Before we embark on our explanation of truth in situated single-type semantics, we make a brief observation about the reductive achievement of this semantics: since situated single-type semantics analyzes the type o as a complex type (viz. $\langle s, \langle s, t\rangle\rangle$), it identifies individuals and propositions only indirectly, i.e. via the introduction of a common reduction base whose elements code objects of both types. This indirect identification is also suggested by Partee (2006), who proposes to analyze the single basic type as the type for properties of situations, $\langle s, t\rangle$. Since the types s and t do not qualify as single-type types – such that we cannot obtain the type $\langle s, \langle s, t\rangle\rangle$ from lower-rank types through the type-forming rule (CT) – we are still justified in calling $\langle s, \langle s, t\rangle\rangle$ the *basic* single-type type.

Below, we first introduce the notions of situation, contextual specification of a situation, and situated proposition (in Sect. 4.1). We then describe the interpretation of CPs and referential DPs as functions from contextually specified situations to situated propositions (in Sect. 4.2) and give a truth-evaluation procedure for CPs and DP fragments in situated single-type semantics (in Sect. 4.3). Section 4.4 specifies the situated interpretation of verbal complements. Section 4.5 discusses the scope of the assertoricity argument.

4.1. **Situations and Situated Propositions.** Situations are informationally incomplete parts of possible worlds (or *partial* possible worlds) which are obtained from possible worlds by first identifying a particular spatio-temporal location in a world (i.e. a *chunk* of a world; see Perry 1986) and subsequently reducing the information about this location to the contextually salient information:

4.1.1. *From Worlds to World-Parts.* World-parts are parts of possible worlds which are obtained by restricting a particular spatial location in a world to a particular time of the world's history. As a result of this restriction, world-parts are identified with world-time-location triples of the form $\langle w, z, l\rangle$ (hereafter called *wzl-triples*). In these triples, the constant w identifies a possible world (including its past and future history; see Lewis 1986). The constants l (for *location*) and z (for *time*; German *Zeit*) denote regions in space and time, respectively.

Because of their world-like character, world-parts are inhabited by individuals (i.e. the individuals which are present at the particular location in the world at the specified time in the world's history) and are shaped by events (i.e. the events which occur at the world's particular spatio-temporal location). Typically, individuals exhibit different properties at different times and – assuming their spatial mobility – in different locations. We restrict an individual's properties at a world-part to those properties that the individual exemplifies at the world's particular spatio-temporal location. Thus, if the time of the world-part associated with (56) succeeds the time of Barbara's getting off the taxi, Barbara will not have the property of getting off the taxi at this world-part.

4.1.2. *The Contextual Specification of World-Parts.* We have previously assumed that world-parts are immediately given. However, in everyday life, world-parts are typically specified indirectly via a communicative context. This context can take the form of the utterance context (e.g. me speaking here and now), of an ostensive context (e.g. the linguist's gesturing towards Barbara in (56)), or of a (potentially fictional) discourse context (e.g. the Sherlock Holmes novels): if the communicative context is the utterance context *simpliciter*, the world-part is associated with the time and location of the utterance in the actual world (i.e. with

the *wzl*-triple $\langle @, \text{now}_@, \text{here}_@ \rangle$).[19] If the communicative context is an ostension, the world-part is associated with the *wzl*-triple which is the spatio-temporal target of the ostension[20] (for (56): with the triple $\langle @, z_@, \text{Barbara}_@ \rangle$). If the communicative context is a discourse context, the world-part is associated with the *wzl*-triple which consists of the world, time, and location of the discourse (for the Sherlock Holmes novels: with the triple $\langle w_7, \text{late-19th-century}_{w_7}, \text{London}_{w_7} \rangle$, where w_7 is the fictional world created by Sir Arthur Conan Doyle).

4.1.3. *Situations as Informationally Incomplete World-Parts.* Section 4.1.1 has introduced world-parts as 'total' objects: in some sense, world-parts are just small worlds which share some of the population of a 'larger' (i.e. spatially or temporally more extended) world. The individual inhabitants of these small worlds have all the properties that they exhibit at the relevant spatio-temporal location of the larger world. However, the participants in a communicative context can only command *some* information about the world-parts which are specified by these contexts. This is the typical or (perceptually) salient information about the targeted world-part, or information which has been introduced in the previous discourse.

We identify this information via the salience function $\mathcal{S}$. This function applies to communicative contexts to yield the contextually salient information about the world-parts which are specified by these contexts. This information includes information about the identity of the inhabitants of the specified world-part and information about the properties of these inhabitants. For example, for the context from (56), the function $\mathcal{S}$ yields the information that the world-part $\langle @, z_@, \text{Barbara}_@ \rangle$ is inhabited by Barbara, that Barbara is arriving at the conference venue of @ at the time $z_@$ and – as we will hereafter assume – that she is wearing a red sweater at @ and $z_@$. The value of $\mathcal{S}$ for the above context will not include any information about $\langle @, z_@, \text{Barbara}_@ \rangle$ that is not shared by the context's communicative participants (e.g. the information that Barbara is wearing a gold necklace at @ and $z_@$).

The specificity of the above properties with respect to a particular *wzl*-triple suggests that these properties are particulars (e.g. tropes, or features), rather than universals (i.e. 'traditional' properties). A possible ontology for situated single-type semantics that uses individuals and tropes is sketched in Appendix B. To avoid commitment to a particular ontology for situated single-type semantics, we hereafter reason about situations in terms of the information that is contained in these situations.

We identify the values of the salience function $\mathcal{S}$ with *situations*. Since the function $\mathcal{S}$ identifies situations on the basis of communicative contexts, we say that situations – like world-parts – are *contextually specified*. Since world-parts that are specified by communicative contexts ground situations in a world, time, and space, we call these world-parts the *referential anchors* of situations, or – more precisely – the referential anchors of the communicative contexts that ground these situations. We will use referential anchors to specify the truth-

[19]Following standard convention, we hereafter let '@' denote the actual world.

[20]These targets need not share the time of the ostension. For example, when listening to a recording of *Rigoletto*, the mental ostension accompanying a speaker's utterance of the name *Caruso* can be used to identify a *wzl*-triple whose time-element is a certain interval in 1903 during which Caruso sang in the recorded performance of *Rigoletto*.

conditions of CPs and DP fragments in situated single-type semantics (in Sect. 4.3), to capture the factivity of some DP/CP-neutral intentional verbs (see Sect. 4.4), and to explain the semantic deviance of some sentences with subject-position DP/CP-coordinations (see Sect. 2.2.1, fn. 10).

The informational incompleteness of situations induces a partial ordering on the set of situations. In particular, a situation σ_2 *includes* a situation σ_1, i.e. $\sigma_1 \sqsubseteq \sigma_2$, if σ_2 contains all information that is contained in σ_1. In virtue of our definition of situations, this condition requires that the location l_2 and time z_2 of the world-part about which σ_2 contains contextually salient information includes the location l_1 and time z_1 of the world-part about which σ_1 contains contextually salient information (s.t. l_2 maintains or expands the perimeters of ${l_1}$[21] and z_2 starts before or simultaneously with z_1 and ends after or simultaneously with ${z_1}$[22]). We call any situation which includes a situation an *extension* of that situation, and identify the *maximal extension* of a situation with the world containing the world-part about which the situation contains contextually salient information. A situation which is extended by another situation is called a *part* of its extending situation.

In virtue of the above, the partial ordering on situations has a bottom element (called the *'empty' situation*; denoted '†') and top elements (i.e. worlds w_n, with $n \in \mathbb{N}$). As a result, it holds for each situation σ that $\dagger \sqsubseteq \sigma \sqsubseteq w_n$ for some w_n, where † is the minimal part of σ and w_n is the maximal extension of σ.

4.1.4. *Situated Propositions.* Situated propositions are functions from situations to the truth-values *true* and *false*. Since situated propositions are, thus, characteristic functions of sets of situations,[23] we will sometimes describe situated propositions as *sets* of situations, and refer to the members of these sets as the *elements* of the situated proposition. Situated propositions are analogues of Lewis' (1986) *propositions* (see Kripke 1963; Stalnaker 1976; Montague 1970a), which are sets of possible worlds. In virtue of the above, situated propositions generalize Lewisian propositions: all Lewisian propositions are situated propositions, but not the other way around.

4.2. **DP- and CP-Interpretations.** We next describe the interpretation of CPs and referential DPs in the type for functions from contextually specified situations to situated propositions. We start with the situated single-type interpretation of simple CPs. To make the introduction of situated single-type semantics as accessible as possible, we focus on CPs with a definite DP subject. The interpretation of other kinds of DPs and of expressions from other syntactic categories (esp. of DP-biased and DP/CP-neutral verbs) is outlined in Appendix A.1.

4.2.1. *The Interpretation of CPs.* In situated single-type semantics, CPs are interpreted as functions of type $\langle s, \langle s, t\rangle\rangle$ which send contextually specified situa-

[21]In this way, the German Empire spatially includes itself, the Kingdom of Bavaria, and Prussia.
[22]In this way, World War I temporally includes itself, the assassination of Franz Ferdinand of Austria, the German march on Paris, and the final armistice.
[23]To obtain Russell's (1905) truth-conditions for sentences containing non-denoting DPs (s.t. the sentence *The present King of France is bald* and its negation, *The present King of France is not bald*, are both evaluated 'false'), we forgo the introduction of a third truth-value, *neither true nor false*, which is often assumed in situational generalizations of possible world semantics (see e.g. Muskens 1995). The truth-conditions for the above sentences are discussed in Sect. 4.3.

tions to situated propositions. Consider sentence (56b) (i.e. *The keynote speaker is arriving*): this sentence is typically uttered in a communicative context (e.g. the linguist's ostensive gesture from (56)) which specifies a situation (here called 'σ_0'). This situation serves as the *argument* of the interpretation of (56b) in situated single-type semantics.

The *value* of the interpretation of (56b) at the situation σ_0 is a situated proposition. In what follows, we use denotation brackets, $[\![\cdot]\!]$, as a notational device for the interpretation of linguistic expressions in situated single-type semantics. The value of (56b) for the argument σ_0 will be denoted by '$[\![$The keynote speaker is arriving$]\!](\sigma_0)$', shortened, for better readability, to '$[\![$The KS arrives$]\!](\sigma_0)$'. We describe the single-type interpretation of CPs at a contextually specified situation σ_0 as *the (σ_0-)situated proposition denoted by* the CP, or as the CP's *situated interpretation (at σ_0)*. Type-$\langle s, \langle s, t\rangle\rangle$ interpretations like $[\![$The KS arrives$]\!]$, which have not (yet) been applied to a contextually specified situation, are called *non-situated interpretations*.

The situated interpretation of (56b) at σ_0 is a set of situations σ in which the keynote speaker of σ is arriving in σ. However, to correctly describe the semantic relation between DPs and certain CPs (see Sect. 6), this set may not be identified with the set of *all* members of this set. Rather, it needs to be restricted to a proper subset of this set whose members are extensions of σ_0. The restriction to extensions of σ_0 ensures that all information from σ_0 is preserved in these members.

The situated interpretation of (56b) at σ_0 is given in (61). Below, σ is a variable over situations:

(61) $[\![$The keynote speaker is arriving$]\!](\sigma_0)$
$= \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \&$ the KS in σ arrives in $\sigma\}$
$= \{\sigma \mid \sigma_0 \sqsubseteq \sigma \ \&$ some inhabitant of σ is the KS in σ and arrives in $\sigma\}$

Note that the interpretation in (61) can take two different shapes, depending on the availability-in-σ_0 of the individual who is the keynote speaker in σ: if σ_0 already contains this individual as an inhabitant, (61) will identify the keynote speaker in σ with this inhabitant (and will attribute the property 'arriving in σ' to this inhabitant[24]). If σ_0 does not already contain this individual as an inhabitant, this individual is added as a 'new' inhabitant in σ. In the first case, the relevant inhabitant of σ can be specified by replacing the description 'some inhabitant of σ' in (61) by a rigid designator of the form '*dthat* [the (perceptually/informationally) salient or suitable individual from σ_0]' (see Kaplan 1978, 1989). In the ostensive situation from (56), this designator takes the form '*dthat* [the target of the linguist's ostension in σ_0]' (see (62)).

[24]Situated single-type semantics largely evades the problem of updates via incompatible information. This problem concerns the fact that a situation's update by a sentence which is *false* in this situation will yield the empty set of situations, such that the values of all false sentences in this situation will be the same. The informationally incomplete nature of situations solves the above problem for a large class of sentences. In particular, since situated single-type semantics identifies contextually specified situations with structures that contain only the typical or salient information about the targeted world-part, situations will only be incompatible with sentences that question the presupposed knowledge, the presented visual scene, or the established common ground. But utterances of such sentences are rather uncommon. The dynamic nature of situated single-type semantics is discussed in some detail in Appendix A.2.

(62) $\{\sigma \mid \sigma_0 \sqsubseteq \sigma$ & *dthat*[the target of the linguist's ostension in σ_0] is the KS in σ and arrives in $\sigma\}$

The identification of *dthat* [the target of the linguist's ostension in σ_0] with Barbara[25] allows us to resolve the description from (61) to (63):

(63) $\{\sigma \mid \sigma_0 \sqsubseteq \sigma$ & Barbara is the KS in σ and arrives in $\sigma\}$

4.2.2. *The Interpretation of Referential DPs.* Our interpretation of CPs already suggests a strategy for the interpretation of referential DPs in situated single-type semantics: like CPs, referential DPs (e.g. *the keynote speaker*) are interpreted as functions from contextually specified situations (again, the situation σ_0) to sets of extensions of these situations. To give the right truth-conditions for the DP *the keynote speaker* – and to correctly describe its semantic relation to CPs like *The keynote speaker is arriving* – we identify $[\![$the keynote speaker$]\!](\sigma_0)$ with the set of extensions of σ_0 in which Barbara is the keynote speaker. This set is given in (64):

(64) $[\![$the keynote speaker$]\!](\sigma_0)$
$= \{\sigma \mid \sigma_0 \sqsubseteq \sigma$ & some inhabitant of σ is the KS in $\sigma\}$
$= \{\sigma \mid \sigma_0 \sqsubseteq \sigma$ & *dthat*[the target of the linguist's ostension in σ_0] is the KS in $\sigma\}$
$= \{\sigma \mid \sigma_0 \sqsubseteq \sigma$ & Barbara is the KS in $\sigma\}$

In virtue of the above, the following proposition holds for the interpretation of CPs and referential DPs in situated single-type semantics:

Proposition 3. *At each contextually specified situation, the situated single-type interpretation of a referential DP* is a (possibly improper) superset of *the situated single-type interpretation of each upward-entailing CP*[26] *containing the DP.*

The obtaining of semantic relations between DPs and CPs (see Sect. 6) is a consequence of the above proposition.

4.2.3. *Example.* We illustrate the situated single-type interpretation of CPs and referential DPs through an example. This example uses the DP fragment *The keynote speaker* (i.e. (56a)) and the CP *The keynote speaker is arriving* (i.e. (56b)). The example obtains interpretations at the ostensive situation σ_0 from (56), in which Barbara is arriving and is wearing a red sweater.

The situated interpretation of (56a) at σ_0 is given in (65) (cf. (64)):

(65) $\{\sigma \mid \sigma_0 \sqsubseteq \sigma$ & Barbara is the KS in $\sigma\}$
$= \{\sigma \mid$ Barbara arrives in σ, Barbara wears a red sweater in σ & Barbara is the KS in $\sigma\}$

To give a concrete example for the situated proposition from (65), we consider the interpretation of (56a) in a universe consisting of five situations, σ_0, σ_1, σ_2, σ_3, and †. We assume that these situations are all extensions of the empty situation † (which is omitted from Fig. 1), that σ_3 is an extension of all other situations, that σ_2 is an extension of σ_1, and that σ_0 and σ_2 do not stand in an inclusion relation. We further assume that Barbara is the only individual in all four situations, that she is arriving (Ab) in σ_0, σ_2, and σ_3, that she is wearing a red sweater (Rb) in σ_0 and σ_3, and that she is the keynote speaker (Kb) in σ_1, σ_2, and σ_3. To emphasize that σ_0 is the *situating* context for the interpretation of (56a), we give it a darker shade in Figure 1.

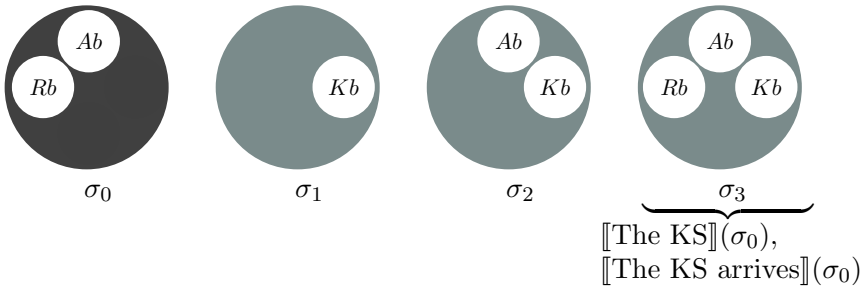

FIGURE 1. The σ_0-interpretations of (56a) and (56b).

Since σ_3 is the only situation in which Barbara is the keynote speaker and in which she has all of the properties which she has in σ_0, the application of the single-type interpretation of (56a) to σ_0 yields the singleton $\{\sigma_3\}$ (underbraced in Fig. 1).

The situated interpretation of the CP (56b) at σ_0 is given in (66) (cf. (63)):

(66) $\{\sigma \mid \sigma_0 \sqsubseteq \sigma$ & Barbara is the KS in σ and arrives in $\sigma\}$
$= \{\sigma \mid$ Barbara arrives in σ, Barbara wears a red sweater in σ &
Barbara is the KS in $\sigma\}$
$= \{\sigma_3\}$

Note that Barbara already has the property of arriving in σ_0, such that the utterance-in-σ_0 of (56b) only updates the information from σ_0 with the information that Barbara is the keynote speaker. Since this is exactly the information that is encoded in the sentence's DP subject, i.e. (56a), the relevant utterance of (56b) effects the same update on σ_0 as the utterance of (56a). As a result, (56b) and (56a) have the same situated interpretation at σ_0, i.e. [[The KS arrives]](σ_0) = [[The KS]](σ_0).

4.3. **DP- and CP-Evaluations.** Our previous considerations have assumed that CPs and DP fragments can be true or false in situated single-type semantics. However, since these expressions do not have their usual type in this semantics (i.e. they are interpreted in the type $\langle s, \langle s, t\rangle\rangle$, rather than in the standard type of CPs, $\langle s, t\rangle$), we cannot identify their truth-value at a world (or world-part) with the value of their interpretation at this world(-part).

To evaluate the truth or falsity of a CP or DP p which is interpreted at a contextually specified situation σ in situated single-type semantics, we check whether the world-part-of-evaluation w is a member of the interpretation-at-σ of p (i.e. whether $w \in [\![p]\!](\sigma)$). The truth-conditions for CPs and DP fragments in situated single-type semantics are given below:

[25]In what follows, we will use *Barbara* as the metalinguistic name for the individual that is identified by the linguist's ostensive gesture from (56). By referring to this individual with the name 'Barbara', we do *not* suggest that the linguist (or her friend) identify this individual as Barbara Partee.

[26]We expect that this inclusion of interpretations holds for all upward-entailing contexts containing the DP (e.g. for the sentence *The keynote speaker is arriving*), but will eventually not hold for downward-entailing contexts (e.g. for the sentences *The keynote speaker is not arriving*, *Nobody is arriving*, or *If the keynote speaker arrives, the Chair is relieved*).

Definition 1 (Truth at a world-part)**.** *In situated single-type semantics, a CP or DP p which is interpreted at a situation σ is* true *at a contextually given world-part (or at the referential anchor of σ, or 'actual' world-part) w if* $w \in [\![p]\!](\sigma)$*. The CP or DP p is* false *at w if* $w \notin [\![p]\!](\sigma)$*.*

As a result of Definition 1 and of the interpretation of CPs and DPs from Section 4.2, situated single-type semantics assigns the value 'false' to all CPs whose subject DPs do not have a referent in the world of evaluation. This is due to the identification of the situated interpretations of such CPs with the empty set (see Sect. 4.2.1), and to the non-membership of any world or world-part in this set. As a result of the above, the two sentences in (67) are both false, although one is the negation of the other.

(67) a. [$_{\text{DP}}$The present King of France] is bald.
b. [$_{\text{DP}}$The present King of France] is not bald.

Note that the above-specified truth-conditions for CPs are much stricter than the truth-conditions for CPs in classical Lewis-style semantics. This is due to the fact that the situated interpretation of a CP in situated single-type semantics also includes information that is contained in the interpreting situation. Consider the evaluation of the interpretation-at-σ_0 of (56b) (i.e. *The keynote speaker is arriving*) at a world, w_1, in which Barbara is the keynote speaker and is arriving, but in which she is wearing a *blue* sweater (and not a red sweater, as in σ_0): since Barbara is wearing a *red* sweater in all members of the interpretation-at-σ_0 of (56b), w_1 will not be a member of this interpretation. The CP (56b) will thus be judged 'false' at w_1. This stricter truth-evaluation is an immediate consequence of the proposed *situated* interpretation of natural language (see Sect. 7).

With the truth-conditions for CPs and referential DPs in place, we next turn to the situation-specific interpretation of verbal complements. The latter will enable the interpretation of embedded CPs and DPs in situated single-type semantics and will prepare our account of entailment arguments for this semantics.

4.4. **The Situated Interpretation of Verbal Complements.** Our previous presentation has assumed that embedded DPs and CPs (e.g. the DP *the keynote speaker* in (56b)) are interpreted at the same contextually specified situation as their larger embedding expression (for (56): at the situation-argument, σ_0, of the sentence *The keynote speaker is arriving*). However, some verbs (e.g. intentional verbs like *remember*) require an internal situation-argument that is different from the situation-argument of their embedding expression (i.e. from their external argument) (see Israel and Perry 1996; Schlenker 2003, 2012; Rabern 2013).[27]

Consider the following variant of (4b):

[27]The difference between these situation-arguments warrants a distinction between two notions of compositionality, dependent on the distribution of the external situation-argument: *compositionality of (non-situated)* ***meaning*** and *compositionality of (situated)* ***content***. Compositionality of meaning (or *chain compositionality*) assumes that $[\![A \circ B]\!](\sigma_0) = \big([\![B]\!]([\![A]\!])\big)(\sigma_0)$, where $\circ$ is a syntactic operation on expressions A and B and $[\![B]\!]([\![A]\!])$ is well-formed. Compositionality of content (or *distributional compositionality*) assumes that $[\![A \circ B]\!](\sigma_0) = [\![B]\!](\sigma_0)\big([\![A]\!](\sigma_0)\big)$ (see Westerståhl 2012; Zimmermann 2018). As a consequence of the distinction between the internal and the external situation-argument of some verbs, situated single-type semantics only exemplifies compositionality of meaning, not of content. The (meaning-)compositionality of situated single-type semantics is illustrated in Appendix A.1.

(68) Pat remembered [$_{\text{CP}}$that Bill had been waiting for her].

This sentence attributes the property of remembering that Bill has been waiting for Pat (at some point in the past) to Pat. However, as is indicated by the different tense of the matrix and the embedded verb, Pat's *remembering* situation (i.e. the (external) situation at which the embedding sentence, (68), is interpreted) is not identical to the object of Pat's remembering in this situation (i.e. to Pat's (internal) *remembered* situation). For example, it is consistent for Bill to be wearing his lumberjack shirt in Pat's remembering situation and to be wearing his favorite Hawaiian shirt in the remembered situation.

To capture the difference between the external and the internal situation-argument of verbs like *remember*, we apply the CP's single-type interpretation to a contextually chosen internal situation. The context-specific choice of situation is implemented by an indefinite choice function f (see Winter 2001; Steedman 2012). This function selects a single (but possibly not uniquely determined) situation from the set of situations, $\{\sigma \mid \sigma \in [\![\text{Bill is waiting for Pat}]\!](\sigma)\}$, in which Bill is waiting for Pat. The function f depends on the particular state or event described by the matrix verb. In particular, for the verb *remember*, this function selects a situation that temporally precedes the external situation.[28] Below, we represent this dependence by co-indexing f with the matrix verb.

The single-type interpretation of *remember* is illustrated in (69).[29] There, σ_0 is Pat's remembering situation. $f_k\big(\{\sigma' \mid \sigma' \in [\![\text{Bill is waiting for Pat}]\!](\sigma')\}\big)$ is the remembered situation, in which Bill is waiting for Pat.

(69) $[\![\text{Pat remembered}\,[_{\text{CP}}\text{that Bill had been waiting for Pat}]]\!](\sigma_0)$
$= \big\{\sigma \mid \sigma_0 \sqsubseteq \sigma$ and, in σ, Pat remembers^k
$f_k\big(\{\sigma' \mid \sigma' \in [\![\text{Bill is waiting for Pat}]\!](\sigma')\}\big)\big\}$

The situation $f_k\big(\{\sigma' \mid \sigma' \in [\![\text{Bill is waiting for Pat}]\!](\sigma')\}\big)$ will typically contain information beyond the truth-conditional content of the CP *Bill has been waiting for Pat*: depending on the particular situation which Pat is remembering, the content of her remembering will include other, additional information about Bill (e.g. that he was wearing his favorite Hawaiian shirt; see Werning and Cheng 2017; Cheng and Werning 2016). Interpretations like (69) thus correspond to vivid readings of intentional attitude reports in the sense of (Stephenson 2010) (cf. Higginbotham 2003).

The neutrality of the verb *remember* between a CP- and a DP-complement (see Sect. 2.1.1) may lead us to expect that occurrences of *remember* which take a *DP* complement also distinguish between their external and their internal situation-argument. This is indeed the case. In particular, the DP complement of the sentence *Pat remembered Bill* (see (4a)) may be interpreted at a different situation-argument than its containing sentence. Thus, Bill may have different properties at the two situations. The interpretation of (4a) is given below:

(70) $[\![\text{Pat remembered}\,[_{\text{DP}}\text{Bill}]]\!](\sigma_0)$
$= \big\{\sigma \mid \sigma_0 \sqsubseteq \sigma$ and, in σ, Pat remembers^k $f_k\big(\{\sigma' \mid \sigma' \in [\![\text{Bill}]\!](\sigma')\}\big)\big\}$

[28]The identification of this situation with a situation that has the same anchoring world as the external situation then captures the factivity of *remember*.

[29]This interpretation is *de re*, i.e. it allows the substitution of co-extensional expressions at the internal situation (cf. transparency) and regards the particular referents of the DP-constituent(s) (here: *Bill*) of the interpreted complement at this situation (cf. specificity).

We will see in Section 6 that the situation-specific interpretation of CPs and referential DPs in situated single-type semantics explains the intuitive semantic relations which obtain between some CPs and referential DPs. We close this section by outlining and refuting an overgeneralization argument against situated single-type semantics, which is based on the truth-evaluability of other (non-CP and non-DP) expressions.

4.5. **The Scope of the Assertoricity Argument.** Our previous considerations have supported situated single-type semantics with reference to the assertoric function of DP fragments. However, assertoricity is not only a property of DP-fragments. It is also a property of non-sentential utterances of expressions from *other* syntactic categories, including adjective phrases (APs) and prepositional phrases (PPs). For example, in the context from (71), the PP (71a) has the truth- and falsity-conditions of the CP (71b). In the context from (72), the AP (72a) has the truth- and falsity-conditions of the CP (72b) (see Stainton 2006).

(71) Sanjay and Silvia are loading up a van. When he sees that Silvia is looking for a missing table leg, Sanjay says (a).
   a. [$_{\text{PP}}$On the stoop].
   b. The missing table leg is [$_{\text{PP}}$on the stoop].

(72) Ray holds up a pen and utters (a).
   a. [$_{\text{AP}}$Purchased at Walmart].
   b. This pen has been [$_{\text{AP}}$purchased at Walmart].

A critic of our approach might use the identical truth-conditions in the pairs of phrases from (71) and (72) to argue for a generalization of the assertoricity argument from the traditional type of referential DPs to the types of non-referential DPs, APs, and PPs. This generalization could, in turn, be used to cast doubt on the force of the assertoricity argument as an argument for single-type semantics, or to support the neutralization of the distinction between the above types (as in Sect. 2.4).

However, this generalization is questioned by the special status of DP fragments among the different kinds of non-sentential utterances: in contrast to the assertoric interpretation of non-sentential occurrences of APs and PPs, the assertoric interpretation of DP fragments only has very limited contextual requirements. For example, in virtue of Barbara's arriving at the confererence venue in the situation described by the linguist's ostensive gesture from (56), this gesture provides all information that is required for the assertoric interpretation of (56a) (i.e. the information that Barbara is arriving).

This differs from the assertoric interpretations of (71a) and (72a), which require either the availability of a more detailed context (for (71): a context containing information about the identity of the missing object) or the provision of further, extra-contextual, information (here: the information that, in the visual situation from (71) – which only includes Silvia looking for *something* –, Silvia is, in fact, looking for the table leg). This requirement is due to the interpretation of APs and PPs as relations between properties of individuals, and to the possible existence of multiple exemplifiers of these properties. For example, in (71), the stoop may be cluttered with any number of objects, or may display another, more salient, object (e.g. a box of nails) that instantiates the property denoted by (71a). The ambiguity of (71a) between (71b) and (71c) in this context requires a further sortal specification of the object.

(71) c. The box of nails is [$_{\text{PP}}$on the stoop].

Admittedly, the identity of the 'intended' object is much less ambiguous in the case of (72). However, it is easy to imagine contexts (e.g. a discussion about places to buy pen refills) – consistent with the immediate communicative context – in which the property from (72a) has a different exemplifier than the one from (72b). In these contexts, (72a) makes a different conversational contribution than (72b). This contrasts with the assertoric interpretation of (56a), which (given an adequately accurate ostension) always makes the same contribution.

This completes our answer to the overgeneralization argument from non-DP fragments. We close this section by indicating another, higher-level, argument for the special status of the DP/CP relation and against the neutralization of the distinction between the semantic types of DPs, APs, and PPs. This argument relies on the *large* number of syntactic and semantic DP/CP similarities (viz. the ability of DPs and CPs to co-occur in numerous syntactic positions, and the ability of DPs to be truth-evaluable and to enter into semantic inclusion relations with CPs; see Sect. 6), and on the *small* number of similarities between DPs and APs and PPs.

We next show how situated single-type semantics answers arguments that are based on the difficulty of substituting a CP by the DP *the proposition* [$_{\text{CP}}$]. Because of the particular role of DP/CP substitutions in these arguments, we refer to members of this class of arguments as *substitution arguments*.

5. Substitution Arguments against Single-Type Semantics

Substitution arguments against single-type semantics include two arguments that are based on the substitution problem from Prior (1971) (see Moltmann 2003, 2013; Bach 1997) and the objectivization effect from Moltmann (2013) (see Pietroski 2000; Forbes 2018). These arguments regard the fact that the replacement of a verb's CP complement by a DP denoting the proposition expressed by the CP often creates a semantically deviant (non-synonymous) sentence (i.e. the substitution problem) or changes the reading of the complemented verb (i.e. the objectivization effect). In Kastner (2015), DPs of the form *the proposition* [$_{\text{CP}}$*that*...] are called *overt definite presuppositionals*. To avoid the presuppositional focus of Kastner's work, and to emphasize our restriction to the DP shell *the proposition*, we will hereafter refer to expressions of this kind as *overt propositional CP nominalizations*, or as *propositional CP nominalizations*.

5.1. **The Substitution Problem.**

The substitution problem is illustrated by the pairs of sentences from (73) to (75):

(73) a. Bill thinks [$_{\text{CP}}$that Pat is avoiding him].
b. $^{??}$Bill thinks [$_{\text{DP}}$the proposition [$_{\text{CP}}$that Pat is avoiding him]].

(74) a. Pat feared [$_{\text{CP}}$that Bill would try to kiss her].
b. $^{??}$Pat feared [$_{\text{DP}}$the proposition [$_{\text{CP}}$that Bill would try to kiss her]].

(75) a. Mary noticed [$_{\text{CP}}$that Pat did not like Bill].
b. $^{??}$Mary noticed [$_{\text{DP}}$the proposition [$_{\text{CP}}$that Pat did not like Bill]].

In particular, while (75a) asserts an obtaining of the notice-relation between Mary and the *fact* that Pat does not like Bill, (75b) asserts the obtaining of this relation between Mary and the *proposition* that Pat does not like Bill. As a result, the complements of *notice* from (75a) and (75b) have a different meaning.

The difference in meaning between a CP and its propositional nominalization is also exemplified by the different conversational contributions of (56b) and (56c) in the context from (56):

(56) Barbara Partee is arriving at a linguistics conference. A participant turns to her colleague, gestures towards Partee, and says (b).
  b. [$_{\text{DP}}$The keynote speaker] is arriving.
  c. $^{??}$[$_{\text{DP}}$The proposition [$_{\text{CP}}$that the keynote speaker is arriving]].

The semantic difference between the members of the pairs in (73) to (75), and between (56b) and (56c), is further evidenced by the fact that the second member of each of these pairs is semantically deviant or (even) infelicitous in many contexts. For example, while it is easy to imagine conditions under which the sentences (56b) and (75a) are true, many of the conditions under which (56c) or (75b) are true will be rather contrived (see Moltmann 2003, p. 82).

5.2. **The Objectivization Effect.** The objectivization effect regarding propositional CP nominalizations (see Moltmann 2003; 2013, pp. 131–132; Pietroski 2000; Forbes 2018) is a particular case of the substitution problem. It differs from most instances of this problem with respect to the semantic naturalness (or felicity) of the resulting sentence: in the objectivization effect, the substitution of a CP complement by its propositional nominalization does *not* yield a semantically deviant or infelicitous sentence. Rather, the substitution changes the reading of the matrix verb to a reading in which the proposition denoted by the CP no longer acts as the *content* of the attitude expressed by the verb. Instead, the proposition becomes the *object* towards which the attitude is directed.

The described change of interpretation is illustrated by the pairs of sentences in (76) to (78):

(76) a. Pat remembered [$_{\text{CP}}$that Bill was waiting for her].
  b. Pat remembered [$_{\text{DP}}$the proposition [$_{\text{CP}}$that Bill was waiting for her]].

(77) a. Bill imagined [$_{\text{CP}}$that Pat would hug him].
  b. Bill imagined [$_{\text{DP}}$the proposition [$_{\text{CP}}$that Pat would hug him]].

(78) a. Mary expects [$_{\text{CP}}$that Pat will avoid Bill at any cost].
  b. Mary expects [$_{\text{DP}}$the proposition [$_{\text{CP}}$that Pat will avoid Bill at any cost]].

In the context of (76), the DP *the proposition that Bill was waiting for her [i.e. Pat]* (see (76b)) plays a semantic role that is fundamentally different from that of the CP *that Bill was waiting for her* (see (76a)): while (76a) reports Pat's memory about a concrete situation, i.e. a situation in which Bill was waiting for her, (76b) reports Pat's memory about an abstract object, i.e. the proposition 'that Bill was waiting for Pat' (see Moltmann 2003, p. 87).

5.3. **Answering the Substitution Arguments.** The possibility of using the above problems as arguments against situated single-type semantics presupposes that the interpretations of CP complements are identical to the interpretations of the CPs' propositional nominalizations. This identity – and the resulting substitutivity of CPs by DPs of the form *the proposition* [$_{\text{CP}}$] in all linguistic contexts – would then predict that the phrases' embedding sentences from (73) to (78) make the same conversational contribution.

However, this identity does not hold. This is due to the informationally *rich* single-type interpretation of CPs at a situation (which also contains all other information that is available in this situation) and to the informationally *poor* single-type interpretation of DPs of the form *the proposition* [$_{\text{CP}}$] at this situation (which only contains the CP's situation-independent truth-conditional content).

The informationally poor interpretation of propositional CP nominalizations is obtained through the particular interpretation of the DP shell *the proposition*.[30] This shell is interpreted as a (curried) function from non-situated CP-interpretations $\boldsymbol{x}$ and contextually specified situations σ' to the value of $\boldsymbol{x}$ at the empty situation, †. The interpretation of the DP shell *the proposition* is given in (79). To make the interpretation of linguistic expressions as similar as possible to the description of DP- and CP-interpretations from the previous sections, we hereafter combine set-theoretic with lambda notation.[31]

(79) $[\![\text{the proposition}]\!] \;=\; \lambda\boldsymbol{x}\,\lambda\sigma'.\,\boldsymbol{x}(\dagger)$

The interpretation of the DP shell *the proposition* enables the compositional interpretation of (56c) at σ_0 as follows:

(80) $[\![\text{the proposition } [_{\text{CP}}\text{that the keynote speaker is arriving}]]\!](\sigma_0)$
$= \big([\![\text{the proposition}]\!]\big([\![_{\text{CP}}\text{that the keynote speaker is arriving}]\!]\big)\big)(\sigma_0)$
$= \big(\big(\lambda\boldsymbol{x}\,\lambda\sigma'.\,\boldsymbol{x}(\dagger)\big)\,\big(\lambda\sigma''.\,\{\sigma \mid \sigma'' \sqsubseteq \sigma \;\&\; \text{the KS in } \sigma \text{ arrives in } \sigma\}\big)\big)(\sigma_0)$
$= \big(\lambda\sigma'.\,\big(\lambda\sigma''.\,\{\sigma \mid \sigma'' \sqsubseteq \sigma \;\&\; \text{the KS in } \sigma \text{ arrives in } \sigma\}\big)(\dagger)\big)(\sigma_0)$
$= \big(\lambda\sigma'.\,\{\sigma \mid \dagger \sqsubseteq \sigma \;\&\; \text{the KS in } \sigma \text{ arrives in } \sigma\}\big)(\sigma_0)$
$= \{\sigma \mid \dagger \sqsubseteq \sigma \;\&\; \text{the KS in } \sigma \text{ arrives in } \sigma\}$
$= \{\sigma \mid \text{the KS in } \sigma \text{ arrives in } \sigma\}$

Note that the contextually specified situation σ_0 no longer figures in the final description of the set from (80) – not even in the choice of referents of the CP's DP-constituents (here: *the keynote speaker*). The interpretation of the DP shell *the proposition* deletes any information that may have been brought in from σ_0. To capture this observation, we call type-$\langle s,t\rangle$ interpretations of propositional CP nominalizations like (80) *unsituated* interpretations.[32]

In the example universe from Section 4.2.3, (80) is instantiated by the set $\{\sigma_2, \sigma_3\}$ (underbraced in Fig. 2). This set is different from the interpretation-at-σ_0 of the CP *The keynote speaker is arriving* (see (56b)), which is instantiated by the singleton $\{\sigma_3\}$.

[30]For reasons of space, we here neglect the interpretation of other CP nominalizations (e.g. *the fact* [$_{\text{CP}}$], or *the possibility* [$_{\text{CP}}$]), which have different semantic properties.

[31]The resulting 'mixed' notation is adopted, e.g., in Ciardelli et al. (2017).

[32]Unsituated interpretations (type $\langle s,t\rangle$) differ from *non-situated* interpretations (type $\langle s,\langle s,t\rangle\rangle$) (see Sect. 4.2.1), which have not (yet) been applied to a contextually specified situation.

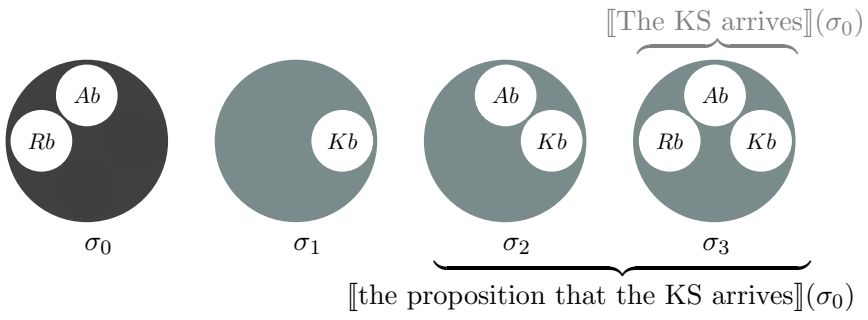

FIGURE 2. The σ_0-interpretations of (56b) and (56c).

The difference between the interpretation of CPs and their propositional nominalizations in situated single-type semantics explains the difference in meaning between the intentional embeddings of (56b) and (56c) (and analogously, for the members of the pairs from (73) to (78)).[33] The objectivization effect is further explained by the fact that a CP's situated interpretation is associated with (the information encoded in) a *situation*, while the situated interpretation of the CP's propositional nominalization is associated with an unsituated propositional *object*. Association with a situation, respectively with a propositional object then motivate the role of the attitude's *content* or *object*.

This completes our presentation and defense of the assertoricity argument for situated single-type semantics. We next present a third series of arguments for this semantics, which is based on the ability of situated single-type semantics to explain the semantic relations between CPs and referential DPs. Because of the prominent role of entailment[34] among the different semantic relations in these arguments, we refer to members of this class of arguments as *entailment arguments*.

6. Entailment Arguments for Single-Type Semantics

Entailment arguments for single-type semantics contain the argument from fragments (see Sect. 6.1) and the argument from neutral contexts (see Sect. 6.2). The first argument is based on the observation that DP fragments may intuitively stand in mutual semantic inclusion (or *equivalence*) relations to their associated CPs in the situation specified by the communicative context, such that the replacement of a DP fragment by its associated CP does not change the conversational contribution of the utterance in this context. The second argument is based on the observation that, in some linguistic contexts, embedded occurrences of DPs also enter into semantic inclusion relations with their containing CPs. This happens in the context of DP/CP complement-neutral verbs and prepositions (see Sect. 2.1) and in the context of DP/CP coordinations (see Sect. 2.2.1). Below, we discuss these arguments in turn, beginning with the argument from fragments.

[33]The compositional interpretation of DP/CP-neutral verbs, which supports this difference, is given in Appendix A.1.

[34]To avoid generalizing the term *entailment* to include the semantic relation between pairs of expressions from distinct syntactic categories, we here call the relation of truth-implication (s.t. q-interpreted-at-σ is true whenever p-interpreted-at-σ is true) *semantic inclusion (of q in p)*.

6.1. **The Argument from Fragments.** We have noted in Section 4 that utterances of DP fragments in a given communicative context may share the truth- and falsity-conditions of their associated CPs. This is the case when the CP does not contain any non-salient information other than the referent of the DP. The propositional interpretation of DP fragments then explains the occasional obtaining of equivalence relations between DP fragments and CPs, such that DP fragments sometimes display the semantic behavior of CPs. This occasional equivalence is evidenced by the fact that, in the context from (56) (i.e. the linguist's commenting her gesture towards Barbara), the replacement of the DP fragment *The keynote speaker* (i.e. (56a)) by the CP *The keynote speaker is arriving* (i.e. (56b)) preserves the linguist's conversational contribution.

We have suggested in Section 4 that dual-type semantics attempt to explain the equivalence of CPs and DP fragments in a given context via ellipsis (see Merchant 2005) or flexible DP-typing (see Progovac 2013). In contrast, situated single-type semantics explains this relation *without* resort to such mechanisms.[35] For convenience, we hereafter refer to the occasional equivalence between the *values* of single-type interpretations at a contextually specified situation σ_0 as ***contextual*** *equivalence* (***at*** $\boldsymbol{\sigma_0}$), or as $\boldsymbol{\sigma_0}$*-equivalence*.

In virtue of the above, the contextual equivalence of CPs and DP fragments has a simpler explanation in situated single-type semantics than in dual-type semantics. However, there are even a number of phenomena which *resist* an analysis through non-standard mechanisms in dual-type semantics, such that they *only* have an explanation in situated single-type semantics. These phenomena concern the semantic inclusion properties of embedded occurrences of referential DPs, whose particular interpretation in the relevant context is not triggered by a mismatch between the type of the verb (or preposition) and the type of its argument.[36] Such inclusion properties will be discussed in the following section.

6.2. **The Argument from Neutral Contexts.** We have seen in the previous section that DP fragments stand in a mutual semantic inclusion relation to their associated CPs in certain communicative contexts, such that the replacement of a DP fragment by its associated CP preserves the relevant linguistic contribution in this context. The inclusion properties of DP fragments are shared by some embedded (i.e. non-fragment) occurrences of referential DPs, which allow their meaning-preserving substitution by a CP in the contexts from Sections 2.1 and 2.2.1. The replacement of the DP *ein(en) Pfeiler* by the CP *dass er [i.e. Peter] einen Pfeiler aufstellte* in the context of the expression *Peter stützte das Dach durch* (see (20)) is an example of such substitutions. Meaning-preserving DP/CP substitutions at certain argument-situations are further exemplified by the replacement of the DP *Bill* by the CP *that Bill had been waiting for her [i.e. Pat]* in the context of the expression *Pat remembered* (see (4), (68)).

[35]Note that, like the ability of single-type semantics to explain the truth-evaluability of DP-fragments (see Sect. 4), the ability of single-type semantics to explain the contextual equivalence of CPs and DP fragments is specific to our particular brand of single-type semantics, i.e. situated single-type semantics. In Sect. 6.2, we will make a similar observation for the ability of single-type semantics to explain the semantic inclusion relations between CPs and non-fragment DPs.

[36]For example, since the standard type of referential DPs matches the standard type of prepositional complements, e, the interpretation of PPs like *durch einen Pfeiler* (see (20a)) does not solicit a shift in the meaning of the DP *ein(en) Pfeiler*. Yet, in the described context, the DP is situationally equivalent to the CP *dass Peter einen Pfeiler aufstellte*.

The equivalence between the members of the above DP/CP pairs is supported by the intuitive redundancy which results from coordinating the complements of the different occurrences of *remember* from (4a) and (68) (in (81); cf. (23)) or of the (pro-)preposition (*da-*)*durch* from (20) (in (82)), and by the difficulty of negating *only one* (but not the other) conjunct in these coordinations (see (86), (84)).

(81) Pat remembered [[$_{DP}$Bill] and [$_{CP}$that he had been waiting for her]].

(82) Peter stützte das Dach [[$_{PP}$durch [$_{DP}$einen Pfeiler]] und [$_{PP}$dadurch, [$_{CP}$dass er einen Pfeiler aufstellte]]].
[*gloss:* Peter supported the roof through a beam and PRO-through that he a beam put up.]
[*translation:* Peter supported the roof through a beam and by putting up a beam.]

Consider the DP/CP coordination from (82): the described feeling of redundancy with respect to this coordination results from the fact that the semantic information of the phrase *dass er [i.e. Peter] einen Pfeiler aufstellte* intuitively already contains the information of the phrase *ein*(*en*) *Pfeiler*, such that the CP semantically *includes* the DP. Since its installation (by Peter) is further the *only* relevant information about the beam in most standard contexts (s.t. the DP also includes the CP), the bracketed DP and CP from (82) are semantically equivalent.

The semantic inclusion of the DP in the CP from (82) is further supported by the possibility of replacing the German coordinator *und* [Engl.: 'and'] in (82) by the specifier *nämlich* [Engl.: 'viz.', or 'namely'] (in (83)), and by the difficulty of negating only the DP conjunct[37] (but not the CP conjunct) in (82) (see (84a)).

(83) Peter stützte das Dach [$_{PP}$durch [$_{DP}$einen Pfeiler]]; *nämlich* [$_{PP}$dadurch, [$_{CP}$dass er einen Pfeiler aufstellte]].
[*gloss:* Peter supported the roof through a beam, *viz.* PRO-through that he a beam put up.]
[*translation:* Peter supported the roof through a beam, *viz.* by putting up a beam.]

(84) a. # Peter stützte das Dach *nicht* [$_{PP}$durch [$_{DP}$einen Pfeiler]], sondern [$_{PP}$dadurch, [$_{CP}$dass er einen Pfeiler aufstellte]].
[*gloss:* Peter did *not* support the roof through a beam, but PRO-through that he a beam put up.]
[*translation:* Peter did *not* support the roof through a beam, but by putting up a beam.]

b. ?? Peter stützte das Dach [$_{PP}$durch [$_{DP}$einen Pfeiler]], aber *nicht* [$_{PP}$dadurch, [$_{CP}$dass er einen Pfeiler aufstellte]].
[*gloss:* Peter supported the roof through a beam, but *not* PRO-through that he a beam put up.]
[*translation:* Peter supported the roof through a beam, but *not* by putting up a beam.]

[37]Since the negation of referential DPs is unavailable in most languages (incl. German and English), we negate instead the first occurrence of the matrix verb.

In particular, since the beam is (trivially) the salient instrument in the installation of a beam, the information that Peter did *not* support the roof *through* a beam is incompatible with the information that he supported the roof *by putting up* a beam (see (84a)).

The semantic inclusion of the CP- in the DP-conjunct of the coordination from (82) is supported by the difficulty of negating only the CP conjunct (but not the DP conjunct) in (82) (see (84b)). In particular, since the *installation of* a beam is the typical way of supporting a roof *through* a beam, the information that Peter did *not* support the roof *by putting up* a beam is incompatible with the information that he supported the roof *through* a beam. The CP conjunct of the coordination from (82) is therefore semantically included in the coordination's DP conjunct *in all typical contexts*.

In contrast to the conjuncts of the coordination from (82), the conjuncts of the coordination from (81) are only equivalent *in some special contexts*. This is due to the fact that the DP *Bill* only semantically includes the CP *that Bill had been waiting for her [i.e. Pat]* in contexts (e.g. Pat's remembered situation from Sect. 4.4) in which Bill's waiting for Pat is a salient property of Bill.[38] The context-specificity of the inclusion of the CP in the DP then effects the context-specificity of the equivalence. Since Bill is (trivially) the agent in Bill's waiting for Pat (s.t. the semantic information of the phrase *that Bill had been waiting for Pat* always contains the information of the name *Bill*), the semantic inclusion of the DP in the CP holds in all contexts, as for the conjuncts from (82).

The (context-)general inclusion of the DP *Bill* in the CP *that Bill had been waiting for Pat* is further supported by the possibility (analogous to (83)) of replacing the coordinator *and* in (81) by the specifier *viz.* (in (85)) and by the difficulty (analogous to (84a)) of negating only the DP conjunct in (81) (in (86a)).

(85) Pat remembered [$_{\text{DP}}$Bill], *viz.* [$_{\text{CP}}$that he had been waiting for her].

(86) a. $^{\#}$ Pat *did not* remember [$_{\text{DP}}$Bill], but remembered [$_{\text{CP}}$that he had been waiting for her].

b. $^{??}$ Pat remembered [$_{\text{DP}}$Bill], but *did not* remember [$_{\text{CP}}$that he had been waiting for her].

The context-specific inclusion of the CP *that Bill had been waiting for Pat* in the DP *Bill* is supported by the fact that the negation of the CP conjunct in (81) (see (86b)) is difficult in those contexts in which Bill's waiting for Pat is a salient property of Bill. The negation of the CP is semantically consistent in contexts in which Bill's waiting for Pat is *not* a salient property of Bill. In (86b), this fact is captured by superscript question marks.

We have noted in the introduction to this section that the semantic inclusion properties of embedded DPs resist an explanation in dual-type semantics. This is due to the fact that the DPs' embedding contexts do not display any obvious type mismatches which would motivate an e-to-t or t-to-e shift (see Strategy (ii) from Sect. 2.3), that the (pro-)preposition *(da-)vor* is not presuppositional (s.t. it does not introduce the determiner Δ; see Strategy (iv)), and that the CP *dass*

[38]These contexts need not be identical to the situation which serves as the argument of the interpretation of (81) (cf. Sect. 4.4). However, since different intentional acts (e.g. remembering) have different targets, the choice of these contexts still depends on this situation.

er einen Pfeiler aufstellte (cf. (20b)) lacks a meaning-preserving overt DP shell (see Strategy (iii); (20b)′, (20b)″ in Sect. 2.3).

Since situated single-type semantics interprets referential DPs in the type of CPs, $\langle s, \langle s, t\rangle\rangle$, it explains the semantic inclusion properties of referential DPs. In this semantics, the semantic inclusion (or entailment) between expressions at a particular situation σ_0 is defined via the inclusion relation between the values of the expressions' interpretations *at that situation* (for the conjuncts from (81): by the inclusion relation between the sets of situations from (87) and (88)).

(87) $\{\sigma \mid \sigma_0 \sqsubseteq \sigma \;\&$ some inhabitant of σ is Bill in $\sigma\}$

(88) $\{\sigma \mid \sigma_0 \sqsubseteq \sigma \;\&$ some inhabitant of σ is Bill in σ and has been waiting for Pat in $\sigma\}$

The *general* semantic inclusion between two expressions is defined via the (pointwise) inclusion between the values of the expressions' interpretations *for each situation-argument*. For convenience, we refer to the inclusion relation between the values of single-type interpretations at a contextually specified situation σ_0 as the ***contextual*** *inclusion* (***at*** $\boldsymbol{\sigma_0}$), or as $\boldsymbol{\sigma_0}$*-inclusion* (analogous to the notion of σ_0-equivalence from Sect. 6.1), and refer to the inclusion relation between the interpretations' values across all contextually specifiable situations as the ***general*** *inclusion*, or simply as *(semantic) inclusion*.

Notably, the discussed inclusion relations between DPs and CPs are independent of the fact that the DP and CP occur in the complement of a DP/CP-neutral verb or (pro-)preposition. The DP's and CP's embedding context is merely a linguistic device which helps display the relevant semantic relation. The use of this device is made necessary by the fact that speakers' judgements about equivalence are typically restricted to CPs. It is enabled by the compositionality of natural language interpretation and by the identity of the embedding contexts of the complements of the two sentences from (4) and (20).

7. Conclusion

In this paper, we have provided different arguments for the adoption of single-type semantics – in particular, for the adoption of a particular kind of single-type semantics, called *situated* single-type semantics. These arguments include the ability of situated single-type semantics to provide a uniform account of the distributional similarities between CPs and referential DPs, to explain the truth-evaluability of DP fragments, and to explain the semantic relations between CPs and DPs. The arguments all capitalize on the ability of situated single-type semantics to model the above phenomena without the use of non-standard syntactic or semantic mechanisms. The presented arguments improve upon the strength and scope of Partee's original argument for single-type semantics: instead of only supporting the indirect uni-directional shiftability between propositions and individuals, they challenge the semantic distinction between propositions and individuals. Since our arguments further draw on different kinds of phenomena (esp. on syntactic vs. semantic phenomena) and are directed at different goals (unification vs. explanation), they further provide more diverse support for single-type semantics than Partee's argument.

Our considerations in this paper have focused on phenomena that illustrate the advantages of situated single-type semantics over traditional dual-typed semantics. However, we have also identified several phenomena whose accommodation seems to pose a challenge for situated single-type semantics. These include

distributional differences between DPs and CPs, the difficulty of meaningfully substituting a CP by the phrase *the proposition* [$_{\text{CP}}$] in many linguistic contexts, and the seeming possibility of generalizing the arguments from distributional DP/CP similarities and from DP assertoricity to other kinds of expressions besides DPs or CPs. Our paper has identified a number of strategies that answer the associated arguments against single-type semantics.

The existence of strong support for situated single-type semantics suggests that this semantics can be used as a compositional theory of natural language meaning (see Appendix A). For the familiar fragment of English from Montague (1973), this suggestion is implemented in Liefke (2014, Ch. 8). However, since this fragment lacks DP/CP complement-neutral verbs and prepositions, specificational constructions, proposition anaphora, and DP-fragments, this implementation does not very well showcase the merits of situated single-type semantics. The single-type interpretation of a proper extension of Montague's fragment by these expressions will be a topic for future work. Such work should also include an explicit proof that situated single-type semantics preserves the modelling and explanatory power of dual-type semantics and that it supports the accepted predictions about entailment.

We close with a note about the relation between situated single-type semantics and Situated Cognition. Situated Cognition is an approach from cognitive science and artificial intelligence that views cognition as strictly tied to the situational context of cognition (see Akman 2009; Clancey 1997). Situated single-type semantics can be regarded as providing the formal background for one of the four paradigms of Situated Cognition, viz. extendedness (of cognition/linguistic understanding into the external environment): the semantics captures this extendedness by having the world-part with respect to which a linguistic utterance is interpreted figure directly in the content of this utterance. The detailed development of the connection between situated single-type semantics and Situated Cognition is left as a project for future work.

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Appendix A. Compositionality in Situated Single-Type Semantics

At different points in the paper, we have suggested the possibility of formulating situated single-type semantics as a compositional theory. Since some tools from standard compositional semantics cannot be straightforwardly applied to situated single-type semantics, we briefly indicate how compositionality can be accomplished in this semantics.[39]

Notably, the presented semantics is only a suggestion for a compositional version of situated single-type semantics, which provides proof of principle for the availability of such a semantics. As such, it makes neither a claim to (conceptual or empirical) completeness, nor does it preclude alternative implementations.

A.1. **Composition Below the Sentence Boundary.** The interpretation of linguistic expressions in situated single-type semantics proceeds analogously to the compositional interpretation of expressions in dual-type semantics (i.e. via function application of the interpretation of one node in a binary-branching syntactic tree to the interpretation of the other node; see Klein and Sag 1985). The single-type types of expressions which enable this interpretation are obtained from dual-type types by replacing all occurrences of the types e and t in the dual-type types of expressions with the single basic type $\langle s, \langle s, t\rangle\rangle$ (see Sect. 1). Common nouns and intransitive verbs (dual-type type $\langle e, t\rangle$) then receive an interpretation in the type $\langle\langle s, \langle s, t\rangle\rangle, \langle s, \langle s, t\rangle\rangle\rangle$. Transitive verbs (dual type $\langle e, \langle e, t\rangle\rangle$) are interpreted in the type $\langle\langle s, \langle s, t\rangle\rangle, \langle\langle s, \langle s, t\rangle\rangle, \langle s, \langle s, t\rangle\rangle\rangle\rangle$.

[39]For a formalization of the principle of compositionally, see Hodges (2001) and Werning (2004). For the notion of compositionality in general, the reader is referred to Werning, Hinzen, and Machery (eds. 2012).

A.1.1. *The Interpretation of DP/CP-Neutral Verbs.* The interpretation of CPs and referential DPs from Section 4.2 already suggests a strategy for the single-type interpretation of DP/CP-neutral verbs like *suck* (see (16)). This strategy sends (curried) ordered pairs of the non-situated interpretation of a CP or referential DP $\boldsymbol{x}$ and a contextually specified situation σ' to the set of extensions of σ' in which a minimal element of the situated interpretation of $\boldsymbol{x}$ at σ' sucks. This element is selected from the set of minimal elements of $\boldsymbol{x}(\sigma')$, i.e. $\Pi(\boldsymbol{x}(\sigma'))$, by the pragmatically given choice function f from Section 4.4. The operator, Π, which identifies the minimal elements of a set of situations, is defined as follows:

$$(89)\quad \Pi(X_{\langle s,t\rangle}) \;:=\; \{\sigma \mid \sigma \in X \;\&\; \forall \sigma' \in X : \sigma' \sqsubseteq \sigma \Rightarrow \sigma' = \sigma\}$$

The interpretation of the verb *suck* is given below:

$$(90)\quad [\![\text{suck}]\!] \;=\; \lambda \boldsymbol{x} \lambda \sigma'. \{\sigma \mid \sigma' \sqsubseteq \sigma \;\&\; f\big(\Pi(\boldsymbol{x}(\sigma'))\big) \text{ sucks in } \sigma\}$$

The interpretation of *suck* from (90) enables the compositional interpretation of sentences of the form of (16a) and (16b) (in (91), (93)). In the description of this interpretation, 'BP' is short for 'beamer projector'.

$$\begin{aligned}(91)\quad & [\![[_{\text{DP}}\text{The beamer projector}]\,[_{\text{VP}}\text{sucks}]]\!](\sigma_0)\\ &= \big([\![_{\text{VP}}\text{sucks}]\!]\big([\![_{\text{DP}}\text{the beamer projector}]\!]\big)\big)(\sigma_0)\\ &= \big(\big(\lambda \boldsymbol{x} \lambda \sigma''. \{\sigma \mid \sigma'' \sqsubseteq \sigma \;\&\; f\big(\Pi(\boldsymbol{x}(\sigma''))\big) \text{ sucks in } \sigma\}\big)\\ &\qquad \big(\lambda \sigma'''. \{\sigma' \mid \sigma''' \sqsubseteq \sigma' \;\&\; \text{some inhabitant of } \sigma' \text{ is the BP in } \sigma'\}\big)\big)(\sigma_0)\\ &= \big(\lambda \sigma''. \{\sigma \mid \sigma'' \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\{\sigma' \mid \sigma'' \sqsubseteq \sigma' \;\&\\ &\qquad\qquad \text{some inhabitant of } \sigma' \text{ is the BP in } \sigma'\}\big)\big) \text{ sucks in } \sigma\}\big)(\sigma_0)\\ &= \{\sigma \mid \sigma_0 \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\{\sigma' \mid \sigma_0 \sqsubseteq \sigma' \;\&\; \text{some inhabitant of } \sigma' \text{ is the BP}\\ &\qquad\qquad\qquad\qquad \text{in } \sigma'\}\big)\big) \text{ sucks in } \sigma\}\end{aligned}$$

In the last line of (91), the choice function f selects a minimal element from the set of situations $\{\sigma' \mid \sigma_0 \sqsubseteq \sigma' \;\&\; \text{some inhabitant of } \sigma' \text{ is the BP in } \sigma'\}$, i.e. from the set $[\![\text{the BP}]\!](\sigma_0)$. If the situation σ_0 already contains the object that is the beamer projector in σ' as an inhabitant – and contains the information that this object is the beamer projector in σ' –, the situation σ_0 is the single minimal element of $[\![\text{the BP}]\!](\sigma_0)$ (i.e. $f\big(\Pi\big([\![\text{the BP}]\!](\sigma_0)\big)\big) = \sigma_0$). If σ_0 does not contain the information that some (specific) inhabitant of σ_0 is the beamer projector in σ' – or if it does not even contain the object that is the beamer projector in σ' –, the chosen minimal element of $[\![\text{the BP}]\!](\sigma_0)$ is a proper extension of σ_0 (s.t. $f\big(\Pi\big([\![\text{the BP}]\!](\sigma_0)\big)\big) \neq \sigma_0$).

The interpretation in (91) illustrates the *meaning*-compositional interpretation of linguistic expressions in situated single-type semantics (see fn. 27): this interpretation proceeds by first applying the interpretation of *suck* to the non-situated interpretation of the DP *the beamer projector*, and subsequently applying the result of this application to the situation σ_0. Since *suck* interprets its complement at its external situation-argument (here: σ_0), the sentence *The beamer projector sucks* can, in principle, also be given a content-compositional interpretation. This interpretation is obtained by applying a σ_0-situated version of the interpretation of *suck* from (90) to the situated interpretation of *the beamer projector* at σ_0 (see (92)):

$$(92)\quad \big([\![_{\text{VP}}\text{sucks}]\!](\sigma_0)\big)\big([\![_{\text{CP}}\text{the beamer projector}]\!](\sigma_0)\big)$$

However, this alternative interpretation strategy is not suitable for the interpretation of DP/CP-neutral verbs like *remember*, whose internal situation-argument is typically different from their external situation-argument (see below). This motivates our adoption of the more general meaning-compositional strategy.

The interpretation of CP-taking occurrences of *suck* is illustrated below:

(93) $[\![[_{\text{CP}}\text{That the beamer projector is broken}]\,[_{\text{VP}}\text{sucks}]]\!](\sigma_0)$
$= \big([\![_{\text{VP}}\text{sucks}]\!]\big([\![_{\text{CP}}\text{that the beamer projector is broken}]\!]\big)\big)(\sigma_0)$
$= \big(\big(\lambda\boldsymbol{x}\,\lambda\sigma''.\,\{\sigma \mid \sigma'' \sqsubseteq \sigma \;\&\; f\big(\Pi(\boldsymbol{x}(\sigma''))\big) \text{ sucks in } \sigma\}\big)\,\big(\lambda\sigma'''.\,\{\sigma' \mid \sigma''' \sqsubseteq \sigma' \;\&\; \text{some inhabitant of } \sigma' \text{ is the BP in } \sigma' \text{ and is broken in } \sigma'\}\big)\big)(\sigma_0)$
$= \big(\lambda\sigma''.\,\{\sigma \mid \sigma'' \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\{\sigma' \mid \sigma'' \sqsubseteq \sigma' \;\&\; \text{some inhabitant of } \sigma' \text{ is the BP in } \sigma' \text{ and is broken in } \sigma'\}\big)\big) \text{ sucks in } \sigma\}\big)(\sigma_0)$
$= \{\sigma \mid \sigma_0 \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\{\sigma' \mid \sigma_0 \sqsubseteq \sigma' \;\&\; \text{some inhabitant of } \sigma' \text{ is the BP in } \sigma' \text{ and is broken in } \sigma'\}\big)\big) \text{ sucks in } \sigma\}$

Note that, in (93) (cf. (91)), *suck* is interpreted as a relation to a single situation (type s). This differs from classical Hintikka semantics for attitude verbs (see Hintikka 1969; cf. Montague 1973), which interprets clausal attitude complements as *sets* of situations/worlds (type $\langle s, t\rangle$). The type-s interpretation of attitude complements is in line with the interpretation of attitude reports in situation semantics (see Barwise 1981; Barwise and Perry 1983; Kratzer 2006) and with Stephenson's (2010) semantics for 'vivid' attitude reports (cf. Higginbotham 2003).

The interpretation strategy of the verb *suck* from (90) is shared by all DP/CP-neutral intentional verbs which identify their internal situation-argument with the situation-argument of their embedding expression. The compositional interpretation of verbs (e.g. *remember*, *imagine*) which do not make this identification requires a slight modification of this strategy. For some initial ideas as to the modified strategy, the interested reader is referred to Section 4.4.

A.1.2. *The Interpretation of DP-Biased Verbs.* The interpretation strategy from (90) works well for DP/CP-neutral verbs (e.g. *suck*, *stink*, *rock*), which express relations to informationally rich situations. It is less suitable for the interpretation of DP-biased verbs (e.g. *arrive*, *pinch*, *elude*), which express relations to informationally poorer objects (e.g. to informationally depleted situations, or to individuals). To provide a suitable semantics for such verbs, we replace the domain of the choice function f from (90) by the set, $\Pi(\boldsymbol{x}(\dagger))$, of minimal elements in the set $\boldsymbol{x}(\dagger)$. Since the set $\boldsymbol{x}(\dagger)$ contains *all* situations σ s.t. $\sigma \in \boldsymbol{x}(\sigma)$, the set $\Pi(\boldsymbol{x}(\dagger))$ will contain very small situations, some of which are only inhabited by a single individual and which do not contain any further information about this individual.

The interpretation of the verb *arrive* is given below:[40]

(94) $[\![\text{arrive}]\!] \;=\; \lambda\boldsymbol{x}\,\lambda\sigma'.\,\{\sigma \mid \sigma' \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\boldsymbol{x}(\dagger)\big)\big) \text{ arrives in } \sigma\}$

[40]As a consequence of the (largely) analogous interpretation of DP/CP-neutral and DP-biased verbs in situated single-type semantics, the interpretation of DP-biased verbs from (94) does not preclude an application to the single-type interpretation of a CP. The semantic deviance of the resulting construction is explained by any one of the strategies from Sect. 3.2.

The above enables the compositional interpretation of the following simplified variant of (56b) (cf. (61)):

$$
\begin{aligned}
(95)\quad & [\![[_{\text{DP}}\text{Barbara}]\,[_{\text{VP}}\text{is arriving}]]\!](\sigma_0)\\
&= \big([\![_{\text{VP}}\text{is arriving}]\!]\big([\![_{\text{DP}}\text{Barbara}]\!]\big)\big)(\sigma_0)\\
&= \Big(\big(\lambda \boldsymbol{x}\, \lambda\sigma''.\, \big\{\sigma \mid \sigma'' \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\boldsymbol{x}(\dagger)\big)\big) \text{ arrives in } \sigma\big\}\big)\\
&\qquad \big(\lambda\sigma'''.\, \{\sigma' \mid \sigma''' \sqsubseteq \sigma' \,\&\, \text{some inhabitant of } \sigma' \text{ is Barbara in } \sigma'\}\big)\Big)(\sigma_0)\\
&= \big(\lambda\sigma''.\, \big\{\sigma \mid \sigma'' \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\{\sigma' \mid \dagger \sqsubseteq \sigma' \,\&\,\\
&\qquad\qquad \text{some inhabitant of } \sigma' \text{ is Barbara in } \sigma'\}\big)\big) \text{ arrives in } \sigma\big\}\big)(\sigma_0)\\
&= \big\{\sigma \mid \sigma_0 \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\{\sigma' \mid \dagger \sqsubseteq \sigma' \,\&\, \text{some inhabitant of } \sigma' \text{ is Barbara in}\\
&\qquad\qquad \sigma'\}\big)\big) \text{ arrives in } \sigma\big\}\\
&= \big\{\sigma \mid \sigma_0 \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\{\sigma' \mid \text{some inhabitant of } \sigma' \text{ is Barbara in } \sigma'\}\big)\big) \text{ arrives in } \sigma\big\}\\
&= \big\{\sigma \mid \sigma_0 \sqsubseteq \sigma \;\&\; f\big(\Pi\big(\{\sigma' \mid \text{Barbara inhabits } \sigma'\}\big)\big) \text{ arrives in } \sigma\big\}\\
&= \big\{\sigma \mid \sigma_0 \sqsubseteq \sigma \;\&\; \text{Barbara arrives in } \sigma\big\}
\end{aligned}
$$

The identity of the sets from the last two lines of (95) is justified by the idempotency of the operation of information accumulation, $\oplus$, which is used to build situations from ontologically basic objects like individuals (see Appendix B). Because of the idempotency of $\oplus$, the situation containing only Barbara, i.e. $\oplus\{\text{Barbara}\}$ – which is the single minimal element of the set $[\![\text{Barbara}]\!](\dagger) = \{\sigma' \mid$ Barbara inhabits $\sigma'\}$ –, is identical to Barbara. A possible ontology for situated single-type semantics is sketched in Appendix B.

We close our discussion of the interpretation of DP-biased verbs with an observation about the use of the interpretation strategy from (94) for an alternative interpretation of DP/CP-neutral verbs: it has been observed that DP/CP-neutral verbs like *remember* and *imagine* are ambiguous between *vivid* (i.e. informationally rich) readings (see Sect. 4.4; cf. App. A.1.1) and *non-vivid* (i.e. informationally depleted) readings (see Stephenson 2010; cf. Higginbothan 2003). We expect that the interpretation strategy from (94) can also be used to obtain non-vivid readings of DP/CP-neutral verbs.

A.2. **Composition Beyond the Sentence Boundary.** Our previous considerations have assumed that the situation-argument of DP- and CP-interpretations in situated single-type semantics is given externally (e.g. as the target of an ostensive gesture, see (56)). However, the situation-argument is often provided by the utterance or discourse context (see Sect. 4.1.2). This context results from an incremental update of some initial situation (e.g. of the perceptual target situation, or of the informational common ground) with the information encoded in sequentially uttered CPs or DP fragments.[41]

The type of DPs and CPs in situated single-type semantics, i.e. $\langle s, \langle s, t\rangle\rangle$, disables the familiar treatment of sequential update from dynamic semantics (cf. Groenendijk and Stokhof 1991; Veltman 1996). This treatment is defined for objects with the same input- and output-type – paradigmatically for objects of type $\langle\langle s, t\rangle, \langle s, t\rangle\rangle$ (i.e. for context change potentials). The incremental update of a type-$\langle s, t\rangle$ information state s with the sequential utterance of two CPs, S

[41] Arguably, the situation-argument can also be obtained by restricting the utterance or discourse context through an ostensive gesture. We assume that such restriction plays a similar role to the salience function $\mathcal{S}$ (see Sect. 4.1.3).

and T, is then analyzed as the application of the context change potential, τ', of T to the result of applying the context change potential, τ, of S to s (i.e. as $\tau'(\tau(s))$).

To compensate for the different types of CP- (or DP-)arguments and values in situated single-type semantics, we analyze the interpretation-at-σ_0 of the sequential utterance of S and T as the application of the non-situated interpretation, $[\![T]\!]$, of T to a minimal element in the situated interpretation of S at σ_0. This element is selected from the set of minimal elements by a pragmatically given choice function f. The use of this function is made necessary by the fact that the ordering on situations is only partial (and, hence, not necessarily connected)[42], such that a set of situations may have more than one minimal element.

The sequential interpretation of S and T in situated single-type semantics is given in (96). Below, ';' denotes the order-sensitive conjunction of utterances of sentences and DP fragments. Π is the minimality operator from Section A.1.1.

$$(96)\quad [\![S;T]\!](\sigma_0) \;:=\; [\![T]\!]\big(f\big(\Pi\big([\![S]\!](\sigma_0)\big)\big)\big)$$

The development of dynamic single-type semantics is left as a project for future research.

Appendix B. An Ontology for Situated Single-Type Semantics

In Section 4.1.3, we have mentioned a possible ontology for situated single-type semantics that has as its basic elements individuals and tropes. More generally, we propose an ontology of information particles. Ontologically, these are particulars, i.e. entities that occur only once in a single world. Particulars, in other words, do not re-occur as complete entities at distinct times and locations in one and the same world. Basic information particles include concrete particulars (i.e. individuals; e.g. Barbara) and abstract particulars (i.e. tropes; e.g. Barbara's arriving at $\langle @, \text{now}_@, \text{here}_@\rangle$, or Barbara's wearing a red sweater at $\langle @, \text{now}_@, \text{here}_@\rangle$).

Situations (usually) are more complex information structures, which are built up from individuals and tropes by the primitive operation of information accumulation, $\oplus$. This operation is a binary, idempotent, commutative, and associative operation with a bottom element $\dagger$.[43] For example, this operation applies to Barbara and Barbara's arriving at $\langle @, \text{now}_@, \text{here}_@\rangle$ to yield the informational depletion of the world-part $\langle @, \text{now}_@, \text{here}_@\rangle$ that is inhabited (only) by Barbara and in which Barbara is (only) arriving (and does not exemplify any other properties) (see (97)).

$$(97)\quad \text{Barbara} \oplus \text{Barbara's arriving at } \langle @, \text{now}_@, \text{here}_@\rangle$$

$$(98)\quad = \bigoplus \big\{\text{Barbara}, \text{Barbara's arriving at } \langle @, \text{now}_@, \text{here}_@\rangle\big\}$$

[42]For two situations σ_1 and σ_2, it may thus hold that neither $\sigma_1 \sqsubseteq \sigma_2$ nor $\sigma_2 \sqsubseteq \sigma_1$.

[43]Thus, it holds for individuals/tropes a, b, and c that $a \oplus a = a$ (idempotency), $a \oplus b = b \oplus a$ (commutativity), $(a \oplus b) \oplus c = a \oplus (b \oplus c)$ (associativity), and $a \oplus \dagger = a$ (neutral element).

The algebraic properties of $\oplus$ allow us to generalize $\oplus$ to sets of arbitrary (countable) cardinality, s.t. $\bigoplus\{a_1, \ldots, a_n\} = (a_1 \oplus \ldots) \oplus a_n$ (see (98)). Because of the idempotency of $\oplus$ and the definition of $\dagger$, it holds for all basic objects a (i.e. individuals and tropes) that $\bigoplus\{a\} = a$ and that $\bigoplus\{\} = \dagger$. The identification of singleton information-accumulations with their selected minimal element (in particular, the identification of $\big(\{\sigma \mid \text{Barbara inhabits } \sigma\} =\big) \bigoplus\{\text{Barbara}\}$ with $f\big(\Pi\big(\{\sigma \mid \text{Barbara inhabits } \sigma\}\big)\big)$) then licenses the step from the penultimate to the last line of (95) in Section A.1.2.

The informational analysis of situations enables us to define the partial ordering on situations, $\sqsubseteq$, (see Sect. 4.1.3) in terms of informational accumulations of individuals and tropes. This definition is given below:

(99) $a \sqsubseteq b$ iff $\bigoplus\{a, b\} = b$

The definition of $\sqsubseteq$ supports the description of the situation in (98) as an extension of the situation $\bigoplus\{\text{Barbara}\}$. The set of (concrete and abstract) inhabitants of σ_0 can then be defined as $\{x \mid x \sqsubseteq \sigma_0\}$. The descriptions '$a$ inhabits σ' and 'a Fs in σ' (i.e. 'a's Fing at the *wzl*-triple, $\langle @, \text{now}_@, \text{here}_@\rangle$, about which σ contains contextually salient information') are analyzed as (100) and (101), respectively:

(100) a inhabits $\sigma \;:=\; \bigoplus\{a\} \sqsubseteq \sigma$

(101) a Fs in $\sigma \;:=\; \bigoplus\big\{a\text{'s } F\text{ing at } \langle @, \text{now}_@, \text{here}_@\rangle\big\} \sqsubseteq \sigma$

This completes our sketch of a possible ontology for situated single-type semantics.

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