Reference & indexicality

Rast, Erich Herrmann

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Reference and Indexicality

Erich Herrmann Rast

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Roskilde University, Denmark

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Erich Herrmann Rast

Abstract

This thesis is a general defence of a context-dependent description theory of reference with special regards to indexical reference on the basis of a truth-conditional theory of meaning. It consists of two parts. In the first part, the roots of the Frege-Russell view are laid out and contrasted with various aspects of direct reference theory and the New Theory of Reference. Two description-based accounts of the reference of proper names, nominal and external description theory, are defended against various known counter-arguments such as Kripke's circularity objection and the Church-Langford translation test. It is shown how the resulting analysis of de dicto belief ascriptions can be made compositional, but also argued that compositionality is not mandatory. The second part deals with forms of indexical and non-indexical context-dependence. Taking into account a range of typological data, referential features of indexical expressions like their egocentricity, token-reflexivity, and the vagueness of spatial and temporal indexicals are laid out. Kaplan's Logic of Demonstratives is then reformulated, but following Cresswell (1990) it is argued that full quantification over modal indices is needed. Various indicators and demonstratives are analyzed on the basis of a description theory of reference in a variant of first-order predicate logic with non-traditional predication theory and two sorts of reified contexts. Examples analyzed include: *I*, *now*, *here*, *actually*, *we*, *the former president*, *the left entrance*, context-shifting indexicals, and demonstratives like Japanese *are*. Finally, essential indexicality is addressed and it is conceded that description theory cannot deal with attitudes de se. In defense of indirect reference it is argued that the cognitive phenomena underlying essential indexicality, as for example I-thoughts, aren't aspects of the public meaning of natural language expressions and that speaking of a 'language of thinking' or 'reference in thinking' are unfitting metaphors for general semiotic reasons.

Résumé

Afhandlingen forsvarer en kontekstafhængig beskrivelsesteori om reference med specielt hensyn til indeksikalske udtryk og på baggrund af sandhedskonditional betydningsteori. Afhandlingen består af to dele. I den første del, fremstilles rødderne i Frege–Russell synspunkt og kontrasteres med forskellige aspekter af direkte reference teori og den Nye Teori om Reference. To beskrivelsesbaserede ansatser af egenavnes reference, nominal og extern beskrivelsesteori, bliver forsvaret imod kendte modargumenter, som for eksempel Kripke's cirkularitetsindvending og Church-Langford-oversættelsestesten. Det vises, hvordan den derfra resulterende analyse af de dicto meningstilskrivelser kan laves kompositionel, men der argumenteres også for, at kompositionalitet ikke er nødvendig. Den anden del beskæftiger sig med former af indeksikalsk og ikke-indeksikalsk kontekstafhængighed. Med henblik på data fra forskellige sproger fremstilles referentielle egenskaber af indeksikalske udtryk som egocentricitet, token-refleksivitet, og vagheden af rumlige og temporale indikatorer. Således bliver Kaplan's Logik for Demonstrativer reformuleret, men med henvisning til Cresswell (1990) argumenteres der for, at der er behov for fuld kvantifikation over modale indekser. Forskellige indikatorer og demonstrativer bliver analyseret på basis af en beskrivelsesteori om reference med brug af en variant af førsteordens prædikatslogik med ikke-traditionel prædikationsteori og to slags af reificerede kontekster. Indeksikalske udtryk, som bliver analyseret, er for eksempel: *now*, *here*, *actually*, *we*, *the former president*, *the left entrance*, kontekstskiftende (context-shifting) indikatorer, og demonstrativer som Japansk *are*. Endelig bliver væsentlig indeksikalitet diskuteret, og det observeres, at beskrivelsesteori ikke kan bruges på de se holdninger. Til forsvar for indirekte reference argumenteres der for, at de kognitive fænomener, som ligger til grund for væsentlig indexikalitet, for eksempel Jeg-tanker, ikke er aspekter af offentlig betydning af naturligsproglige udtryk, og at tale om et 'tænkningens sprog' eller 'reference i tænkning' er upassende metaforer af almindelige semiotiske grunde.

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Part I

Reference

Chapter 1

Introduction and Terminology

1.1   Introduction

This work is a general defense of a context-dependent *description theory of reference*, a variant of indirect reference theory, on the basis of truth-conditional meaning theory. The following central theses will be defended:

☆ **Thesis 1.** *Speaker reference by means of singular terms can be analyzed adequately by means of formal definite descriptions (iota terms or iota quantifiers) in the scope of rational belief operators.*

☆ **Thesis 2.** *Identifying reference, i.e. successful identification of the referent of a singular term by a speaker or at least the speaker's ability to do so, is not generally a requirement by virtue of linguistic competence.*

☆ **Thesis 3.** *Semantic reference can both be analyzed adequately in a Millian way, i.e. according to direct reference theory, and by using rigidified formal definite descriptions.*

☆ **Thesis 4.** *The objective, linguistic meaning of a proper name is the complex, rigidified property of being called such-and-such plus possibly some defining properties that are fixed by experts. The corresponding description theories NDT and EDT are explanatory and descriptively adequate.*

☆ **Thesis 5.** *The subjective meaning of a proper name for some speaker is the complex property of being called such-and-such plus possibly some identification criteria the speaker associates with this name.*

☆ **Thesis 6.** *Indexicals in the narrow sense are egocentric and in the broad sense are object-centric.*

☆ **Thesis 7.** *Indexicals can be analyzed by means of formal definite descriptions that depend on the context of utterance or a reported context in case of shifters.*

☆ **Thesis 8.** *Indexicals in thinking are trivially essential, but corresponding readings of subject uses of «I» and other essential indexicals are highly stipulative. Essential indexicality is a matter of episodal thinking and not an aspect of the meaning of natural language expressions.*

So in a nutshell this is a critique on Kripkean direct reference theory. However, none of the above theses implies that direct reference theory is wrong and it is nowhere to be argued for such a strong claim in the following chapters. The purpose of this work is rather to *clarify* various notions of indexical and non-indexical reference and context-dependence and thereby *reveal* that alleged tensions between direct and indirect reference theory are the symptom of talking cross purpose rather than the symptom of a deep philosophical problem.

The argumentation is divided into two parts. The first part, to which this chapter belongs, is about non-indexical reference. In this part any kind of context-dependence is ignored—not just the one elicited by indexicals. In the second part about indexicals, context-dependence is taken into consideration—primarily that of indexicals, but also dependence on the broader conversational context. This separation is done for expository purposes. During the whole first part it ought be taken into account that later—in chapters 7 and 8—proper names and definite descriptions will generally be evaluated with respect to the conversational context.

The present chapter 1 is introductory to the first part on reference and covers the following topics: notational conventions, truth-conditional semantics as the background of the investigation, the tension between empirical versus ideal language perspective, and the notions of speaker reference, semantic reference, and extralinguistic reference as well as various aspects thereof. The purpose of this is to situate the following chapters in their methodological and meaning theoretical background and to provide some terminology to work with.

Chapter 2 has two main goals. The first one is to introduce indirect reference theory by example of comparing Frege's and Russell's quite similar views on proper names. Description theory based on Russell's Name Claim can be considered the Russellian branch of indirect reference theory. It will be adopted in favor of a Fregean theory, because Fregean senses make too strong ontological presumptions. Variants of description theory, such as Searle's bundle theory, are also discussed. The second goal of the chapter is to explore the role of identifying reference and establish Thesis 2.

Chapter 3 introduces Kripke's well-known arguments against description theory, his rigidity thesis and the New Theory of reference. Some of the early replies to the Kripkean challenge to description theory are outlined: the wide scope theory and descriptions rigidified by means of an actuality operator. These are defended against some recent attacks on descriptivism by Soames (2002). Given the vast amount of informal arguments that Soames launches against description theory, this defense has to remain sketchy. The intention of the second half of chapter 3 is, however, only to make description theory plausible. In later chapters this position will be strengthened by giving concrete examples of analyses based on description theory.

The part on non-indexical reference ends with chapter 4, in which two versions of indirect reference theory are laid out: nominal description theory (NDT) based on (Bach 1981, 1987; Loar 1976; Jacobson 1990) and what will be called external description theory (EDT). Arguments for Thesis 1 and Thesis 3–5 are given, where the focus is on speaker reference. Many views introduced in this chapter are non-standard; they result from a shift in perspective that gives the process of analyzing natural language expressions by translating them into a formal language a more prominent role than usual. The resulting analysis of de dicto belief ascriptions is prima facie non-compositional, but it is shown by example how it could be made compositional if this was deemed necessary.

The second part brings indexicality and context-dependence into play. Chapter 5 is a general introduction to indexicals, who in the current terminology comprise indicators and demonstratives. As noted by Bühler (1934) and others, the main feature of indexicals is their egocentricity. Taking data given by Schlenker into account, some context-shifting indexicals ('shifters') have to be considered object-centric rather than egocentric, but otherwise they work the same way as egocentric indexicals (Thesis 6). The main domains of indexicality are: person, temporal, spatial, and modal domain. Examples of indexical uses are given for each of them. Reference by means of indexicals is explained by resorting to utterance-based reference rules, and finally indexical

reference is compared to non-indexical reference. As opposed to proper names, indexicals have a rich descriptive content which is commonly used for the purpose of attempting to identify their referent in concrete contexts of utterance. They can be regarded as strictly rigid shortcuts for definite descriptions.

After this informal introduction, some more technical issues of analyzing indexicals in logical languages are addressed. This is unavoidable, since Kaplan's account of indexical reference based on direct reference theory has had tremendous influence on the philosophy of language. A reformulation of Kaplan's Logic of Demonstratives of (Kaplan 1989) is thus given in chapter 6. The formalism, called DIML, is introduced and some example analyses are given. It is also shown how diagonalization can be used for expressing the subjective meaning of terms and how minimal extensions of DIML deal with shifters. These accounts remain unsatisfactory, though, because unmodified double-index frameworks have some limitations. One principal limitation is established by Cresswell's argument in (Cresswell 1990), which says that full quantification over indices is needed in order to analyze a natural fragment of English.

In the light of Cresswell's argument, an alternative formalism called FOLC is introduced in chapter 7. This is just first-order predicate logic with non-traditional predication theory and some minor non-standard features to enhance readability. In FOLC, contexts of utterance are reified into the object language, and some designated parameters for the current context of utterance and the conversational context are kept during evaluation of formulas. Various indexicals are analyzed in this framework on the basis of description theory. Among them are: basic tenses according to Comrie (1985), the indicators «I», «now», «here», «actually», «yesterday», «the former president», «we», «the left entrance», the demonstratives «this», «that», «kore», «sore», «are», and examples of shifters. The purpose of this exercise is not to advocate FOLC as a general framework, for which it isn't intended, or to claim that the analyses given are descriptively adequate in each and every respect, but to show by example how the rich descriptive content of indexicals can be taken for an analysis of their truth-conditional content that is reasonably fine-grained and reflects how indexical reference works. This establishes Thesis 7 by plausibility and refutes the converse claim.

Chapter 8 finally addresses some mainly philosophical issues that can broadly be subsumed under the phrase *the subjective meaning of indexicals*. First, ways to express non-rigid readings of indexicals in FOLC are explored in analogy to the respective analysis of de dicto readings of proper names given in chapter 4. Although no natural language expressions correspond directly to them, they can be taken to encode speaker reference by means of indexicals. A big challenge to any description theory of reference is, however, the problem of essential indexicals laid out by Castañeda (1967), Perry (1979) and others, which is the topic of the final sections. After the standard arguments for essential indexicals and de se attitudes have been reformulated, their relevance for linguistic theory is challenged by a series of arguments pro Thesis 8. The argument boils down to this: In thinking some indexicals are irreducible and self-reference in thinking is identification free. But examples of persistent tokens and general considerations

about the connection between language and episodal thinking strongly suggest that semantic reference of indexicals is never infallible, whereas it is hard to see why any allegedly infallible mode of speaker reference by means of an indexical ought to be considered a matter of semantic competence.

1.2 Chapter Overview

The remainder of this chapter is organized as follows. Section 1.3 just lists some notational conventions that are assumed throughout the book. Then, in section 1.4, the meaning theoretical background of the investigation will be outlined. This involves a commitment to truth-conditional meaning theory. Two different perspectives on language are laid out in section 1.4.2: ideal language versus empirical perspective. This distinction is crucial in evaluating other dichotomies like semantic versus speaker reference. The rest of the chapter is devoted to terminologically introducing various aspects of *reference*. In section 1.5.1, characterizations of speaker reference and semantic reference (denotation) are given and special cases like equivocation and conflation are named in section 1.5.2. Section 1.5.3 introduces the distinction between the presupposed number of referents of a term and the actual number of its referents. Finally, in section 1.5.4 these notions will be generalized.

1.3 Notational Conventions

The following notational conventions are used:

Integers. The set of integers without 0 is denoted $\mathbb{N}$. The set of integers including 0 is denoted $\mathbb{N}_0$.

Metavariables. Sets for syntactic entities like TERM are also used as metavariables for their elements, for example VAR can be a mnemonic for the sets of variables of a language or be a mnemonic for any element of that set; what is meant can be deduced from the context. Other metavariables are introduced explicitly.

Powerset. The power set, i.e. the set of all subsets, of a set A is written $\wp(A)$.

Cartesian Product. For two sets A, B, the Cartesian product is written $A \times B$. The n-ary product of a set with itself is written A^n, which is the same as $A_1 \times \cdots \times A_n$ $(n \in \mathbb{N})$.

Functions. Functions are specified in two alternate ways. First, $f : A \to B$ specifies a function f from set A to set B. Second, B^A specifies a function from A to B, where the name of the function has to be given elsewhere.

Definitions. (a) Definitions by abbreviation are given in an $EBNF$-style notation, as for example in $lhs := rhs1$ and $lhs := rhs1 \mid rhs2$. These context-free grammar rules can be recursive, as for example in $a := b$ and $b := c \mid a$. In some linguistic examples, $\to$ is used instead of $:=$. (b) Non-abbreviative definitions are marked as such in the text or it should

be clear from the context that the respective clause is a definition, and an ordinary equality sign $=$ will be used in such a definition.

Logical Notation. Unless defined explicitly or noted otherwise, standard first-order predicate logic with operator-argument style syntax, capital letter predicates, x, y, z and optional indices as variables, and a, b, c and optional indices as constants is assumed. The following symbols are used for the standard truth-functional logical connectives, where common names are given in parentheses: $\land$ (conjunction), $\lor$ (disjunction; adjunction), $\supset$ (material implication; subjunction), $\equiv$ (material equivalence; bisubjunction), $\neg$ (truth-functional negation; outer negation; negation). Standard quantifier symbols used are $\exists$ for FOL existential quantification, $\forall$ for FOL universal quantification, and $\exists!$ for the FOL-definable *there is exactly one* quantifier, except where otherwise noted. In first-order modal logic, these symbols are used for quantifiers relativized to an existence predicate, whereas starred variants like $\exists^*$ and $\forall^*$ are used for quantification over the full domain.

Substitution Operator. $A[\phi/\psi]$ is the formula obtained from A by substituting all occurrences of ϕ that are free in A by ψ, where an occurrence of ϕ is free in A iff it is not the case that this occurrence of ϕ is a variable bound by a quantifier in A.

A formulation of first-order, constant-domain normal modal logic (FOML), that will be used at various places, can be found in Appendix A.

1.4   Background and Methodological Remarks

1.4.1   Meaning Theory: The Background

Reference in general concerns the relations between expressions of a language, speakers of that language, and the world. Considerations about such relations only make sense as part of a theory of meaning. As there is a vast number of concurring approaches to meaning and a vast number of opinions about the meaning of «meaning», this investigation has to be restricted to only a limited number of aspects of meaning, simply for reasons of space and conciseness. The following distinctions will be used. Let a *meaning constituting entity* be an entity that in relation to a corresponding source language expression contributes to the meaning of another, usually larger expression of the source language. What counts as a meaning constituting entity of course depends on the underlying concept of meaning and on the aspects of meaning that the theory is bound to describe and explain. If a theory focuses on at most one aspect of meaning, it is a *single aspect theory* (SAT). Likewise, a theory that is bound to describe or explain two aspects of meaning is a *dual aspect theory* (DAT).[1] There is no principal reason why there shouldn't be triple, quatruple, or quintuple aspect theories of meaning, but this investigation only deals with two such aspects. The first one is *truth-conditional meaning*. Early Wittgenstein explains the idea that is central to this aspect of meaning:

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[1] This term is also used for an epiphenomenalist position on the Mind–Body problem. The two usages have nothing to do with each other.

> "To understand a proposition means to know what is the case, if it is true. (One can therefore understand it without knowing whether it is true or not.) One understands it if one understands its constituent parts." (Tractatus, 4.024)

Following this line of thinking, a specification of meaning constituting elements that encodes the contribution of lexical items to the truth conditions of an utterance in a certain conversational context will be regarded a specification of the *truth-conditional role* of these items, and these meaning constituting elements themselves will be called the *truth-conditional content* of the lexical items in question. At sentence level, the truth conditional content of a lexical item must contribute to the truth-conditional content of the other lexical items that together form a sentence in a given conversational context in a way that allows accounting for the truth or falsehood of the complete utterance. A theory that deals with truth-conditional content is a *truth-conditional theory of meaning*. Following the tradition of truth-conditional semantics, whose origins can be found in the works of Frege, Russell, Wittgenstein, and the Vienna Circle, an ideal and fully competent speaker needs to implicitly know the truth conditional content of expressions he uses.[2] However, reference and particularly reference by means of indexical expressions lives in a certain tension with truth-conditional content in single aspect theories. Phenomena like referential opacity and essential indexicality suggest that there is another aspect of meaning that has to be considered relevant for a general theory of meaning but is not fully covered by truth-conditional content. This more controversial aspect of meaning is the *cognitive role of expressions*, and the meaning-constituting elements that specify this role is the *cognitive content* of these expressions. The cognitive role of expressions is connected to the behavior of speakers that use them, either because it serves in explaining a speaker's understanding of expressions or because it accounts for the transcendental conditions of the use of linguistic expressions. However it may be spelled out in detail, a theory of meaning that specifies the cognitive role of expressions is also a *cognitive theory of meaning*.[3] In the following, the cognitive role of expressions will be considered in addition to their truth-conditional content whenever this is necessary to adequately represent philosophical arguments. When cognitive content will come into play, however, this only happens on the background and in contrast with the truth-conditional component of the theory. A truth-conditional approach to meaning, that basically follows the above Wittgenstein quote, will be assumed throughout this thesis, and neither will any fundamental, external critique on truth-conditional semantics be considered nor will alternative semantic frameworks like representational meaning theory, as for example in (Fodor 1987), be taken into account.

The most salient criterion in dealing with truth-conditional content is the substitutability of expressions salva veritate. In a negative formulation, this criterion says that two expressions do not have the same truth-conditional content if a sentence containing the first expression can have a different truth-value than the sentence that is obtained by substituting in this sentence

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[2]Hereby, the underlying notion of an ideal, competent speaker is based on the distinction between a speaker's linguistic competence and his actual performance that Chomsky (1965) first stipulated for the syntactic domain. Cf. (Cresswell 1982).

[3]See (McGinn 1982) for a discussion of cognitive roles in DATs. McGinn argues for a DAT in which the two components are autonomous, but this shall not be presumed in the current terminology. Cf. LePore and Loewer (1986) for critique on McGinn's view.

an occurrence of the first expression by the second one. At least for sentences that don't contain any indexicals, this criterion is so natural that Cresswell (1982, p. 69) calls it the *Most Certain Principle* (MCP). Unfortunately, it is much more difficult to find a similar criterion for the cognitive content of expressions, and the notion of cognitive content is problematic per se, because it is inherently vulnerable to objections based on a rejection of behaviorism. In order to become relevant for an explanation of behavior, cognitive content must somehow represent individual, mental representations that can play a role in episodal thinking. But entities like ideas, mental images, or perceptual presentations are problematic in many respects. Nevertheless, many arguments in the philosophy of language, like for example the irreducibility thesis that will be discussed in chapter 8, seem to depend on entities that encode presentations in thinking that are relevant to a speaker's behavior regardless of their role in the specification of general truth-conditions. Whenever the cognitive role of expressions in that sense comes into play, this will be made explicit.

1.4.2 Empirical versus Ideal Language Perspective

Historically, truth-conditional meaning theory has evolved from a logical analysis of language that was originally motivated more by philosophical than by linguistic considerations. Analysis of language as a philosophical discipline has often been strongly connected to new developments in logic and often had the purpose of clarifying and correcting philosophical arguments. Works like (Frege 1892, 1918), (Russell 1905, 1940, 1963), (Wittgenstein 1921), or (Carnap 1928b, a, 1934) represent this tradition. They are driven by the idea that a formal analysis of natural languages purifies them from their deficiencies and ultimately leads to an ideal logical language that can serve as a proper foundation of all sciences.[4] This position will from now on be called *ideal language perspective*. There's another perspective on the relation between formal systems and natural languages that is ultimately the result of the *Chomskian Revolution* in linguistics initiated by (Chomsky 1957, 1965). In this view, a formal treatment of natural languages must yield a descriptively and explanatory adequate model of how language works. Montague (1974b, a) has brought this tradition from syntax to semantics. Much of the work that is done by linguists in formal semantics nowadays is following this tradition. From now on, it will be called *empirical perspective* on natural languages, because in the end it must rely on the acquisition and appropriate modeling of empirical data about the actual use and understanding of a certain natural language.

There is a tension between these two perspectives, because there doesn't seem to be any clearcut borderline between the actual use and understanding of a natural language and the correct ways of representing knowledge (in a philosophical, epistemically motivated sense of «to know») about the world by means of language and drawing truth-preserving conclusions from this knowledge. From a logical point of view, one might reject a certain linguistic phenomenon as a deficiency of natural language. If so, the logical analysis can easily become inadequate

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[4]Logical languages are formal languages that allow an adequate representation of premises and the drawing of truth-preserving conclusions from them. Natural languages are languages that have been or are spoken by speakers as a mother tongue, such as English, French, Tagalog, or Warlpiri. When speaking about languages, usually not just the set of strings produced by a grammar will be meant, but also their interpretation.

for describing this phenomenon, simply because the logical language will not be intended to serve this descriptive purpose. Conversely, one might try to deal with some data for descriptive purposes with which it would make no sense to deal from a strictly logical point of view. Three examples will illustrate this point. The first example is the Liar Paradox. There is no doubt that a liar sentence can easily be expressed in English by uttering 1.1.

(1.1) This sentence is false.

From a purely descriptive point of view this utterance must have a meaning. But from a truth-conditional point of view it is doubtful whether it has any truth-conditional content at all, although it consists of meaningful expressions of the English language. From an ideal language perspective, 1.1 should be excluded from logical analysis. This is desirable from a logical point of view in order to maintain consistency. From a more empirical perspective, on the other hand, it can at least under certain circumstances make sense to include liar sentences into a model of the English language, simply because they can be uttered and each of their constituent parts is meaningful.

The fact that certain phenomena that occur in natural languages are ignored doesn't for itself justify the claim that logical analysis is prescriptive. Any theory involves a decent amount of idealization and therefore excludes or simplifies certain phenomena. There are, however, cases in which logical analysis is prescriptive in a very straightforward manner. Consider, as a second example, contrastivity as it is presupposed by the word «but» in 1.2.

(1.2) Ravens are birds but they are black.

(1.3) Ravens are birds and they are black.

From an ideal language perspective both sentences have the same truth-conditions, which can be used as an argument for the pragmatic nature of the contrastivity requirement that is violated in 1.2. This point of view is implicitly prescriptive, since it is based on general logical considerations and it is hard to come up with any independent criteria to support it. There are alternative viewpoints, for example the following meaning rule could be given for a contrastive use of «but».

$$\llbracket A \,\mathbf{but}\, B \rrbracket = \begin{cases} 1 \text{ if } \llbracket A \supset \mathbf{Usually}\, \neg B \rrbracket = 1 \text{ and } \llbracket A \wedge B \rrbracket = 1 \\ 0 \text{ otherwise} \end{cases} \tag{1.4}$$

Given a suitable interpretation of **Usually**, and given that the fact that ravens are birds doesn't imply that they are usually not black, this rule would make 1.2 false.[5] On the other hand, one may defend just as well the point of view that «but» has the same truth-conditions as «and», and that 1.2 is only pragmatically unacceptable. There may be descriptive criteria for deciding which analysis is more adequate, but at least the position that «but» and «and» have

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[5]$\llbracket \mathbf{Usually}\, \neg B \rrbracket = 1$ alone would suffice, but the idea not adequately represented by material implication is that $\mathbf{Usually}\, \neg B$ should follow from the meaning of A, so the redundancy in the above definition serves an illustrative purpose.

the same truth-conditional content has a strong prescriptive flavor. Following the ideal language perspective, someone might assert that the contrastivity requirement of «but» is not a matter of truth-conditional content at all. This person could argue that the **Usually** operator in 1.4 indicates this, because what follows only usually is not what follows logically, is not strictly truth-preserving, and therefore is of no interest to the logician. Both views are viable alternatives, because the term *truth-conditions* allows for narrow or broad, more or less strict interpretations.

A tension between ideal language perspective and empirical perspective is even more obvious in the third example. Consider what Strawson (1950) calls existence presuppositions and their failure. Such cases will here be called *violations of the presupposition of number*. This uncommon name is chosen, because in the possibilist view adopted here there are objects that don't actually exist, for example Superman, but still can be counted. According to possibilism, one may talk veridically about non-existent objects, and non-denotation and non-existence therefore have to be kept apart. The following example illustrates a violation of the number presupposition.

(1.5) The present king of France is bald.

Russell (1905) argues that such a sentence must be false, if there is no present king of France, whereas Strawson (1950, 1964) argues that in this case an utterance of 1.5 doesn't have a truth value. From a mostly empirical perspective, this question must finally be decided by finding out how speakers' reactions differ in such cases in comparison to, say, utterances that are obviously false in a certain context, but do not violate any presupposition of number. Then it will be a matter of criteria like how fine-grained the analysis is supposed to be, how different kinds of speaker reactions can be classified, or what the theory is bound to explain in general, whether there will be two truth values or another value is added, a partial logic is used, or whether a completely different framework has to be used.

From an ideal language perspective, however, there can be motivations for maintaining bivalence that are completely independent from actual natural language use. For example, only bivalence might be considered being logically correct, or someone might argue that any third value cannot be a genuine truth-value. Such arguments don't need to rely on empirical data and involve a prescriptive component. It is hard to exactly determine this prescriptive aspect, but it must somehow involve the claim that only bivalent logical systems are logically correct, and that therefore an ideal language must be bivalent. *Correctness* in this context cannot mean pure mathematical correctness, since intuitionist and many-valued logical systems can be correct in that sense as well and it cannot mean the same as descriptive adequacy in this case either. Being logically correct in the context of arguing for bivalence rather means that a formal system that doesn't preserve bivalence isn't the right one—in a prescriptive sense.[6] Prescriptive requirements understood in this sense are not normative requirements. The way in which correctness comes into play in the strife for an ideal language doesn't have much to do with normative sentences like «You ought to pay your debts». The prescription doesn't say that you *should* use a bivalent logical system, but rather says that you would be wrong if you didn't use one, and

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[6]If there was fundamental and continuing disagreement about whether $2 + 2$ is equal to 4, and consistent alternative ways of obtaining different results, then elementary arithmetics would be prescriptive as well. But neither of those premises hold.

wrong in this case cannot be understood in a moral sense but must be understood in the sense of *being mistaken*. Notice that *being mistaken* taken from the ideal language perspective doesn't mean that the theory is descriptively inadequate. Prescriptive requirements of the ideal language perspective don't concern the data, but rather concern the methodology.

The tension between the empirical and the ideal language perspective plays a role in chapters 2, 4, 5, and 8.

1.5 The Notion of Reference

1.5.1 The Multiple Uses of «Reference»

The term «reference» is a highly equivocal philosophical terminus technicus. A singular term may be said to refer to a particular object. Understood in this way, singular reference is at least a dyadic relation between terms of a language and objects in the world. This usage dates from a translation of Frege's use of «Bedeutung» (meaning).[7] Some authors prefer the term «denotation» or «designation».[8] In another terminology a speaker is said to refer to some particular, when he uses a singular term. For example, Strawson writes:

> "'Mentioning', or 'referring', is not something an expression does; it is something that some one can use an expression to do." (Strawson 1950, p. 326)

Understood in this way, singular reference is at least a triadic relation between speakers of a language, terms of a language used by speakers, and objects in the world. Finally, the term «reference» is sometimes also used in a sense that doesn't seem to involve any kind of language at all. A person or, more generally speaking, any kind of agent (persons, animals, computer programs, . . .) might be said to refer to some particular when the agent interacts with that particular in a meaningful, intelligent, or otherwise distinguished way. To avoid equivocations, the terminology has to be fixed. This will involve the use of some set theory and first-order predicate logic, but there is nothing 'deep' in the use of formalism here; it just makes it a bit easier to see what is said of what. With respect to some formal or natural language under consideration, the following sets need to be distinguished. Dom is the set of all objects, Exp is the set of all expressions, Trm is the set of all singular terms, Agt is the domain of agents, Spk is the set of speakers, and $\mathrm{Spk} \subseteq \mathrm{Agt} \subset \mathrm{Dom}$ and $\mathrm{Trm} \subseteq \mathrm{Exp} \subset \mathrm{Dom}$. The following distinctions can then be made.

☆ **Ref 1** (Extralinguistic Reference). *Extralinguistic reference is a relation between agents and objects.*

Notation: $E(x, y)$ *where* $x \in \mathrm{Agt}$ *and* $y \in \mathrm{Dom}$.

☆ **Ref 2** (Speaker Reference). *Speaker reference is a relation between speakers of some language, terms of that language, and objects.*

Notation: $R(x, y, z)$ *where* $x \in \mathrm{Spk}$, $y \in \mathrm{Trm}$, *and* $z \in \mathrm{Dom}$.

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[7]See (Frege 1892).

[8]Black translates «Bedeutung» as «reference» (Frege 1980), whereas Church (1956) translates it as «denotation».

☆ **Ref 3** (Semantic Reference, Denotation). *Semantic reference or denotation is a relation between terms of some language and objects.*

Notation: $D(x, y)$ *where* $x \in \mathrm{Trm}$ *and* $y \in \mathrm{Dom}$

Any of these relations might have more argument places in a specific theory of reference, but what counts here is that they differ in their *minimal* number of arguments. As an example to motivate the distinctions, consider a robot manipulating colored blocks and pyramids such as the SHRDLU system of (Winograd 1972). Suppose that upon the request «Take the red block!» the system takes a blue block. Suppose further that to the question «Which block did you take?» it answers «The red block.» Apparently the system makes a linguistic error, but let's suppose the error is systematic. Despite this little deficiency the robot has to refer extralinguistically to the blue block in order to be able to successfully grab the blue block. But unlike the quite successful real system, the system in the present example is not a competent speaker of the demonstrated fragment of English, since it speaker-refers to the blue block by using the definite description «the red block». Still in the given situation the term «the red block» denotes or semantically refers to the red block, if there is one. Extralinguistic reference could be a useful notion even if the system would not be able to deal with a fragment of English, for example for describing planned actions as in moving a robot arm to the blue block and lifting it up. The other two notions need not coincide, as the example shows, and it will be addressed later whether and in what way they depend on each other and whether and for which sorts of terms they need to coincide in case of an ideal competent speaker.

As a terminological choice, (Ref 1)–(Ref 3) ought not be controversial. Some people might disagree with conflating «denotation» and «semantic reference» as in (Ref 3). The latter term is for example used by Kripke (1977) in a reply to Donnellan (1966), whereas the former is used by Mill (1843) and (Russell 1905). There doesn't seem to be any clear distinction between «denotation» and «semantic reference» in the literature, and conflating both of them seems to reflect common usage better than drawing a sharp line between them.[9] When extralinguistic reference, speaker reference, and semantic reference are considered relations, this admits a number of cases that might not be thought of at first glance. For example, speaker reference and semantic reference could be partial with respect to singular terms, i.e. not every singular term must be required to denote an object, and not every speaker must be required to refer to an object when he uses a singular term. Two singular terms might denote one object, or one singular term might denote two or more objects, and analogous cases may occur for speaker- and extralinguistic reference. Purportedly deviant cases are allowed and no special restrictions will be assumed unless further noted.

1.5.2 Equivocation, Co-Extensionality, and Conflation

The simple terminology introduced so far allows for the following characterizations:

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[9]Cf. Lyons (1977, pp. 174-6). According to Lyons *reference* is utterance-dependent, whereas Mill's *denotation* is not, but this is, like the above characterizations, just one suggestion among many. Bear in mind that context-dependency is excluded for the time being. To take it into account, it is only necessary to switch from sentences to utterances, terms qua type to terms qua token (used for communication), and so on.

$$d_1$$
$$(a) \quad t$$
$$d_2$$

$$t_1$$
$$(b) \qquad d$$
$$t_2$$
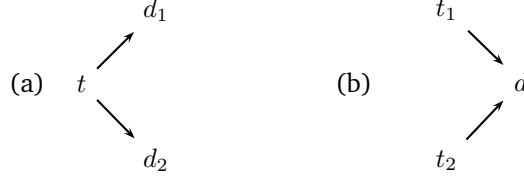
Figure 1.1: (a) Equivocation and (b) Co-Extensionality.

☆ **Ref 4** (Equivocation of a Singular Term). *A singular term t is equivocal iff. t denotes more than one object.*

$$\exists x \exists y \big(D(t,x) \wedge D(t,y) \wedge (x \neq y) \big)$$

The fact that a singular term is equivocal is an equivocation, and a language that admits equivocations is equivocal or said to contain equivocations. A singular term is n-times equivocal if it denotes n objects, where $n > 1$.

☆ **Ref 5** (Equivocation by a Speaker). *A speaker a commits an equivocation in using a singular term t iff. a refers to more than one objects by means of t.*

$$\exists x \exists y \big(R(a,t,x) \wedge R(a,t,y) \wedge (x \neq y) \big)$$

From an ideal language perspective, any equivocation is a fallacy. From an empirical perspective, singular terms satisfying the above conditions can also be ambiguous, in case of which the fact that the term denotes more than one objects is taken as a feature rather than a deficiency of natural language. Many ambiguous expressions in natural languages are homophonic variants of expressions that from a diachronic perspective have different origins. In the following, either the attribute *equivocal* or *ambiguous* may be used depending on the perspective. The opposite phenomenon is co-extensionality and, as a fallacy on behalf of the speaker, conflation.

☆ **Ref 6** (Co-Extensionality of Singular Terms). *Two or more singular terms $t_1, \ldots, t_n$ are coextensional iff. $t_1, \ldots, t_n$ denote the same object.*

$$\forall x \forall y \big((D(t_i, x) \wedge D(t_j, y)) \supset (x = y) \big) \text{ where } 1 \leq i < j \leq n$$

☆ **Ref 7** (Conflation of Singular Terms). *A speaker a is conflating two or more singular terms $t_1, \ldots, t_n$ iff. a refers to the same object in using $t_1, \ldots, t_n$ and $t_1, \ldots, t_n$ are not co-extensional.*

$$\forall x \forall y \big((R(a, t_i, x) \wedge R(a, t_j, y)) \supset (x = y) \big)$$

where $1 \leq i < j \leq n$

The attributes *co-referential* and *co-extensional* will be considered synonyms as far as singular terms are concerned. (Ref 1)–(Ref 7) are terminological characterizations and clarifications rather than definitions. The same holds for the terminological characterizations in the following sections.

1.5.3   Singular and Individual Terms, Empty Singular Terms

What are singular terms? Singular terms are sometimes characterized as denoting one object as opposed to many, and proper names are often mentioned as paradigmatic examples of singular terms. In formal languages, individual constants traditionally play the same role. However, the claim that each proper name denotes one and only one object is blatantly wrong if it is taken literally, since many proper names are equivocal.[10] Consider the following example.

(1.6) Peter is hungry.

There are plenty of persons called «Peter» and even a combination of first name, middle names, and last name like in «Peter Henry Smith» will sometimes not denote exactly one person. A similar problem arises when a proper name doesn't denote an object. Quine (1960, §20) also points out the trivial fact that singular terms cannot be distinguished from general terms by taking into account their actual referents, since for example a singular term like «Pegasus» may be empty, whereas a general term like «natural satellite of the earth» may refer to exactly one object. The source of such problems is that the two parts of a singular term's number presupposition, i.e. the *uniqueness condition* that a proper name denotes at most one object and the condition that it has to denote at least one object, are *prescriptive* requirements of a language, but there is no guarantee that this requirement is actually fulfilled.[11] When a speaker in a natural language uses a proper name, he presupposes that there is a referent of that name and that there is only one such referent.[12] In formal languages, on the contrary, the denotation relation has to be modeled explicitly, and so the uniqueness condition can easily be required to be satisfied. On the other hand it is of course possible to construct a formal language in which neither the uniqueness condition has to be fulfilled nor a singular term has to denote. So a distinction has to be made between the prescriptive purpose of an expression, the role it is supposed to fulfill, and the role it actually fulfills. Singular terms can be classified into singular terms that denote nothing, singular terms that denote one object, and singular terms that denote more than one object. However, a singular term is a term that is *required* to only denote one object, whereas a general term is a term that is required to denote more than one objects. These requirements are prescriptive in a weak sense of «to require», namely that they can be *violated* by not fulfilling them. The following terminology will be used.

☆ **Ref 8** (Empty Singular Term). *A singular term t is an empty singular term iff t doesn't denote an object.*

$$\neg \exists x D(t, x)$$

☆ **Ref 9** (Empty Speaker Reference). *A speaker reference of speaker a by means of a singular term t is empty iff. there is no object that a refers to by means of t.*

$$\neg \exists x R(a, t, x)$$

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[10]See for example (Castañeda 1989, pp. 25), (Perry 1997b, pp. 9).

[11]Using slightly different terminology, this is pointed out by Wessel (1998, pp. 313-6).

[12]For an actualist *there is* means that the referent must actually exist, whereas for the possibilist the quantifier is only a means of counting and objects that don't actually exist might also be countable. Possibilism is assumed throughout this work.

☆ **Ref 10** (Individual Term). *A singular term t is an individual term iff t denotes exactly one object.*

$$\exists!xD(t,x)$$

☆ **Ref 11** (Individual Speaker Reference). *A speaker a refers individually by means of a singular term t iff. there's exactly one object a refers to in using t.*

$$\exists!xR(a,t,x)$$

(Ref 8) reflects common terminology, (Ref 10) is based on the German terminology of Wessel (1998). (Ref 10) and (Ref 11) represent the analogous cases when speaker reference is concerned.

1.5.4 Generalizations

The notions in the previous sections can be generalized to arbitrary referential expressions. The idea behind these generalizations is that linguistic rules require referential expressions to fulfill a numerical requirement, whereas of course the world itself, the current state of affairs determine whether this requirement is fulfilled or not. The prescriptive requirement is the *presupposition of number*, whereas the latter is the *actual number of referents*. A violation occurs whenever the presupposition of number doesn't match the actual number of referents. This violation is a case of *presupposition failure*. Likewise, a referential expression is n-referential if its purpose is to refer to n-individuals, where n is either a natural number or a general condition on natural numbers like $n > 0$ or $n < 1$.[13] Thus, singular terms are 1-referential, referential expressions marked by the dual number are 2-referential, and referential expressions marked by the plural number are under normal circumstances $n > 1$-referential.

Now let an expression with a *referential quotient* $\frac{n}{m}$ be an expression that has n actual referents but presupposes m referents. Thus, a $\frac{0}{1}$ expression is an empty singular term, a $\frac{1}{1}$ expression is an individual term, and an $\frac{n}{1}$ expression where $n > 1$ is an equivocal singular term. One may then classify various violations of number presuppositions by means of their referential quotient.

☆ **Ref 12** (Referential Saturation and Undersaturation).
An expression with referential quotient q is referentially (a) empty iff $q = 0$, (b) saturated iff $q = 1$, (c) unsaturated iff $q < 1$, and (d) oversaturated iff $q > 1$.

Likewise, the semantic reference of an expression can be called empty, saturated, unsaturated, and oversaturated respectively, and the attribute *referentially* can be dropped for brevity. Let's further say that a speaker *refers in an* $\frac{n}{m}$ *way by using a referential expression* iff the expression is m-referential, but the speaker refers to n objects in using the expression, and assume formulations for speaker reference that are analogous to the above ones. Based on this terminology, equivocation, conflation, and co-extensionality can be generalized as follows.

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[13]Regarding natural languages, it is an empirical question whether complex conditions like $1 < n < 4$ are needed. It seems to be a reasonable hypothesis that there are no more conditions than being equal to, greater than, or smaller than a certain number.

☆ **Ref 13** (Equivocation)**.**
Referentially oversaturated expressions are equivocal.

☆ **Ref 14** (Speaker Equivocation)**.**
A speaker a commits an equivocation by means of an expression t if he refers by means of t in an $\frac{n}{m}$ way and $n > m$.

☆ **Ref 15** (Co-Extensionality)**.**
Two or more expressions $t_1, \ldots, t_n$ are co-extensional iff they denote the same objects.

☆ **Ref 16** (Co-Extensional Use)**.**
A speaker a is using two or more expressions $t_1, \ldots, t_n$ co-extensionally iff a refers to the same objects in using $t_1, \ldots, t_n$.

☆ **Ref 17** (Conflation)**.**
A speaker a conflates two or more expressions $t_1, \ldots, t_n$ iff $t_1, \ldots, t_n$ are not co-extensional and a uses $t_1, \ldots, t_n$ co-extensionally.

These generalizations will hardly be used, because the majority of examples in the following chapters will only involve the use of singular terms. However, it must be kept in mind that there are many $n > 1$-referential expressions to which the above generalizations apply, for example «we» and «$\underset{\longrightarrow}{\text{they}}$».

Chapter 2

Indirect Reference

2.1   Chapter Overview

In the last chapter, speaker reference and semantic reference have only been introduced as re-
lations, but these relations have not been specified in detail. This can hardly qualify as a sat-
isfactory account of reference. In this and the following chapters a closer look will be taken at
genuine philosophical *theories of reference*, where any matters related to context-dependency are
suppressed until chapter 5.

There are two main strands of such theories. According to the *indirect reference view* refer-
ence must always be mediated by some sort of meaning. This is also sometimes referred to as
the Frege–Russell view on reference, as it goes back to the work of Frege (1892, 1918) and Rus-
sell (1905).[1] Russellian descendants of the indirect reference theory are also called *description
theories of reference*. The opposite view is naturally called *direct reference*, and the corresponding
theory of reference is commonly called the *New Theory of Reference*.

In this chapter, indirect reference is addressed. The New Theory of Reference will be outlined
and contrasted with the indirect reference view in the next chapter 3. The exposition of the
main ideas underlying the indirect reference view is somewhat biased. It emphasizes attractive
features of indirect reference, whereas the powerful and well-established attacks on this point of
view by Kripke and his followers are saved for the next chapter. Section 2.2 lays out the origins of
indirect reference, and section 2.3 provides an overview of variants of description theory. Various
motivations for description theory are given in section 2.4, and finally, in section 2.5, it will be
argued for Thesis 2 that speakers aren't generally required by virtue of linguistic competence to
be able to successfully identify the semantic referent of a singular term.

2.2   Original Proposals: Frege and Russell

According to the indirect reference view, the denotation relation or the relation of speaker ref-
erence always involve some kind of mediation by some kind of meaning. But what kind of
mediation, what kind of meaning, and mediation between what? There are many answers that
could be given to any of those questions, but in the literature some kind of 'standard views' on
indirect reference have evolved, based on Frege's and Russell's otherwise quite differing views
on natural language. Before we delve into this Frege–Russell view, a word of caution is in place.
The 'standard views' on reference commonly attributed to authors like Frege or Russell from a
macroscopic perspective do not always coincide exactly with what the authors have actually sug-
gested when their work is put under the magnifying glass. There's always a trade-off between
brevity and exegetical correctness. This should be kept in mind, especially since for lack of space
the following expository sections have to remain sketchy; references to more detailed literature
will be given whenever it deems necessary.

The articles in which the basic ideas underlying indirect reference have first been formulated,
i.e. (Frege 1892, 1918) and (Russell 1905), belong to some of the most influential and contro-
versial texts in the philosophy of language. The idea that some or all singular terms in natural

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[1]Cf. (Kripke 1981, pp. 27-29).

languages have a meaning that determines their semantic referent is simple and straightforward, but has had tremendous impact on the formation of semantic, epistemological, and even ontological theory in analytic philosophy of the 20th century.[2] As the following comparison will show, Frege and Russell held very similar views on the reference of proper names, albeit they differ with many other respects.

2.2.1 Russell's Analysis of Proper Names

Russell (1905) proposed a description theory of proper names in reply to Frege (1892) and Meinong (1971). Russell's description theory is based on the following claims.

✩ **DTR 1** (Proper Names). *There are two sorts of proper names:*

1. *Logical Proper Names: Logical proper names denote their referents directly.*

2. *Ordinary Proper Names: Proper names in natural languages usually are hidden, abbreviated definite descriptions.*

It should be noted that Russell doesn't customarily talk about logical versus ordinary proper names, since hidden descriptions in his opinion aren't strictly speaking proper names at all. Leaving this terminological matter aside, the above theses can be found in (Russell 1905, 1971, 1963). Let us now take a closer look at the second thesis that Lycan (2000) calls the *Name Claim*.[3] Russell analyzes definite descriptions the following way:

✩ **DTR 2** (Definite Descriptions). *A sentence or utterance containing a definite description, i.e. one of the form «the A is B», is analyzed in three parts:*

1. *(Non-Emptiness Condition) There exists an x such that $A(x)$, and for this x:*

2. *(Uniqueness Condition) There is at most one x such that $A(x)$.*

3. *(Body) It is the case that $B(x)$.*

The non-emptiness and the uniqueness condition taken together make the number presupposition. Formally, Russellian definite descriptions can be introduced in various ways, but as they are first-order definable it is best to introduce them by abbreviation. The following abbreviation defines a quantifier that comes quite close to Russell's original proposal in (Russell 1905).

$$
\begin{aligned}
&\imath\mathrm{VAR}_1\mathrm{WFF}_1\,\mathrm{WFF}_2 \\
&:= \exists\mathrm{VAR}_1\big(\mathrm{WFF}_1 \wedge \forall\mathrm{VAR}_2(\mathrm{WFF}_1[\mathrm{VAR}_1/\mathrm{VAR}_2] \\
&\qquad \supset \mathrm{VAR}_1 = \mathrm{VAR}_2) \wedge \mathrm{WFF}_2\big) \\
&\text{for new } \mathrm{VAR}_2
\end{aligned}
\tag{2.1}
$$

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[2]Cf. (Searle 1958, p. 169).
[3]See (Lycan 2000, pp. 38–40).

Natural Language: *English*   Formal Language: *FOL*

$$\text{Peter is hungry} \xrightarrow{\;analysis\;} \imath x(Fx)(Gx)$$
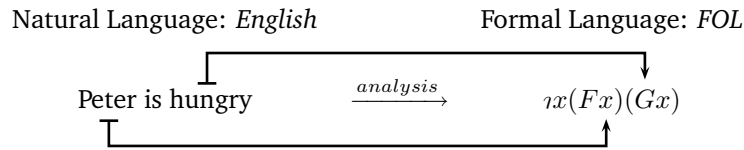
Figure 2.1: Analysis as a translation from natural language to formal language.

Instead of a quantifier, Russell also uses the so-called *iota operator* that yields the single object that satisfies a possibly complex property. Since talking of objects is only meaningful when the terms in question occur in a larger, well-formed formula, the use of a iota quantifier and the use of a iota operator boil down to the same. However, it is easier to deal with scoping issues if an abbreviation as a quantifier is used, if no other scoping mechanism like λ-abstraction is available. Therefore, subsequent examples will be formulated using the quantifier abbreviated by 2.1, here called *iota quantifier*. When in the following there will be talk about formal definite descriptions, this is meant to be apply to iota terms built by a iota operator, but is also meant to apply, in a derived sense, to the restriction part of iota quantifier expressions, i.e. to formula schemes like $\imath x A(x)(\dots)$. This is a sloppy way of talking, since a part of an abbreviation is strictly speaking meaningless, but makes sense, because an expression of the form $\imath x A B$ can be read as *the x, that uniquely is A, satisfies B*. The attribute «definite» will sometimes be dropped when it is clear that a definite description and not a bare description without uniqueness condition is meant.

There are three crude arguments against Russell's description analysis of proper names that can be rejected in a jiffy. First, as Lycan (2000) points out, Russell's Name Claim must be considered separately from his analysis of natural language definite descriptions.[4] The role of context is suppressed in this chapter, but even if definite descriptions are taken as context-dependent, there are examples of natural language determiner phrases using the definite article that don't express a uniqueness condition, such as a generic use of the German determiner «der» in «der Wal ist ein Säugetier» (*The wale is a mammal*; 'wales are mammals'). This doesn't affect an analysis of proper names as definite descriptions, since the idea of this analysis is that a definite description in some formal language is used for encoding the truth-conditional content of a proper name, and hence the (formal) definite description is chosen to be unique in order for the analysis to be correct. Related to this a second point needs to be clarified. There's a dangerous equivocation in the use of «definite description». On one hand, the phrase can be used for a iota term or—in the above derived sense—part of a iota quantifier, and on the other hand it is used for certain natural language expressions, such as English phrases starting with «the». This can lead to the erroneous and nonsensical view that Russell suggested to replace proper names with natural language definite descriptions, for example to replace English proper names with English phrases of the form *the A*. This cannot be adequate from a truth-conditional point of view, since proper names and definite descriptions fulfill different linguistic roles, for example regarding rigidity (see chapter

3). Instead, the Name Claim must be understood as an *analysis* in the sense of a translation of natural language expressions into expressions of an ideal language, as illustrated in figure 2.1.

Third, it isn't compelling to claim that description theory is inadequate as an analysis of proper names, because many proper names are equivocal. A referentially oversaturated proper name can only be understood fully by eliminating the equivocation. For example, in a situation in which two people are named «Peter», the truth-conditional content of

(2.2) Peter is hungry.

is definitely not that both of the persons called «Peter» are hungry. The speaker refers to only one of them when he uses «Peter», and whatever iota expression is used as the formal equivalent of this proper name must likewise conform with the uniqueness condition in a given context. The fact that a speaker might be smart enough to temporarily delay the ascription of the property of being hungry to one object or temporarily ascribe it to more than one object and later, when the referent has been singled out, adjust his internal presentation of what has been said doesn't justify dropping the uniqueness condition from a truth conditional perspective.[5]

Let us now turn briefly to Russell's notion of logical proper names, which actually belongs to chapter 3 and is only mentioned here for the sake of completeness. Russell discusses this view in (Russell 1963), where he claims that a person sometimes can be in direct acquaintance with sense data or universals. This special epistemic mode of access can be expressed as a relation of the person to a so-called *Russellian singular proposition*. According to (Russell 1963), a singular proposition is a collection consisting of the object itself, for example a universal or an individual sense datum, and the property ascribed to this object. Formally, such a proposition is sometimes written as an ordered pair $\langle a, P \rangle$ containing the object a and the property P, but this notation can be misleading, since Russell (1963) emphasizes that a person cannot be in direct acquaintance with a concrete particular, i.e. a concrete spatio-temporally extended object in physicalist space.[6] Following Russell in this respect, direct acquaintance therefore can play no role in a theory about reference of *natural language expressions*, and proper names in natural languages have to be analyzed as descriptions.[7] Only indexical expressions, egocentric particulars in Russell's terminology, can be means of direct speaker reference, and all of these expressions are reducible to one: this.[8] The suggestion to analyze indexicals as directly referential expressions has been readopted later by Kaplan (1988, 1989, 1990b) and will laid out in chapter 6. In any case ordinary proper names according to Russell are definite descriptions in disguise.

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[4]See (Lycan 2000, p. 37-49).

[5]From a merely cognitive perspective, on the other hand, it might make sense to drop it. Castañeda (1990b) argues for this view. Cf. section 4.5.6.

[6]See (Russell 1963, p. 155); (Russell 1971, pp. 198; 200-3). Following Quine (1948), one may say that logic is ontologically neutral and whatever we quantify over exists in some way. A constant like a can denote a property moment or sense datum. However, usually more object-like entities are associated with the use of a constant. It is also doubtful whether logic is indeed ontologically neutral to a sufficient degree. For example, standard, out-of-the-box first order logic doesn't provide ways to build particulars out of property moments or other special means that can be necessary to make alternative ontologies like trope theory, process ontologies, or property theory work.

[7]As Evans (1982, p. 44) notes, Russell is primarily concerned with thinking and not with the meaning of public language expressions, but since acquaintance is a very restricted mode of epistemic access in thinking, it can a fortiori hardly play a role in the analysis of meaning in public language.

[8]See (Russell 1963, p. 162, N.B. fn.2), (Russell 1966, pp. 107-8).

2.2.2   Frege on Sense and Reference

Since Frege's views on proper names is based on his theory of meaning, a brief summary of it is given in this section. As is well known, Frege proposed a dyadic meaning theory by making a distinction between *Bedeutung* and *Sinn*. *Bedeutung* is usually translated as *reference, referent*, or *denotation*, and *Sinn* is often translated with *meaning* or *Fregean sense*. These translation practices are the result of deliberate choices by early adopters of Frege's work like Russell (1905) and Church (1956).[9] Despite some exegetical concerns, the widely accepted translations of *Bedeutung* into (both semantic and speaker) *referent* and of *Sinn* into *Fregean sense* or meaning will be used from now on.[10] The Frege to be presented here is so-to-say the folk-Frege, as he has been perceived by many philosophers of language, whereas more thoroughgoing Frege-interpretations can for example be found in (Dummett 1981, 1991) and (Baker and Hacker 1984). A few historical remarks have to be made in this context. Frege revolutionized Aristotelian logic by introducing quantifiers into his *Begriffsschrift* (concept writing) and thus can with full right be regarded as one of the founders of modern logic. Unfortunately, he has never presented a formal system that directly encodes his sense versus reference distinction. Therefore, his views on sense and reference have to be extracted from his sparse, more general and colloquial writings that don't deal directly with the *Begriffsschrift* and the foundations of mathematics. It is also not without irony that long after Frege's death the sense versus reference distinction was revived to a large extent with the goal of accounting for phenomena that Frege himself considered deficiencies of natural language, whereas the ideal language perspective that Frege advertised and endorsed during his whole lifetime plays only a marginal role in contemporary philosophy.

There is an equivocation in Frege's use of *Bedeutung* that makes it hard to translate. On one hand, he uses it to refer to the semantic referent itself, i.e. in case of a singular term an object, allowing for a 'standard' translation as it has been proposed above. On the other hand, *Bedeutung* can also come in two flavors depending on the way it is used: a customary use triggers the *gerade* (even) reference and a non-customary use triggers the *ungerade* (odd) reference.[11] In this case, he uses the notion in a functional way. The even reference of an expression, understood in a functional way, yields the customary semantic referent, i.e. an object, whereas the odd reference is a Fregean sense, namely the Fregean sense of the expression when it is used in the customary way. Some simple graphics should make these distinctions sufficiently clear. Figure 2.2a depicts a Frege-Triangle that results from the customary use of an expression, whereas in figure 2.2b the same expression has odd reference.

Frege uses senses in combination with the customary/indirect use and even/odd reference distinction to explain a variety of special phenomena that are related to the interpretation of natural language, such as referential opacity in attitude ascriptions,[12] informativity and the cognitive

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[9]Russell (1905, p. 483) and Church (1956, p. 4; fn. 7) translate *bedeuten* as *denote*, while Black translates it as *refer* (Frege 1980).

[10]A rather dubious point about these translations is that ger. *Bedeutung* is not all that different from eng. *meaning*, and by some general exegetical principle of charity one ought to assume that Frege has chosen the term deliberately and by intention. Beaney (1997, pp. 36-46) discusses this problem in more detail.

[11]See (Frege 1994b, p. 43: orig. pag. 28).

[12]See (Frege 1994b, pp. 51-2: orig. pag. 37-8).
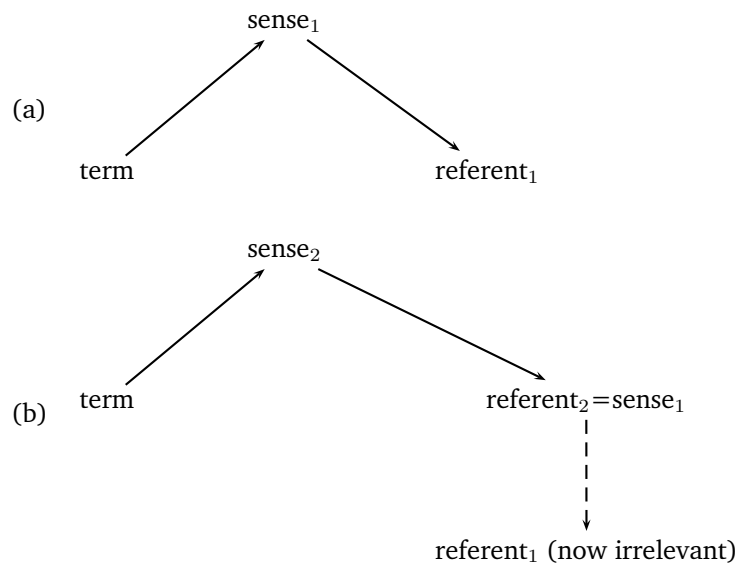
Figure 2.2: (a) Customary, direct use versus (b) non-customary, indirect use of an expression according to Frege.

role of singular terms,[13] presuppositions,[14] sentence mood,[15] or the nature of judgements[16]. In the following chapters only referential opacity and informativity/cognitive role of singular terms will play a role apart truth-conditional content and the following characterization of Frege's sense–reference distinction only comprises some of its aspects.

☆ **Fre 1** (Semantic Aspects of Sense and Reference). *1. A sense determines the referent(s) of the expression of which it is a sense.*

   2. The senses of subexpressions are combined in a regular way to the senses of the whole expression in which they occur.[17] (Compositionality)

   3. A complete sentence customarily refers to a truth-value (true or false).[18]

   4. The sense of a complete sentence is grasped as a thought.

These aspects make Fregean senses meaning-constituting entities for the truth-conditional content and, indirectly by the notion of grasping thoughts, for the cognitive role of an expression. A number of restrictions have to hold between expressions, senses, and referents:

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[13] See (Frege 1994b, pp. 40-3: orig. pag. 25-28; 47: orig. pag. 32), (Frege 1986, p. 38-9: orig. pag. 65-6).

[14] See (Frege 1994b, pp. 47: orig. pag. 32-3; 54-5: orig. pag. 39-41; 59-62: orig. pag. 44-8).

[15] See (Frege 1994b, p. 53: orig. pag. 38-9).

[16] See (Frege 1994b, pp. 50: orig. pag. 35-6; 58: orig. pag. 43).

[17] See e.g. (Frege 1994a); cf. (Dummett 1981, pp. 152-9). It is, however, exegetically doubtful whether Frege ever endorsed such a principle and which form thereof. Cf. section 4.6.2 of chapter 4.

[18] See (Frege 1994b, p. 48: orig. pag. 34); cf. (Dummett 1981, pp. 180-6).

$$(a) \quad e \longrightarrow s \longrightarrow a \qquad\qquad (b) \quad e \begin{smallmatrix} \nearrow s_1 \searrow \\ \searrow s_2 \nearrow \end{smallmatrix} a$$

$$(c) \quad e \begin{smallmatrix} \nearrow s_1 \longrightarrow a \\ \searrow s_2 \longrightarrow b \end{smallmatrix} \qquad\qquad (d) \quad \begin{smallmatrix} e_1 \longrightarrow s_1 \searrow \\ e_2 \longrightarrow s_2 \nearrow \end{smallmatrix} a$$

$$(e) \quad \begin{smallmatrix} e_1 \searrow \\ e_2 \nearrow \end{smallmatrix} s \longrightarrow a \qquad\qquad *(f) \quad s \begin{smallmatrix} \nearrow a \\ \searrow b \end{smallmatrix}$$
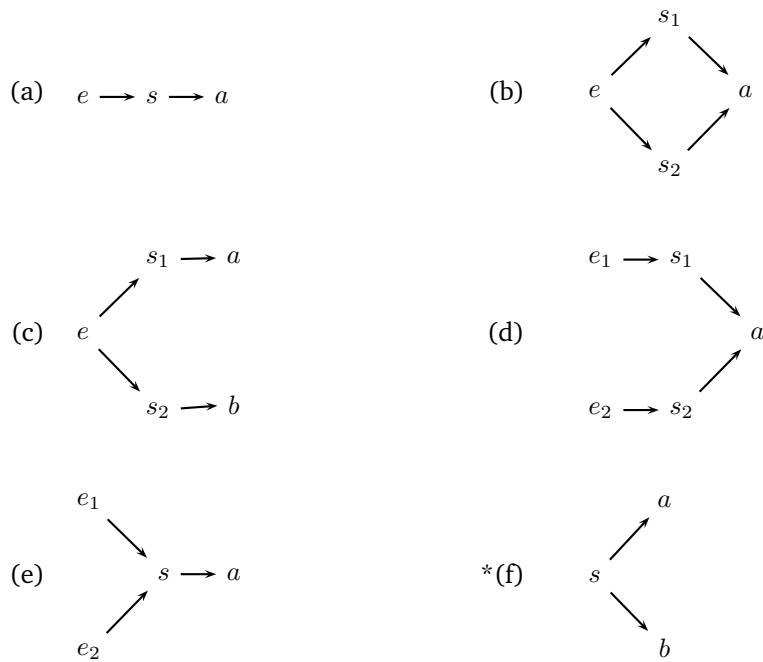
Figure 2.3: Some relations between expressions e, Fregean senses s and referents a, b. (*=not allowed)

☆ **Fre 2** (Sense and Reference).   *1. If two expressions don't have the same referent, they cannot have the same sense.*[19]

    2. Two different senses can have the same referent.[20]

    3. One sense always has the same referent, if there is one.

    4. An expression has one or more Fregean senses.[21]

    5. An expression can have a sense but no semantic referent.[22]

Figure 2.3 depicts some of the combinations that are admitted by these rules and one case (f) that isn't admitted. There is no general agreement on all of these restrictions in the literature on Frege and among Neo-Fregeans. Only principles (Fre 2.1), (Fre 2.2), and (Fre 2.3) are relatively uncontroversial. The first one is crucial to Frege's theory. In combination with (Fre 1.3) and

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[19]Cf. (Baker and Hacker 1984, p. 290).

[20]See e.g. (Frege 1994b, p. 41: orig. pag. 26-7), (Frege 1969, pp. 208-12).

[21]See (Frege 1994b, p. 42: orig. pag. 27).

[22]See (Frege 1994b, pp. 42: orig. pag. 28; 47: orig. pag. 32-3); cf. (Dummett 1981, pp. 160-71), (Baker and Hacker 1984, p. 290).

(Fre 1.2), principle (Fre 2.1) ensures that senses indeed represent truth-conditional content; it is a general version of the MCP that was mentioned in section 1.4.1 of chapter 1. Without principle (Fre 2.2), a theory with Fregean senses would hardly be more expressive than a theory without them. If (Fre 2.3) wouldn't hold, then the Fregean sense of a singular term could itself be ambiguous, equivocal, or indexical. If so, a Fregean sense wouldn't solely determine the semantic referent and therefore couldn't represent the complete truth-conditional content of the term.

The remaining principles are more or less controversial. Since Frege considered it a deficiency of natural language that an expression might have more than one sense,[23] some formal reconstructions of Frege's theory restrict (Fre 2.4) such that each expression must have exactly one or no more than one Fregean sense.[24] (Fre 2.5) is also sometimes rejected in general.[25] Frege doesn't have much to say about the case when an expression has no Fregean sense at all. Perhaps, as an imperfection of natural language, completely meaningless expressions might occur, but they can hardly play a role in a meaning theory.[26] Finally it must be noted that (Fre 1.1) has also been challenged. As Evans (1982, 1990) emphasizes, Frege considered a sense as the epistemic way in which the referent of a singular term is being given to a speaker.[27] If this is the only way in which Fregean senses ought to be viewed, as Evans urges, then it is strictly speaking false to claim that they determine the referent. Evans adopts Frege's ideal language perspective, but not the passages in which Frege talks about imperfections of natural language, and so his rejection of (Fre 2.5) and (Fre 1.1) leads to an ideal-language centered interpretation—Evans doesn't really deny this.[28] His interpretation may be called *Evans–Frege* in order to set it apart from a more liberal interpretation that allows for (Fre 2.5) and (Fre 1.1).

2.2.3 Frege on Proper Names

First of all, something like logical proper names doesn't exist in Frege's theory. According to Frege, any kind of reference is mediated by a Fregean sense, i.e. by meaning in the present terminology. Apart from this difference, Frege and Russell have quite similar positions regarding proper names. This can be seen in a famous footnote in which Frege writes:

> "Bei einem Eigennamen wie 'Aristoteles' können freilich die Meinungen über den
> Sinn auseinandergehen. Man könnte z.B. als solchen annehmen: der Schüler Platos
> und Lehrer Alexanders des Großen. Wer dies tut, wird mit dem Satze 'Aristoteles war

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[23] See (Frege 1994b, p. 42 fn.2).

[24] See e.g. (Church 1956, p. 7-8). Frege himself doesn't seem to allow (Fre 2.4) just before the footnote (Frege 1994b, p. 42: orig. pag. 27), but discusses cases when speakers grasp different senses of the same proper name in (Frege 1986, pp. 38-9: orig. pag. 65-6). Notice that a theory, according to which each expression has exactly one Fregean sense isn't more expressive than a quotational analysis that discards Fregean senses all together.

[25] See (Church 1956, p. 7), and especially (Evans 1982, p. 22-33) and (Evans 1990).

[26] There is an obvious problem of accounting for the cognitive significance of purportedly meaningless expressions like Meinong's round square when at the meantime both sorts of content in a DAT are to be explained and described by the same meaning-constituting entity. This problem shall not be pursued further.

[27] See (Evans 1982, ch.1).

[28] See (Evans 1982, p. 14; 17).

aus Stagira gebürtig' einen anderen Sinn verbinden als einer, der als Sinn dieses Na-
mens annähme: der aus Stagira gebürtige Lehrer Alexanders des Großen. Solange nur
die Bedeutung diesselbe bleibt, lassen sich diese Schwankungen des Sinnes ertragen,
wiewohl auch sie in dem Lehrgebäude einer beweisenden Wissenschaft zu vermeiden
sind und in einer vollkommenen Sprache nicht vorkommen dürfen." (Frege 1994b,
p. 42; fn. 2 orig. pag. 28)[29]

So the meaning of a proper name can be given by a definite description that has the same
Fregean sense. Furthermore, two speakers might associate different Fregean senses with the
same proper name, which is an imperfection of language. As long as these Fregean senses de-
termine the same referent, they represent the same truth-conditional content. A similar example
can be found at the end of the Gustav Lauben passage in (Frege 1986, p. 39; orig. pag. 65-
6). However, in this passage Frege also points out that if two speakers associate with the same
proper name two different Fregean senses that determine the same referent, then they don't
speak the same language, as long as they don't *know* that these different senses determine the
same referent. In an ideal language the users of a proper name would always associate one and
the same sense with a given proper name.

2.2.4   A Brief Comparison of Russell and Frege

The differences between Russell's and Frege's views on proper names are small.[30] Russell al-
lows singular propositions as meaning-constituting entities with which a person can be in direct
epistemic connection via acquaintance, whereas Frege considers this form of direct reference im-
possible. As he points out in a letter to Russell, an object like the Mont Blanc "[. . .] cannot itself
be a component part of the thought that Mont Blanc is more than 4,000 metres high." (Frege
and Russell 1988, p. 56)[31] Frege's ontology of senses is strictly homogeneous, as in his opinion
all senses belong to an ontic realm of their own, whereas Russell's ontology is heterogeneous in
the sense that he allows collections containing entities of such a different sort as properties and
objects.[32] Russell's reply to Frege is thus: "We do not assert the thought, for this is a private
psychological matter: we assert the object of the thought, and this is, to my mind, a certain
complex (an objective proposition, one might say) in which Mont Blanc is itself a component
part." (Russell 1988, p. 57)[33] Russell (1905) seems to commit some use–mention errors and
the relevant passages are hard to understand, but his critique on Fregean senses seems to boil

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[29]"In the case of an actual proper name such as 'Aristotle' opinions as to the sense may differ. It might, for instance,
be taken to be the following: the pupil of Plato and teacher of Alexander the Great. Anybody who does this will attach
another sense to the sentence 'Aristotle was born in Stagira' than will a man who takes as the sense of the name: the
teacher of Alexander the Great who was born in Stagira. So long as the reference remains the same, such variations of
sense may be tolerated, although they are to be avoided in the theoretical structure of a demonstrative science and ought
not to occur in a perfect language." (Frege 1980, p. 58; fn.)

[30]See also (Kaplan 1975) for a formal comparison of Church's Frege reconstruction with Russell's views.

[31]Cf. Frege's letter to Philip Jourdain (1914) cited by Evans (1982, pp. 14-5).

[32]See also (Frege 1986, pp. 40-3: orig. pag. 66-9); cf. (Dummett 1981, pp. 91-3).

[33]In this reply, Russell doesn't seem to be aware that thoughts in Frege's terminology are already objective entities.

$$
\begin{array}{ccc}
& s_2 & \qquad s_1 \qquad s_2 \\
& | & \qquad | \qquad | \\
\text{(a)} \quad s_1 \leftarrow e_2 & & \text{(b)} \quad e_1 \leftarrow e_2 \\
| & & \\
e_1 & &
\end{array}
$$
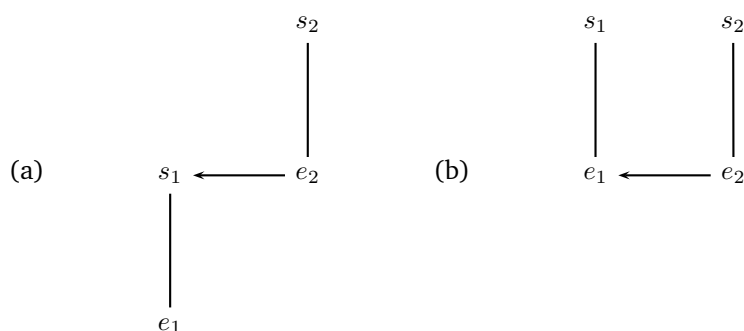
Figure 2.4: Using an expression to explain meaning itself (a), versus using an expression to explain what an expression means (b). A line indicates the connection of an expression with its Fregean sense, whereas an arrow $a \leftarrow b$ indicates that b is an explication of a.

down to the following.[34] Fregean senses cannot be characterized in a satisfying way, since any explication of a Fregean sense can only be provided by using expressions, which in turn have a sense that has to be explained, and so on. Figure 2.4 illustrates the resulting problem.

If meanings are entities of their own, i.e. Fregean senses, then they have to be explicated and described by natural language expressions as anything else is explained. So in an explication like (a) in the figure, the higher-order sense s_2 would have to determine the lower-order sense s_1, but then s_2 is left unexplicated and cannot match the meaning of the explanandum s_1. An infinite regress is the result: An explication of a sense presumes a higher-order sense, which in turn would have to be explicated using an expression with a sense of even higher-order, and so on. This leaves Fregean senses inexplicable. The correct way to provide the meaning of an expression is to provide paraphrases in the way it is depicted as case (b) in the figure. If so, Fregean senses become mere stipulations, because they cannot be explicated directly. Although it doesn't necessarily affect the feasibility of modern, formal reformulations of Frege's theory, this circle argument is a serious objection that must be taken for granted. Various authors agree that Frege indeed has to assume an infinite hierarchy of senses.[35] As a general circularity objection this critique is weak in light of the fact that, no matter which model of explication (a) or (b) is assumed, it is a basic hermeneutic principle that an *exhaustive* explication of what an expression means can never be given by paraphrase. It is fair to assume that Russell has been aware of this problem and his critique in (Russell 1905) isn't intended to be a variant of a fundamental hermeneutic circle argument; he rather points out that any actual explanation of meaning is given by expressions, and thus meanings seem to be redundant if they are thought of as entities on their own that belong to a "third realm" (Frege). For Russell, providing or explicating the

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[34] See Linsky (1967, p. 7-8) and (Linsky 1983, pp. 69-70) for more on use–mention errors. The following argument is based on (Russell 1905, pp. 485-7). It is admittedly hard to retrieve it literally from what Russell writes in this passage, but hopefully comes close to what he had in mind.

[35] See Carnap (1970), (Linsky 1967, pp. 44-6).

meaning of an expression is done by demonstration or by providing other expressions, and in case of doing logical analysis this is done by providing expressions of a formal language.

Apart from this controversy, which is ultimately about the ontological nature of meaning-constituting entities, Frege and Russell vastly agree on the meaning of singular terms such as proper names, except that Russell also adheres to a limited version of direct reference. Frege explicates the Fregean sense of a proper name by providing definite descriptions with the same sense.[36] Russell explicates the meaning of an ordinary proper name by translating it into a quantified expression of a formal language, whose restriction is interpreted as a complex predicate that the semantic referent has to satisfy uniquely. According to both views, proper names have an objective meaning, be it called a unary property or a Fregean sense, and this meaning determines the semantic referent. In both theories, different speakers may associate different meanings with one and the same proper name, and different meanings may determine one and the same semantic referent. Likewise, differences in the cognitive significance of proper names may be explained by differences in meaning, insofar as it is grasped, for example, when it is said that two speakers don't fully understand each other, because they don't realize that the meanings associated with a proper name determine one and the same semantic referent.

The fact that Frege and Russell basically share the same views on proper names doesn't mean that a choice between their approaches is arbitrary. According to Frege, Fregean senses neither belong to actuality, i.e. the 'outside world' or the totality of what can be Given to someone, nor belong to internal, episodal thinking as a matter of empirical psychology. They belong to a third ontic realm. This is probably the part of Frege's theory that other philosophers have found the least appealing. Furthermore, Frege never presented a formal account of his sense–reference distinction, and it is far from clear in what sense modern reconstructions of Frege's theory in intensional logics really reflect his ideas. In contrast to this, formal definite descriptions (iota expressions) are first-order definable and don't presume any special ontology. Therefore, Russellian descriptions will from now on be preferred as a realization of the indirect reference view. Formal definite descriptions (iota expressions), as they will be used in the following chapters, are only a vehicle to express the indirect reference view, though. What counts is the underlying idea that speaker reference involves a speaker's attempt to identify the referent of a singular term by means of some of its properties.

2.3 Other Variants of Indirect Reference and Discussion

A vast number of positions can be subsumed under the label *indirect reference* or *Frege–Russell view*. One influential variant, Searle's cluster view in (Searle 1958), will be sketched in the next section. Other possible variants of description theory will merely be listed to get some working taxonomy and in order to make it clear that there is no such thing as *the* theory of indirect reference or *the* description theory. Some variants aren't very useful, and it would be futile to take a

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[36] As Dummett (1981, pp. 97-8; 110-1) notes, Frege is forced to talk this way, but there is no reason to assume that he held the view that *any* proper name has the same sense as some corresponding complex description. See also (Burge 2005, p. 224). This point can be conceded, but this makes the senses of names without corresponding description only more mysterious than those of names that can be explicated.

close look at all of them. What will turn out to be crucial is the role of *identifying reference*, which in the current terminology means that a speaker successfully identifies the semantic reference of a term or is at least able to do so in a given situation. This will be addressed in more detail in section 2.5.

2.3.1 Searle's Cluster Theory

After motivating the indirect reference view, Searle (1958) observes that it has some puzzling features. First, if the meaning of a proper name can be given by a description that determines its semantic referent, then certain statements about the semantic referent would be analytic. In the implausible case that the description was complete, this would even have the effect that certain false statements about the semantic referent would be contradictory.[37] Second, a proper name doesn't seem to have the linguistic function of specifying certain characteristics of an object like definite descriptions do. It is not the purpose of proper names to assert that the referent has certain properties.[38] Searle continues in pointing out that the necessary and sufficient conditions for applying a proper name don't involve providing identity criteria for the semantic referent of the proper name. Conversely, "[...] the looseness of the criteria for proper names is a necessary condition for isolating the referring function from the describing function of language." (Searle 1958, p. 172)

The variant of indirect reference that results from this view has been called the *cluster theory* of proper names.[39] According to it, the definite description representing the meaning of a proper name is a large disjunction of properties that are commonly attributed to the semantic referent of the name, and a speaker that refers to an object by means of the name will only loosely associate some of the disjuncts with the name.[40] In this view, speaker reference is given a clear priority over semantic reference. The meaning of a proper name is a loose cluster of properties, but if it makes sense at all to say that this cluster determines the semantic referent, then it can do so only in a likewise vague way. Aristotle is the person that satisfies some properties in the cluster, perhaps the majority of them, but the uses of «Aristotle» by various speakers don't specify exactly which of those properties would determine Aristotle. In fact, there might not be any properties in the cluster that determine an object uniquely. Searle (1958) leaves it open how to implement cluster theory formally. His point of view has many similarities with prototype theory which has been used in cognitive linguistics to account for various 'fuzzy' phenomena of language like the lexical categorization of color predicates.[41] In the context of truth-conditional semantics, such approaches are problematic. Either the cluster uniquely identifies the semantic referent of a name, which turns the account into the original Frege–Russell analysis, or it cannot serve as a complete specification of the truth-conditional content of that name.

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[37]See (Searle 1958, pp. 168-70).
[38]See (Searle 1958, p. 170-1).
[39]See e.g. (Devitt and Sterelny 1999, p. 50), (Lycan 2000, p. 42-3). It is also sometimes called *bundle theory*.
[40]See (Searle 1958, p. 172-3).
[41]See (Taylor 1989) for an overview.

2.3.2   Other Non-Modal Variants of Description Theory

There are various ways to interpret or deliberately modify description theory without switching to a cluster theory. Alternative interpretations of Frege are possible because he regards certain cases like empty proper names as deficiencies of language. Depending on the weighting of the ideal language versus the empirical perspective, in the broadest sense *Fregean accounts* may differ from each other considerably. The same holds for in the broadest sense *Russellian accounts*, i.e. variants of the description theory.[42] Description theories can differ in a number of respects, and the following list summarizes some of them. The language that is being analyzed, which is usually a natural language like English, Tagalog, or Warlpiri, is called *source language* and the formal language used for the analysis is called *target language*.

1. Expression–Meaning Axis

   (a) Trivial Description Theory
       A proper name of the source language is analyzed as one definite description of the target language.

   (b) Varying Description Theory
       A proper name of the source language is analyzed as one out of several alternative definite descriptions of the target language. The alternative definite descriptions are co-extensional with each other.

2. Particular–General Axis (Context Dimension)

   (a) Context-Dependent Description Theory
       Definite descriptions of the target language may denote different objects depending on the conversational context.

   (b) Context-Independent Description Theory
       Definite descriptions of the target language always denote the same object independently of a conversational context, or the target language doesn't encode conversational contexts at all.

3. Individual–Public Axis

   (a) Matching Description Theory
       In order to understand a proper name of the source language, a speaker must have implicit knowledge of the meaning of the definite description that determines the semantic referent of the proper name.

   (b) Non-Matching Description Theory
       In order to understand a proper name of the source language, a speaker must have implicit knowledge of the meaning of some definite description of the target language,

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[42]This is not to be confused with the use of *Russellian* in the attribute *Neo-Russellian*, which is unfortunately sometimes used for the so-called Millian view that will be discussed in the next chapter. This use of *Russellian* goes back to Russellian propositions and direct acquaintance, not the Name Claim.

but this expression doesn't need to be one that determines the semantic referent of the proper name.

4. Objective–Subjective Axis

   (a) Identifying Description Theory
      In order to understand a proper name of the source language, a speaker must be able to successfully identify the semantic referent that is determined by the definite description of the target language corresponding to the proper name, by virtue of implicitly knowing the meaning of an appropriate definite description of the target language.

   (b) Non-Identifying Description Theory
      In order to understand a proper name of the source language, a speaker must implicitly know the meaning of an appropriate definite description, but doesn't need to be able to determine the semantic referent of the proper name.

5. Content–Form Axis

   (a) Restricted Description Theory
      Only a certain sort of descriptively adequate definite descriptions of the target language are suitable candidates for an analysis of some proper name of the source language.

   (b) Unrestricted Description Theory
      In principle, any sort of descriptively adequate definite description of the target language can be a candidate for the analysis of some proper name.

The individual–public and objective–subjective axes only concern speaker reference, and not all axes permit the same number of variants. Some combinations aren't very interesting. For example, a trivial, matching, context-independent description theory just says that every speaker must associate the same meaning with a proper name in any context. The approaches that will be defended in chapter 4 and later are varying,[43] non-matching, non-identifying, restricted and, starting from chapter 5, context-dependent.

2.4 Motivations for Indirect Reference

So far, not much has been said about the motivation for indirect reference theory. Frege's and Russell's main reasons for adopting indirect reference were epistemic. When direct acquaintance plays no role or is rejected, a speaker has to find out whether the referent of a proper name, or any other referential expression whatsoever, exists and which object given in experience is that referent. This principally requires the speaker to identify the referent by means of certain properties it is supposed to have. But there is also less foundational reasons more closely tied

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[43]Regarding speaker reference. Concerning semantic reference, what will be called nominal description theory is trivial, while what will be called external description theory may vary depending on the nature of linguistic labor division.

to the meaning of natural language expressions. Indirect reference serves in explaining various features of reference that might seem puzzling at first glance, especially if a clear distinction between speaker reference and semantic reference isn't made. Some of them are quickly summarized in the following paragraphs. First, an example is given, then the corresponding problem is formulated, and finally the answer suggested by the indirect reference position is outlined.

2.4.1 Cognitive Significance of Co-Extensional Proper Names

(2.3)   a. Hesperus = Phosphorus

       b. The Morning Star is equal to the Evening Star.

(2.4) Hesperus = Hesperus

This is the canonical example based on (Frege 1994b) that can be found nearly everywhere.[44] The corresponding problem called *Frege's Puzzle* is: How can two co-extensional proper names have different cognitive significance to one and the same (or different) speakers at the same occasion of their use? Since the semantic referent of «Hesperus» and «Phosphorus» is one and the same object, it cannot serve in explaining why a speaker might find 2.3 *informative*, while a sentence like 2.4 may be considered *uninformative*. One obvious answer is given by the *quotational analysis*. In this view 2.3 are interpreted as asserting that «Hesperus» and «Phosphorus» have the same semantic referent, whereas 2.4 is interpreted as asserting the more obvious fact that the two occurrences (tokens) of «Hesperus» have the same referent. Frege endorses this analysis in his early work on the *Begriffsschrift*, but later rejects it because the connection between sign and semantic referent is arbitrary.[45] In contrast to this, the indirect reference view explains the difference in cognitive significance between 2.3 and 2.4 by pointing out that (a) «Hesperus» and «Phosphorus» have different meaning, which a speaker has to grasp in order to understand any of the names, or that (b) a competent speaker may associate different meanings with «Hesperus» and «Phosphorus» respectively in his episodal thinking.

At this place it must be mentioned that cognitive significance and informativity of an utterance are not the same. Utterances can be informative to someone in a number of ways that are in no direct connection to their literal meaning. Think for example of so-called traffic analysis as a way of attacking cryptographic systems. An utterance can always be informative in a way that cannot be conveyed by what it literally means, because a recipient might at any time take any features of the utterance situation into account. *Informativity* is a rather broad, pragmatic term, that can for example be made precise on grounds of information theory, but it will not be used further here. In contrast to this, the cognitive significance of an expression is an aspect of its meaning.

2.4.2 Referential Opacity of Proper Names in Attitude Ascriptions

(2.5) Peter believes that Hesperus appears in the evening.

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[44] See (Frege 1994b, pp. 40-2; orig. pag. 25-8).

[45] See (Frege 1994b, p. 40-1: orig. pag. 26); cf. (Dummett 1981, p. 544), (Baker and Hacker 1984, p. 220; 280-1). This only holds for discursive and non-natural signs; see section 8.4.3.

(2.6) Peter believes that Phosphorus appears in the evening.

The problem with such examples is that, if «Hesperus» and «Phosphorus» are co-extensional, then they have to be substitutable salva veritate. However, it has been asserted on numerous occasions that an utterance like 2.5 might be true, whereas in the same conversational context an utterance like 2.6 would be false, or vice versa. Variants and refinements of this problem are known under various labels like *double vision problems*, the *problem intensional contexts*, the *problem of propositional attitudes*, the *problem of propositional content*, the problem of *blocked substitutability of co-referential expressions*, just to mention a few. Following Quine (1956), from now on the term *referential opacity* will be used. There are two basic positions regarding referential opacity. According to the first position, both 2.5 and 2.6 must have the same truth-value, and two co-extensional proper names are intersubstitutable salva veritate. Still, in a given conversational context and relative to the belief states of the discourse participants, the uses of some co-extensional substitute name might be pragmatically inappropriate. This is the *pragmatic view* on referential opacity.[46] A more common position is to acknowledge that 2.5 and 2.6 have a reading under which they can differ in truth-value. This is the *semantic view* on referential opacity. Given this position, compositionality requires «Hesperus» and «Phosphorus» to differ in truth-conditional content in such a reading, and thus the semantic referent cannot in general represent the truth-conditional content of a singular term. Such readings, according to which terms are referentially opaque, will generally be called *de dicto readings*, as opposed to *de re readings* of attitude ascriptions in which terms work the same way as outside of an attitude ascription. Yet another referentially opaque interpretation of terms in attitude ascriptions, de se readings, will be addressed in chapter 8.

Frege's approach to attitude verbs is one way to solve this problem. Outside the scope of an attitude verb a sentence denotes a truth-value, whereas within the scope of certain attitude verbs like «to believe», a sentence denotes its meaning, i.e. its ordinary Fregean sense, which by the compositionality principle consists of the meanings (Fregean senses) of its parts.[47] Description theory provides basically the same explanation, *as far as singular terms like proper names are concerned*. According to description theory, a proper name may have a referentially opaque reading within the scope of an attitude verb, because the attitude holder doesn't need to associate the same meaning, which is in this case represented as a definite description in a formal language of analysis, with two co-extensional proper names. Recall that even in a fixed description theory, two co-extensional proper names may be analyzed by two different descriptions. Another, more common way to solve the problem of referential opacity using description theory is as follows. Utterances like 2.5 are regarded as being semantically ambiguous between a wide scope de re reading and a narrow scope de dicto reading. In the wide scope reading, the proper name is evaluated without being affected by the meaning of *to believe*, thus can be said to lie outside the *priority scope* of the attitude verb, whereas in the narrow scope reading the proper name is semantically dependent on the meaning of the attitude verb. How this can be done formally will be shown in chapter 4.

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[46]It has for example been defended by Salmon (1986, 1989).

[47]See (Frege 1994b, p. 51-2); cf. (Dummett 1981, pp. 186-92).

2.4.3   Synthetic Identity Statements Involving Co-Extensional Proper Names

(2.3)   a. Hesperus = Phosphorus

        b. The Morning Star is equal to the Evening Star.

(2.4) Hesperus = Hesperus

Related to the previous points is the epistemic issue of synthetic versus analytic statements involving co-extensional proper names. Frege (1994b) starts by claiming that an identity statement like 2.3 is synthetic in the Kantian sense, because it may expand our knowledge of the world, whereas a statement like 2.4 is analytic, in the sense that the truth of the identity statement would follow from the linguistic rules that govern the use of «Hesperus» and «=».[48] Since Quine (1964) has challenged this Neo-Kantian analytic–synthetic distinction, its popularity has declined. Nevertheless, given that literal meaning is an idealization, the distinction can be maintained, and if this is done, then indirect reference can be used to explain an epistemic difference between 2.3 and 2.4. A description theory can be used to explain the analytic–synthetic difference in the same manner as it is used to explain differences in cognitive significance simpliciter. This can for example be done by stipulating that in the same conversational context a speaker must associate the same meaning with the same proper name, but may associate different meanings with different proper names. Since in the Frege–Russell view the meaning determines the semantic referent, it seems plausible to assume that in the first case the speaker implicitly knows that the one meaning of the two occurrences of the same proper name in 2.4 determines one and the same semantic referent, if there is one at all, no matter whether the speaker is able to identify this referent or not. Conversely, it would require successful identification of the semantic referent by means of the meanings of «Hesperus» and «Phosphorus», in order to confirm the identity expressed by 2.3.

2.4.4   Cognitive and Truth-Conditional Content of Proper Names for Non-Existent Entities

(2.7) Odysseus is an ancient Greek hero.

(2.8) Superman is an ancient Greek hero.

(2.9) Superman can fly.

(2.10) Odysseus can fly.

If proper names had no independent meaning apart from their denotation, as a crude direct reference theory would presume, then one would expect proper names for non-existent entities to be substitutable for each other at least in any context that is not referentially opaque. But even in non-embedded, assertive utterances, it sometimes seems rather odd to substitute one

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[48]See (Frege 1994b, p. 40; orig. pag. 25-6); cf. on Frege (Searle 1958, p. 166-7), on Russell (Linsky 1967, p. 65-6).

such name for another. For example, even if it is assumed that neither Odysseus nor Superman actually exist, it seems to be clear that 2.7 means something different than 2.8 and 2.9 something different than 2.10.

If a sort of representational meaning is considered, as it may be encoded by cognitive content in a DAT, this judgment is independent from the debate about possibilism and actualism. Even an actualist that considers all of the utterance false, because neither Superman nor Odysseus exist, would have to concede that 2.7 means something different from 2.8. Even though an actualist has the option of claiming that the truth-conditional content of «Odysseus» and «Superman» must be the same—an entity that must guarantee the contribution of falsity to the main clause no matter how it is formally represented—, that in this sense they say the same, he must concede that their cognitive content in a DAT differs.[49] A possibilist, on the other hand, will, presuming that the common views about Odysseus and Superman are veridical, consider 2.7 and 2.9 true and consider 2.8 and 2.10 false, although neither Odysseus nor Superman exists. If this is indeed the case, then the two proper names must differ in truth-conditional content as well. Arguably, the problem is more pressing for the actualist, since the possibilist can resort to the view that the different proper names refer to different possibilia. But modest possibilists, as opposed to full-flavored Meinongians, will still have to concede that some proper names might be empty. For example, if a mathematician uses the name «Fluffy» for the round square he has been dreaming of last night, then the proper name «Fluffy» will be empty for the modest possibilist and the actualist alike, but it still seems to have a different meaning than a proper name «Tuffy» invented by a physicist as a name for the electron with integer spin that he was thinking about yesterday after he had consumed a bottle of wine.

In a description theory of reference, different descriptions associated with different proper names account for their difference in meaning, be that meaning truth-conditionally relevant, cognitively relevant, or both.

2.4.5 Psychological and Epistemological Aspects of Speaker Reference

Indirect reference supports to some extent psycholinguistic hypotheses about the way speaker reference is realized in episodal thinking. Consider for example 2.11.

(2.11) Alice: Who is John Smith?
     Bob: That's the guy with a beard wearing that purple t-shirt.

When someone asks, who the bearer of some proper name *is*, he will expect to be given a description of that person in reply. Likewise, we often use a proper name competently without having ever made acquaintance with its bearer. These facts provide some good evidence that proper names in thinking act as some kind of placeholders that are connected to a mental representation of a description of the bearer of the proper name. In a concrete situation, a speaker

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[49]*What is said* can also be called *propositional content,* but here talk about propositions is generally avoided and instead formal expressions of the target language, i.e. the formal language of analysis, are themselves regarded as meaning-constituting entities, as long as they are taken as expressions that can be evaluated in the target language relative to an intended model of the target language that is built in conformance with the interpretation of the corresponding source language expression.

may try to identify the bearer of the name by means of (the mental representation of) the description that is associated with a proper name, and if this identification is successful, it has to be unique *relative to what the speaker believes to be the case in the given situation*. Suppose that Alice believes John Smith to be a 40-year old computer scientist wearing glasses. If one and only one person in the given situation appears to Alice like being a 40-year old computer scientist wearing glasses, for example because there is only one person wearing glasses, then she will not ask a question like in 2.11. If on the other hand she believes this information to be incomplete, then she may ask a question like in 2.11. If she accepts and trusts the answer, she may add the description to her internal 'database' and use the additional information to purportedly identify the bearer of the name. Of course, in many other cases Alice might not be interested in identifying the bearer of the proper name.

This view on the (armchair) psychology of speaker reference is rather compelling, because it fits quite well with our everyday understanding of proper names prior to any theorizing about them.[50]

2.5   On Identifying Reference

It will now be argued in favor of Thesis 2 that successful identification of the semantic referent of a proper name is not generally a requirement by virtue of linguistic competence. This thesis is related to some traditional 'big' philosophical questions: Is it feasible to have an ideal language in which all reference is indirect, i.e. in which there are no singular terms? As Quine (1950) shows, it is technically possible to have a logic without singular terms, i.e. in this case without individual constants,[51] but this technical answer isn't satisfying, especially since Quine (1960) also shows, vice versa, how to explain variables away. A more satisfying answer would require investigating the transcendental conditions of epistemic access to particulars. Is it possible to be in infallible, direct acquaintance with particulars, as for example sense-data reductionists claim? These questions will not be dwelled upon further, because our current interest is in the connection of identifying reference with the use of linguistic expressions and not in foundational issues. Examples will show that identifying reference sometimes is required on behalf of the speaker, but that it is not required by virtue of semantic competence (Thesis 2). While certain epistemic situations are such that the ability to identify the referent of a proper name can be expected by other discourse participants, this ability is not required at all in other situations, and may sometimes be required or not required by virtue of mainly non-linguistic conventions. The term *identifying reference* is here sometimes used in a bit sloppy way. In the first place the notion says that a speaker has to be able to successfully identify the semantic referent of a proper name on the basis of his implicit knowledge of the descriptive meaning of that name. But sometimes it will also just be used to express the fact that a speaker has successfully identified the semantic referent by means of certain criteria. What is meant should be clear from the context. What is never meant by *identifying reference* is the mere attempt of a speaker to identify the semantic referent, i.e. the act of identifying it. This will always be called an *attempt* to identify the

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[50]See (Searle 1958, p. 168).
[51]See (Quine 1972, p. 230-4).

referent. The term *identifying reference* is also used by Strawson (1964), but in a very different sense than the one assumed here. Strawson writes:

> "I have explained identifying reference – or the central case of identifying refer-
> ence – as essentially involving a presumption, on the speaker's part, of the possession
> by the audience of identifying knowledge of a particular item. Identifying knowl-
> edge is knowledge of a particular item distinguished, in one or another sense, by the
> audience from any other." (Strawson 1964, p. 79)

Although related with the present use through Strawson's notion of identifying knowledge, this terminology is much more pragmatic in nature and not used here. In order to get a better grasp of the role of identifying reference, as it is understood here, it is helpful to first take a look at Donnellan's distinction between referential and attributive uses of definite descriptions in (Donnellan 1966) and then transfer this to the description analysis of proper names.

2.5.1 Donnellan on Definite Descriptions

Among others, Donnellan (1966) discusses the following example.

(2.12) Who is the man drinking martini? (Donnellan 1966, p. 287)

Used referentially, as Donnellan calls it, one may get the desired answer even if there is only water in the glass of the person the question is about. On the other hand, Donnellan argues, definite descriptions can also be used attributively. If the description in 2.12 is used attributively, the speaker wants to find the one man that is drinking martini, whoever that is. Conversely, the speaker has a specific person in mind if he uses the description referentially. According to Donnellan, the referential use of a definite description doesn't require it to be referentially saturated. As Kripke (1977) points out, this can be granted but doesn't count as a good argument against semantic reference. Taken literally, an assertive sentence containing a definite description that doesn't denote in the given situation must be false or, following Strawson (1950, 1964), without truth-value. Only because the sender and the recipient make the same mistake can communication be successful, and in such a case a question like 2.12 can have the effect of getting the desired answer.[52] But such cases are clearly accidental, and Kripke (1977) argues convincingly that successful communication on the basis of mistaken speaker references can hardly serve as the basis of a semantic distinction.[53] Donnellan's examples in (Donnellan 1966) can, however, be taken to support Thesis 2. They indicate that it is not a matter of linguistic competence whether the object that a speaker believes to be the referent of some definite description turns out to be the actual semantic referent or not. The speaker who utters 2.12 in the described situation may perhaps be criticized for lack of competence about drinks, but not for lack of competence of the English language.

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[52]The term «speaker» is here mostly used in the sense of *speaker-hearer*. The speaker in the narrow sense is the *sender*, and the *recipient* is any kind of speaker who interprets an utterance; this doesn't have to be the addressee.

[53]Cf. (Kripke 1981, p. 25, fn. 3).

2.5.2   Transfer to Proper Names

If description theory is the right approach, then one would expect the above point also to hold for speaker reference by means of proper names. However, there are scenarios that seem to speak clearly in favor of identifying reference.[54] Consider for example the following dialog.

(2.13) *Situation: Alice and Bob both believe that Debora is called «Carol».*
    Alice: Carol is drunk.
    Bob: Yes, but you can only recognize it from what she says.

In this particular conversational context the communication between Alice and Bob is successful. But given the fact that Debora is actually called «Debora» and not «Carol», claiming that successful identification of the referent is not required in this case would be odd. Conversely, it seems that Alice in the above conversational situation is not a fully competent speaker, if for example she points at Debora when she's being asked who is called «Carol». So it seems that identifying reference in this case is required on behalf of the sender, though perhaps not on behalf of the recipient.

Yet other cases speak against this view. Consider for example the following question.

(2.14) Alice: Who is Carol?
    Bob: The girl wearing a blue dress and having a slurred speech.

A speaker asking a who-question might only associate a rather minimal description with «Carol». For example, Alice's question in 2.14 can be paraphrased as 2.15.

(2.15) Alice: Who is the person called «Carol»?

In this case, Alice only associates a property such as *being called «Carol»* with the proper name «Carol» that has no value for identifying reference under normal circumstances, unless the people are wearing name tags. Donnellan (1970) gives a similar, even stronger example:

> "Suppose a child is gotten up from sleep at a party and introduced to someone as 'Tom', who then says a few words to the child. Later the child says to his parents, 'Tom is a nice man'." (Donnellan 1970, p. 434)

The child doesn't need to be able to successfully identify Tom by virtue of using «Tom» competently. Suppose, on the other hand, the dialog in example 2.14 continues and Bob associates with «Carol» a complex property like *being a drunk girl wearing a blue dress*, but in fact there are two girls that wear a blue dress and appear to be drunk in the given situation. In this case, other discourse participants will feel entitled to require Bob to be able to give justice to his answer by pointing out, either verbally or non-verbally, which of the two women he has meant. In almost all imaginable epistemic situations in which the epistemic agent is perceiving the objects in

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[54]Note that it would be plain wrong to claim that linguistic competence is generally not a matter of a person's epistemic connection to the 'outside' world, since for example implicit knowledge of the truth-conditional content of «green» requires a speaker to have the ability to decide green objects from red ones under normal circumstances.

question, identification ought to be feasible, simply because under normal circumstances people are quite capable of discriminating macroscopic objects from each other when they experience them through their senses. However, in other situations, for example when it is not possible to identify the semantic referents of a proper name or an individual speaker is not capable of doing so, actual successful identification cannot be expected and the ability to successfully identify the semantic referent might not be expected either. To look at another example, consider a situation in which Alice is to utter 2.16 while scanning through customs documents. In this case, she might not be required to be able to identify the ship in question, simply because this is not part of her job.

(2.16) Alice: The RMS St. Helena has a capacity of 128 passengers.

This is an example of a requirement on behalf of the speaker or lack thereof that is a matter of mainly extralinguistic conventions. Depending on the obligations of her job, Alice might or might not be required to be able to identify the RMS St. Helena when she uses «RMS St. Helena».

2.5.3 Concluding Remarks

The above examples and similar ones confirm Thesis 2. There is certainly a range of requirements on a speaker to identify the semantic referent of a proper name; their strength depends on the epistemic and the social context. But these requirements are only to a very small extent linguistic in the case of proper names. If some ability to successfully recognize the semantic referent is expected, as in example 2.13, then it is for example expected because the given conversational context epistemically supports the successful identification of the semantic referent to a high degree and other discourse participants expect a speaker to be able to successfully identify the semantic referent of a proper name the more they believe themselves that they could do so, if they were in the same epistemic position as that speaker. But requirements that arises out of mutual expectations *based on the features of the particular utterance situation* and may further depend on the conversational and the broader social context aren't requirements by virtue of linguistic competence. Examples like 2.16 show this quite clearly. It is not always possible to clearly decide between linguistic and extralinguistic conventions, because linguistic labor division argued for by Burge (1979a, 1982) and others also applies to proper names. When for example a history professor is all the time using the name «George Washington» but unable to recognize George Washington on a one-dollar bill something in his use of the name *and* his expert status is odd—presuming that the professor doesn't suffer from impaired vision. But there is no doubt that many other speakers that are unable to recognize George Washington use the name competently.

Things look different if they are considered from a genuine epistemic and therefore more skeptic perspective. Implicitly knowing the complete truth-conditions of an utterance requires the cognitive ability of an ideal epistemic agent to decide in any given situation of the epistemic input whether it falsifies a given utterance, confirms it, or does neither of it. This must include the cognitive ability of the agent to decide of any given object whether it is or isn't the bearer of a proper name. For if the agent wasn't able to decide which object was the bearer of some

proper name, he couldn't decide of the whole epistemic input whether it confirms, falsifies, or is irrelevant to an utterance containing the proper name. Identifying reference is required for falsification and confirmation and thus strictly speaking part of the truth-conditional content of an utterance. From an epistemological, ideal language perspective identifying reference is clearly required.

So reference exemplifies the tension between ideal language view and the empirical perspective on language. Linguistic competence doesn't presume identifying reference, but the originally epistemic motivation for doing truth-conditional semantics does require identifying reference. Indirect reference can deal with both views, but not at the same time. A varying description theory without identifying reference can exploit a possible mismatch between the literal meaning of a proper name and the meaning that a particular speaker associates with it, in order to account for the various phenomena that are related to the cognitive role of that name. A fixed or varying description theory that requires identifying reference encodes by virtue of the meaning of a proper name conditions of epistemic access to the bearer of that name. As description theories, both views have in common that they take the meaning of a proper name as the result of translating, in a rule-governed way, a proper name from some natural source language into some definite description in some formal target language.

Chapter 3

Direct Reference

3.1   Chapter Overview

In this chapter, the theory of *direct reference* is laid out and the main arguments in favor of *rigid designation* and against description theories are summarized. The New Theory of Reference based on (Kripke 1981) is outlined. Kripke's main arguments are based on modal considerations within the framework of normal modal logic with a possible world semantics. According to his modal argument, names are rigid designators, whereas definite descriptions need not be rigid, and therefore cannot represent the meaning of proper names. The *Kripkean challenge* to the descriptivist is then to explain how descriptivism is still feasible, if definite descriptions are non-rigid by default, and some of the descriptivists' answers to this challenge will be defended in the last part of this chapter.

The chapter is organized as follows. Rigid designation and Kripke's original arguments in favor of the New Theory of Reference are described in section 3.2. Another aspect of direct reference is laid out in section 3.3. Under the label *Millian view on reference* this aspect comprises any way of looking at reference as a connection between a speaker and an object that is in some way immediate in thinking, during the act of referring to to the object or in the specification of truth-conditional and cognitive content. Section 3.4 finally addresses the ongoing debate on the question whether a modal form of descriptivism, i.e. a theory of descriptions that explicitly deals with rigidity in a modal logical setting, is feasible or not. Some of the known arguments against description theory will be discussed critically. Although no decisive argument in favor of descriptivism is given in this section, it will at least be made plausible that some forms of descriptivism can peacefully live together with Kripke's rigidity thesis.

3.2   Direct Reference and Rigidity

As the name suggests, direct reference theory assumes that it is at least under certain circumstances and by means of certain expressions possible to refer to objects without any mediation through meaning or Fregean senses. The original and main arguments in favor of direct reference in (Kripke 1972) are centered around the concept of a rigid designator in modal contexts, which will be sketched in the following section.

There are some aspects of (Kripke 1972) that will not be addressed here at all. For example, Kripke propagates an epistemic notion of a contingent apriori, but it would lead too far apart to discuss this epistemological issue.[1] For lack of space Kripke's controversial thesis that natural kind terms are rigid won't be addressed either.

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[1] An exposition of Kripke's apriori and a critique on it can be found in (Kupffer 2004).

3.2.1 Rigid Designation and Kripke's Modal Argument

The notion of rigid designation is intrinsically tied to Kripke-style possible world semantics for normal modal logics, insofar as possible worlds in this framework stand for arbitrary counterfactual situations.[2] Kripke gives the following informal definition of a rigid designator:

> "Let's call something a *rigid designator* if in every possible world it designates the same object, a *non-rigid* or *accidental designator* if that is not the case. [...] A rigid designator of a necessary existent can be called *strongly rigid*." (Kripke 1981, p. 48)

So a rigid designator is a term that in any counterfactual situation semantically refers to the same object, if this object exists in that situation, and a strongly rigid designator is a term that is a rigid designator and whose semantic referent exists in any counterfactual situation, i.e. exists necessarily. Given that, Kripke's central tenets are:

☆ **Kri 1** (Rigidity Thesis). *Names are rigid designators.*[3]

☆ **Kri 2** (Refutation of Description Theory). *A description or cluster theory of proper names is incompatible with the fact that names are rigid designators.*[4]

What is the main argument for these theses? Among many others, Kripke discusses the following example.

(3.1) Aristotle was fond of dogs. (Kripke 1981, p. 6)

(3.2) The last great philosopher of antiquity was fond of dogs. (Kripke 1981, p. 7)

Assuming that Aristotle was indeed the last great philosopher of antiquity, this definite description is actually co-extensional with «Aristotle». However, as Kripke points out, under some counterfactual circumstances the last great philosopher of antiquity could have been someone else than Aristotle, but it is impossible for Aristotle to not having been Aristotle. Kripke's point is subtle. He admits that Aristotle could have been called differently than «Aristotle» in some counterfactual situation, just as the last great philosopher of antiquity could have been someone else than Aristotle. But Kripke argues that Aristotle could not have been someone else than Aristotle, and therefore «Aristotle» denotes Aristotle in every possible world (state of affairs) in which Aristotle exists. Hence, the proper name «Aristotle» is a rigid designator, whereas a co-extensional definite description doesn't need to be rigid. At least in their customary reading, definite descriptions are *non-rigid*. Kripke generalizes from the various examples he discusses and claims that this distinction holds for any proper name in natural language and any definite description in natural language. While there might be uses of definite descriptions that are rigid, definite descriptions are non-rigid in general, whereas proper names are always rigid.

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[2]See (Kripke 1981, pp. 9-10; 15-20). Strictly speaking, possible worlds aren't the same as (possible) situations, since the former are 'bigger' then the latter in the sense that they correspond to maximally consistent sets formulas. A possible world makes either a formula A or its negation $\neg A$ true, which is a requirement that may be dropped for possible situations. Cf. (Gärdenfors 1988, p. 25). For the current purpose, the difference doesn't matter.

[3]See (Kripke 1981, p. 48-9).

[4]See (Kripke 1981, pp. 10-2; 57).

If Kripke's argument is correct and modalities are taken into account, the alleged rigidity of proper names has consequences for their truth-conditional role. A necessary condition of understanding the truth-conditions of an utterance is to grasp the conditions under which it would be true and the conditions under which conditions it would be false. This boils down to being able to decide of any counterfactual situation whether a given utterance would be true in this situation or false, or, as one may add, it cannot be clearly decided whether it is true or false. So given that they are rigid, the truth-conditional content of proper names in a modal setting must be different from that of any non-rigid definite description that in fact is co-extensional with that name in the actual world.

Kripke's main argument can be made more explicit by including the modal component into the examples. Consider the following utterances.

(3.3) Aristotle might not have been Aristotle.

(3.4) The last great philosopher of antiquity might not have been Aristotle.

Taken literally, example 3.3 is necessarily false. Only in some non-literal reading, according to which the second occurrence of «Aristotle» is interpreted as the property of *being called «Aristotle»*, example 3.3 may be judged as being true.[5] Conversely to this, under any canonical way of understanding «might», example 3.4 is true, because it is perfectly conceivable that some other philosopher than Aristotle would have been the last great philosopher of antiquity. Kripke (1981) backs up his claims with many more examples of this kind. His argumentation strategy is to first give examples of the different interpretations of proper names and definite descriptions with respect to counterfactual situations, and then generalize these examples to any kind of definite descriptions and proper names. Although the generalizing step is an empirical induction, the overall argument is rather plausible. There is not much reason to doubt that examples similar to the above one can be constructed for any other kind of genuine proper names and definite descriptions. Special cases like rare descriptive uses of proper names don't falsify the thesis that in their common uses, given some canonical interpretation, ordinary proper names are rigid.

3.2.2 Rigid Designation as a Formal Notion

Rigid designators can be defined precisely in normal first-order modal logic (FOML). This is instructive for two reasons. First, although he doesn't introduce formal definitions explicitly in (Kripke 1981) because he wants to support his thesis by 'intuitive' modal considerations that are independent of any formal framework, Kripke certainly has a formal definition of rigid designators in mind when he discusses rigid designation.[6] Second, it will turn out to be useful to have formal and informal characterizations of rigid designators later in this chapter in the discussion of rigidified description theory. The version of FOML assumed in the following definitions is

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[5]Example 3.3 is pragmatically marked to an extent that some speakers might consider it non-true (in the sense of neither true nor false), senseless, or inappropriate. The reason for this is that it violates Grice's Cooperative Principle (Grice 1975), because the utterance is necessarily false. By pragmatic recovery strategies, the non-literal reading will then be computed as the preferred reading. For Kripke's argument only the fact matters that the utterance is necessarily false.

[6]See (Kripke 1981, p.15, fn. 16).

multi-modal normal modal logic with relational constant-domain semantics, where the following non-standard symbols are used: E is the existence predicate, $\Diamond_\pi$ and $\Box_\pi$ are diamond and box modalities with modality index π, $\forall^*$ and $\exists^*$ are possibilist quantifiers ranging over all objects (actual objects and possibilia), and $\forall$ and $\exists$ are quantifiers relativized to the existence predicate. Moreover, $[\![.]\!]_g^M(w)$ is a function interpreting both formulas and terms with respect to a model M, assignment g, and world w. (See Appendix A for the complete specification.) In this version of FOML, rigid and strongly rigid designators can be defined semantically as follows.

☆ **Kri 3** (FOML Rigid Designator).
A term t is a rigid designator with respect to some modality π iff for all $w, u \in W$ such that $wR_\pi u$: if $[\![Et]\!]^M(u) = 1$ then $[\![t]\!]^M(w) = [\![t]\!]^M(u)$, for any model M.

☆ **Kri 4** (FOML Strongly Rigid Designator).
A term t is a strongly rigid designator with respect to some modality π iff t is a rigid designator with respect to π and for all $w \in W$: $[\![Et]\!]^M(w) = 1$, for any model M.

Like in the informal case, a term is non-rigid if it is not rigid. Definitions similar to the above ones could also be given by syntactic schemes like formula 3.5 and formula 3.6 respectively.[7]

$$\forall^* x\big(t = x \supset \Box_\pi(Et \supset t = x)\big) \tag{3.5}$$

$$\forall^* x\big(t = x \supset \Box_\pi(Et \wedge t = x)\big) \tag{3.6}$$

All of the above definitions are compatible with a certain conception of actualism, according to which no statements can come out true in some world if the semantic referent of a singular term in the respective statement doesn't exist at that world. However, since for the actualist denotation and existence coincide, (Kri 3) has to additionally require that the referent of the term exists in the actual world, i.e. $[\![Et]\!]^M(w) = 1$ must hold if a strict actualist position is adopted. If on the other hand a possibilist position is adopted, then it is possible to make a veridical assertion about something which doesn't exist. In this case, there is an alternative view on rigid designation according to which the definition becomes independent from existence. (Kri 5) reflects this and is probably the simplest way to characterize rigid designators.

☆ **Kri 5** (FOML Possibilist Rigid Designator).
A term is a possibilist rigid designator with respect to some modality π iff for all $w, u \in W$ such that $wR_\pi u$: $[\![t]\!]^M(w) = [\![t]\!]^M(u)$, for any model M.

If a version of FOML is used in which terms are allowed not to denote, and thus $[\![t]\!]^M(w)$ can be undefined for some possible world w, then the above definitions have to be modified accordingly to ensure that t at the respective world denotes.[8] With respect to non-denoting

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[7]The definitions do not amount to the exactly same conditions on frames, since for example the semantic definition of strongly rigid designators stipulates existence of the semantic referent in all worlds, even inaccessible ones, whereas the corresponding syntactic scheme stipulates existence in worlds accessible from the actual one. However, the definitions will coincide for all practical purposes in all symmetric R_π-frames, because in these frames $\Box_\pi Et \supset Et$ holds, and furthermore any completely inaccessible worlds are irrelevant, because they can be eliminated from a model without affecting validity and satisfiability of formulas.

[8]See $FOML_\iota$ in Appendix A for a system with non-denoting terms.

terms, there is a further formal distinction that can be made. Terms that denote the same object in all worlds in which it exists, and thus are rigid but additionally don't denote anything in any world in which this object doesn't exists are called *persistently rigid designators*, whereas terms satisfying (Kri 5) and denoting in any world are also known as *obstinately rigid designators*.[9]

3.2.3   The New Theory of Reference

Apart from his critique on description and cluster theories of reference, Kripke also gives a positive account of reference, which will henceforth be called the *New Theory of Reference*.[10]   It is based on the following claims.[11]

☆ **Kri 6** (Fixing of Semantic Reference)**.** *The reference of a proper name is initially fixed by (a) ostension or (b) by a definite description in an act of naming or baptism.*

☆ **Kri 7** (Determination of Semantic Reference)**.** *The uses of a proper name are connected with the original act of baptism by virtue of causal chains. In the beginning of a causal chain is the initial act of baptism, and a use of a proper name semantically refers to the object that was fixed as its referent in this initial act.*

The purpose of the second point is to naturalize the notion of denotation in order to explain why proper names are rigid. According to the New Theory of Reference, a proper name has no meaning in the sense of some description or cluster of properties that the user of the proper name needs to implicitly know or associate with he proper name in order to understand it or use the name correctly by virtue of linguistic competence. In order to understand a proper name or use it correctly, a speaker only has to intend to use it as an expression that denotes the same object as in the original act of fixing its reference. A speaker acquires a proper name by observing uses of the name by other speakers, which ultimately means that there is a causal connection between his use of the name and the use of the name from which the speaker has learned his use. Likewise, a speaker that acquires a proper name during the initial act of baptism is in a causal connection with the proper name and its referent. Equivocal proper names are then homonymous but different from each other, because they have different historical causal chains linking them back to different objects in different acts of baptism. Figure 3.1 illustrates a causal chain.

A causal chain of uses of a proper name is not something abstract, but rather something that is fully determined by processes of the actual world at various stages in time. Since the causal chain of a name is fully determined by the actual course of history of the world, it explains why proper names are rigid while at the same time not requiring the speaker to implicitly know any meaning of the proper name. The proper name itself is meaningless, except for the fact that it rigidly denotes the semantic referent.

Why does Kripke not just say that a proper name semantically refers under any counterfactual circumstances to the referent that has actually been baptized? The answer is that, according

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[9]See (Stanley 2001, p. 556-7).

[10]Kripke (1981) doesn't really consider his suggestions a full-fledged theory of reference (Kripke 1981, pp. 93-5; 97), but it has later been dubbed that way.

[11]See (Kripke 1981, pp. 96-7, N.B. fn. 42; 135-9); cf. (Soames 2002, pp. 4-5).
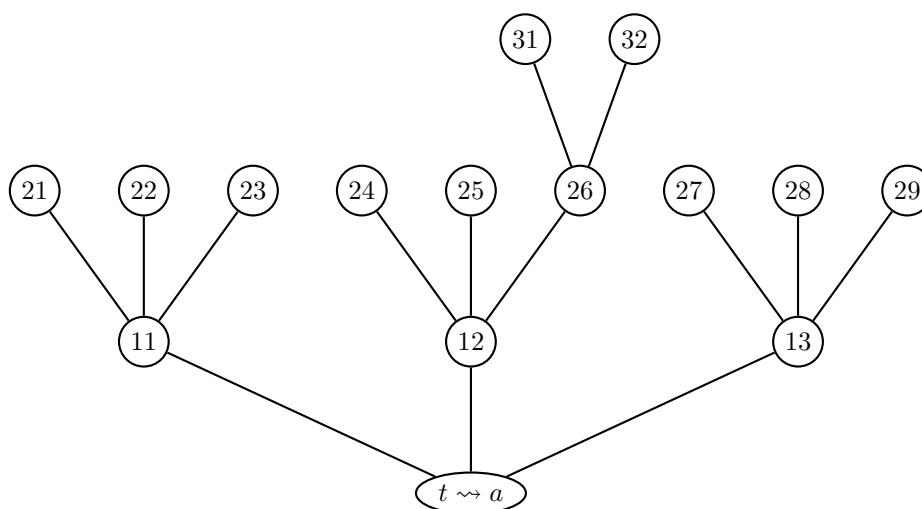
Figure 3.1: All 15 uses of a proper name t are causally linked to an initial act of baptism that fixes the referent a.

to Kripke, a description like *the person that is actually called «Aristotle»* would be circular for explaining the reference of «Aristotle». He formulates the following principle:

> "(C) For any successful theory, the account must not be circular. The properties which are used in the vote must not themselves involve the notion of reference in a way that is ultimately impossible to eliminate." (Kripke 1981, p. 68)

Formulated in the above way this principle is not controversial, but it can be interpreted in controversial ways. In chapter 4 it will be argued against Kripke (1981, pp. 68-73) that this principle doesn't preclude *nominal description theory* (Bach 1987) based on the properties of *being called such-and-such*. However, one of the strong points of the New Theory of Reference is undoubtedly that it accounts for the fact that proper names are rigid designators (descriptive adequacy) *and* provides an explanation why they are rigid (explanatory adequacy). Furthermore, Kripke's suggestion is compatible with certain empirical observations, for example that in many cases speakers aren't aware of any description of the referent of a proper name when they use the name, that in many conversational situations in which proper names are used identifying reference doesn't seem to play any role, and that proper names many times seem to act as mere placeholders similar to the role of variables in logic. Kripke's suggestions also fit very well together with and have partly inspired arguments in favor of *semantic externalism*, such as the ones in (Putnam 1975) and (Burge 1979a). However, it should be noted that there is—up

to the time of this writing and to the author's knowledge—no formal implementation of the New Theory of Reference that in fact represents causal chains between uses of proper names originating from a shared act of baptism. The only thing that is encountered in one or another form in formal implementations is rigidity conditions like (Kri 3), (Kri 4), or (Kri 5).

3.3   Direct Reference as Immediacy of Reference

The New Theory of Reference and Kripke's arguments against description and cluster theories supports another position that can be subsumed under the label direct reference. According to this position, the referent itself is the semantic content of rigid terms. The referent itself is thought of as representing the truth-conditional content of a proper name, and it can likewise also determine the cognitive content of a proper name or another rigid term. A speaker can have a form of direct epistemic or cognitive access to a particular, and the particular itself in a sense fixes the content of his thoughts. This way of looking at direct reference will be laid out in the following sections.

3.3.1   Millianism, Semantic Reference, and Rigidity

The position that proper names have no descriptive meaning on their own is already expressed by Mill (1843), who formulates it in the following way:

> "Proper names are not connotative: they denote the individuals who are called by them; but they do not indicate or imply any attributes as belonging to those individuals." (Mill 1994, p. 135)

Thus, this position is also known as the *Millian view on proper names*. Accordingly, a specification of truth-conditional or cognitive content is labeled *Millian* or *de re* if it involves direct reference to objects, for example by the use of constants. Several remarks are in place about Millianism as a view on reference.

First, as far as only semantic reference is concerned, Mill's position merely constates that the linguistic purpose of a proper name is to denote an object and not to assert of that object that it has a certain property. Semantic reference supports the Millian view simply by virtue of the fact that it is an idealization from the way that speakers actually refer to objects by means of a certain kind of referential expression. Notice further that, if semantic reference serves as a corrigens that allows one to assert that a speaker's reference fails, as in example 2.13 on page 38, then semantic reference trivially cannot be the sum of all speaker references by means of the respective term. The relation between speaker reference and semantic reference must be considered an instance of Chomsky's originally syntactic distinction of performance versus competence in the semantic domain. Given that, a *semantic argument* against description theory that is based on the possibility of failure of identifying reference is prone to a petitio principii. While the purporter of indirect reference will insist that there must be some description or cluster that represents the *actual* meaning of a referential expression and may be determined by complex social processes, it will always be *possible* that an individual speaker may fail to identify the

semantic referent by means of this description or cluster even if he associates it correctly with the referential term in question.

Second, as argued in section 2.5, identifying reference is not generally a requirement on behalf of the speaker by virtue of linguistic competence. This suggests that the Millian view is more adequate than any indirect reference view in order to deal with semantic reference, but only because it already stipulates semantic reference as an idealization, whereas the motivation of a purporter of indirect reference is rather to describe and explicate speaker reference prior to drawing the connection to a derived and idealized notion of semantic reference. In that sense Millianism versus the indirect reference view is a linguistic reoccurrence of the realism versus anti-realism debate found in continental epistemology prior to the linguistic turn.

Third, Millianism alone doesn't entail the rigidity thesis but is merely compatible with it, although Kripke and others at some occasions seem to suggest the entailment thesis.[12] As Martí (2003) points out, if a proper name simply names its semantic referent, then it may still be considered as naming another referent in other, counterfactual situations.[13] Correspondingly, it is a matter of choice whether individual constants in first-order modal logic are implemented as rigid or as non-rigid terms.[14] That English proper names are rigid is a contingent fact of the English language and not a consequence of the Millian view. For suppose it was a consequence of the Millian view; then any formal or informal implementation of the Millian view in which proper names or their formal counterparts were non-rigid would be inconsistent, but this is clearly not the case. Direct reference may nevertheless be understood as including both the rigidity thesis and the Millian view on proper names, since the rigidity thesis is compatible with the Millian view on proper names, whereas Kripke's modal arguments show that the rigidity thesis is by default incompatible with non-modal description theories.[15]

3.3.2 Millianism and Speaker Reference

Let us now turn to the aspect of immediacy, which in the present context is a metaphor for any kind of 'direct' cognitive connection with some object. This aspect of Millian specifications is generally problematic. If Millianism is indeed trivially adequate for describing semantic reference up to being a formulation of semantic reference, then one would expect it to raise descriptive and explanatory difficulties whenever speaker reference matters for truth-conditional or cognitive content respectively. This has been recognized by all purporters of the Millian doctrine including Kripke (1979) himself. Exactly in which cases speaker reference matters, and which aspects thereof, is controversial, as it depends on a variety of factors like (i) the underlying theory of what an utterance *expresses*, of *what is said* by an utterance, (ii) whether the pragmatic or the semantic view on referential opacity is adopted,[16] (iii) the status of speaker reference in the underlying theory of meaning, and (iv) the criteria for determining the cognitive role of expressions in a dual aspect theory.

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[12] See e.g. (Kripke 1981, pp. 26-34), (Recanati 1993, p. 12).

[13] See (Martí 2003, p. 168-70).

[14] In Appendix A they are by default non-rigid and have to be made rigid by imposing rigidity conditions.

[15] See (Kri 2) on page 43.

[16] See section 2.4 in chapter 2.

Millianism can make the distinction between speaker reference and semantic reference much in the same way as it has been done in chapter 1 and thus can account for identifying reference and its failure. A Millian analysis of speaker reference amounts to stipulating a direct connection between a speaker and some particular when the speaker uses or interprets a given referential term. In which way such a connection can be direct and whether the directness/immediacy metaphor makes sense at all is not clear, though. An example of a relational analysis of belief illustrates the problem faced by the Millian. Consider example 3.7.

(3.7) Alice believes that Bob loves Carol.

Accounting for the de dicto reading of such attitude ascriptions is obviously difficult, because it is a logical law that co-extensional expressions can be substituted salva veritate in any context.[17] A feasible Millian solution is to use constants that are non-rigid in the scope of belief operators, but rigid in the scope of alethic modal operators. This relativized rigidity will be implemented in the next chapter, where it will also be shown that direct and indirect reference aren't far apart with respect to this interplay between doxastic and alethic modalities. A deeper problem for Millianism is in specifying cognitive content in a suitable way. Whatever the presentation of an object in a speaker's cognition may be, or however it may be best described, such a presentation cannot be the object itself, since objects aren't in our head and objects have infinitely many properties, but immanent presentations of objects in cognition must be finite.[18] While description theory at least tries to account for this fact and is by default compatible with it, Millianism by default doesn't account for it. As a remedy, Millian specifications of content have to be augmented by additional entities akin to Fregean senses, in order to be able to deal with the assorted phenomena that in a broad sense have to do with speaker reference. This has resulted in mixed, genuine dual aspect theories in which, unlike to Frege's original approach, truth-conditional content and cognitive content of expressions are represented by different sorts of meaning-constituting entities and referential expressions sometimes not only contribute a bare particular to the representation of semantic content in question, but also some mode of presentation.[19] For example, Recanati (1993) distinguishes between wide and narrow content, where the former represents what an utterance expresses, i.e. what is said, and is analyzed in terms of singular propositions, but narrow content includes what Recanati calls *linguistic modes of presentation* and represents the content of the attitude a speaker may hold towards an utterance.[20]

In this context a related problem concerning de re readings of attitude ascriptions must be mentioned: Quine's Ortcutt puzzle in (Quine 1956). Ralph believes for good reasons that Ortcutt is a spy, but doesn't believe that the man he has seen at the beach is a spy, even though Ortcutt actually is the man Ralph has seen at the beach. If an attitude holder's acquaintance with the referent through his senses is a necessary condition for attributing de re belief to him, Ralph's attitude towards Ortcutt, the man at the beach, can be de re, but then his belief system would be

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[17]It has occasionally been denied that co-referential terms are substitutable salva veritate in any context, but in the present view this is regarded a logical error. In the present view—following Frege, Russell, and many others—*any* such alleged blocked substitutability arises from insufficient logical analysis.

[18]Cf. on finiteness of cognitive content (Castañeda 1990a, p. 739). Cf. section 8.4 of chapter 8.

[19]Cf. (Ackerman 1979b, p. 58).

[20]See (Recanati 1993, Ch.3).

inconsistent. According to Quine (1956) this is an undesirable point of view, because it would incorrectly indicate that Ralph was irrational. One solution proposed by Kaplan (1968) is to regard the de re belief in question as a a de dicto belief about the object under the respective acquaintance relation. But in the present point of view, de re just means *involving the object independently of any epistemic way to access it*, and a description analysis of a proper name can be de re by giving the iota quantifier wide scope with respect to the belief operator just like a Millian analysis. Following Marcus (1981), in Quine's puzzle Ralph is considered not to have a genuine de re belief at all, because nobody can believe de re in an inconsistency. The attribute «de re» is thus understood as involving no referential opacity of any terms in an attitude ascription whatsoever. This is in contrast to the more common point of view that, following Quine, the Ortcutt puzzle reveals that de re belief needs to be revised. So in the present view both Millians and descriptivists can attribute bare de re belief, which is based on the semantic reference of all the terms in the belief ascription. The Millian may for example use Russellian propositions and the descriptivist may use iota expressions with wide scope in regards to the doxastic modal operator.[21] However, the Millian faces the problem posed by the Ortcutt example for other notions of belief as well.

One problem with enriching a Millian specification in order to get a more 'fine-grained' specification of cognitive content is a hidden equivocation in the notion of cognitive content itself. It will be argued in the next chapter that the way in which mixed theories deal with cognitive content is misleading; from a descriptivist point of view, the crucial point is not that of getting a specification of content that is 'fine-grained' enough, but rather that speaker reference from an epistemic point of view involves a speaker's attempt to identify the semantic referent by means of certain properties he believes it to have.[22] For now it suffices to notice that bare Millianism and speaker reference live in a tension, because cognitive or epistemic access to a particular has to be described as a relation between an agent and some finite presentation of the object. Suppose an object itself is thought to constitute part of the representation of meaning in the formal language, or more precisely speaking, a directly referential term like an individual constant is used in the formal language of analysis for the specification of some kind of cognitive content, and further assume that this representation is not augmented by some additional Fregean mode of presentation or alike. Then this representation has two rather undesirable characteristics. First, it cannot account for and doesn't encode dispositions of the speaker to use certain, but not other referential expressions in order to speaker refer to the object in question, since there is no path back from the referent to the referring expression. Second, the representation doesn't presume that the referent of the directly referential expression in question has certain properties by means of which it is purportedly identified by the speaker prior to asserting something about it, since an object has all the properties it has and not some properties that someone ascribes to it. Both characteristics make bare Millianism problematic. On the other hand, Millianism has its strength in being compatible with the rigidity thesis. Non-modal descriptivism isn't compatible with the rigidity thesis, and therefore has to be revised.

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[21] The technical details will be discussed below and in the next chapter.
[22] See section 4.3.1.

3.4   Direct versus Indirect Reference

In this section, the indirect reference view will be defended against the Kripkean challenge. This could be achieved by a general attack on modality like the one by Quine (1976). Such foundational, external critique will not be considered further. There are less fundamental ways to defend indirect reference that will be outlined now. This is done in two parts. First, ways to adjust description theory in order to deal with rigidity are summarized in section 3.4.1. Then, in section 3.4.2, some known critique on these positions is addressed and at least partially refuted.

3.4.1   Some Known Defences of Description Theory

The replies to Kripke that are going to be outlined in the following paragraphs are description theories that make the description itself rigid in one way or the other. Although they differ in the technical apparatus used, they boil down to the same underlying idea. If a rigid term denotes the object that it actually denotes in all possible worlds in which this object exists, then any definite description that is a suitable analysis of this term must pick out the very same actual semantic referent in those worlds as well. These theories will henceforth be subsumed under the label *modal description theories*.

Essential Properties

Perhaps the simplest descriptivist reply to the Kripkean challenge is already anticipated in (Kripke 1981). The definite description determining the semantic referent of a rigid term must involve an essential property. But which one? The most straightforward suggestion is to simply analyze a proper name like «Aristotle» by a stipulated unary property *Aristotelize* that is true of Aristotle and only Aristotle in any possible world in which Aristotle exists. This solution is highly technical, stipulative, and not very satisfying. In Kripke's opinion, it also falls prey to the circularity prohibition (C), because there doesn't seem to be any way to further explicate the meaning of such a property without resorting to the name «Aristotle» and the fact that this name is rigid. The circularity prohibition would even be violated in cases of abstract mathematical objects. For example, a property like *being number 9* may be an essential property, if the common judgment is correct that mathematical statements are necessarily true, but still one would have to explain the semantic reference of «9». Stipulating essential properties for empirical objects is even less appealing, because it leads to an undesirable form of metaphysical essentialism. What, one may ask, would the essence of Aristotle be? In the light of Kripke's modal arguments, it can at least be said that the candidate for such a property cannot be any kind of experiential property or quality. It generally doesn't convince to merely stipulate an essential property and subsequently eliminate all rigid terms by definite descriptions in same the way in which Quine (1950) suggests to eliminate all individual constants in first-order predicate logic,[23] as long as there are no plausible, non-circular candidates for a suitable essential property. There are similar, inherently quotational properties like *being called «Aristotle»* that can be used, as long as they are rigidified

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[23]See (Quine 1972, p. 230-4).

in some suitable way (see below), and in fact will be used in the next chapter, but using more or less mysterious properties like *being Aristotle* or *Aristotelize* will not be considered any further.

Rigidified Descriptions

Although there doesn't seem to be any natural (non-logical) property or even quality of empirical objects that is essential, some sophisticated formal mechanisms have been suggested as candidates to ensure that a definite description is rigid. One common suggestion is to rigidify a definite description by means of an actuality operator.

One of the first suggestions of this kind can be found in (Plantinga 1978), who proposes the following. Suppose P is a unique property of the actual Aristotle, as it would be used according to non-modal description theory to determine the semantic referent. Then one may build a complex property $P\alpha$, which Plantinga calls "α-transform of P".[24] Hereby, α is an index for the actual world, and the α-transform of a property P is read (schematically) as *being-P-in-α*. It is obvious that any such property is not contingent and picks out the same individual in all possible worlds in which the object exists that uniquely satisfies P in the actual world.[25] Burge (1979b) makes a similar suggestion in order to defend Frege's original theory against the claim that he couldn't explicate the sense of a proper name by a definite description, because definite descriptions are non-rigid. Burge suggests an operator @ that evaluates its argument always with respect to the actual world.[26] He has a specific operator in mind that in a double-index theory (see chapter 6) picks out the actual world even if an utterance is made under counterfactual circumstances (Burge 2005, p. 230: fn. 15a); in the following section, a simpler operator will do in order to illustrate how such an operator works in ordinary FOML.[27]

Implementing an Actuality Operator

A simple way to implement an actuality operator is to add a designated actual world to the model and make the operator jump back to this world during evaluation like in the following definition.

☆ **ML 1** (Actuality Operator). *An actuality-augmented FOML model $M = \langle W, R, [\![.]\!], w_0 \rangle$ with designated point of evaluation consists of a standard FOML model augmented by some $w_0 \in W$. An actuality operator is added to the language by the following rules.*

Syntax WFF := @ WFF

Semantics $[\![@ \, \mathrm{WFF}]\!]_g^M (w) = [\![\mathrm{WFF}]\!]_g^M (w_0)$

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[24] See (Plantinga 1978, p. 132).

[25] Another proposal based on Plantinga's can be found in (Ackerman 1979b, a).

[26] See (Burge 2005, pp. 229-30).

[27] His operator allows Burge to evade some critique based on considering utterances made under counterfactual circumstances. Such an operator can be added to a double-index theory based on a designated index, the same way as below in FOML, but this is not necessary in the present view, because such a critique can be dismissed on general grounds. Arguments based on the meaning of *source language expressions* in non-actual utterance contexts are pointless. There is no way to ensure in such contexts that the same language is spoken as in actual ones. Even fictitious utterances have to be considered *as if* actual. In the *target language* non-actual contexts of utterance may occur, for example because of diagonalization, but this is then the result of analyzing an actual source language expression.

The iota quantifier introduced in formula 2.1 on page 19 of the last chapter can be reused in the modal setting without major changes. There are, however, subtle, yet important differences in the semantics of such an abbreviated quantifier or a corresponding iota operator that have to be taken into account. The normal modal logic used throughout this chapter (see Appendix A) implements a constant-domain semantics, in which one domain is given for all worlds and the quantifiers $\exists^*$ and $\forall^*$ range over all objects in this domain. To obtain the same expressivity as in versions of FOML that use a varying-domain semantics, i.e. models with a domain function that assigns to each world its own domain over which the actualist quantifiers range, $\exists$ and $\forall$ have to be introduced as abbreviated quantifiers that are relativized to an existence predicate E. Depending on which quantifiers are used in its abbreviation, the iota quantifier behaves differently. Let's first take a look at the version of the iota quantifier that is relativized, here denoted by the same symbol $\imath$ as in the non-modal case of the last chapter. Then formula 3.8 expands to 3.9.

$$\Box\,\imath x[@\,Gx]Fx \tag{3.8}$$

$$\Box\,\exists^*\,x[Ex \wedge @\,Gx \wedge \forall^*\,y(@\,Gy \supset x = y) \wedge Fx] \tag{3.9}$$

This formula has the reading that in all $\Box$-accessible worlds w_i there exists an object that in the actual world uniquely has property G and this object has property F in w_i. A more expressive quantifier can be obtained by using the non-relativized possibilist quantifiers, here denoted by the symbol $\imath^*$. Then formula 3.10 expands to 3.11.

$$\Box\,\imath^*\,x[@\,Gx]Fx \tag{3.10}$$

$$\Box\,\exists^*\,x[@\,Gx \wedge \forall^*\,y(@\,Gy \supset x = y) \wedge Fx] \tag{3.11}$$

This formula has the reading that in all $\Box$-accessible worlds w_i the object that is uniquely G in the actual world (whether it exists anywhere or not) is F in w_i. Using the same non-relativized quantifier, we can also express formula 3.9 as 3.12, and furthermore get formula 3.13 as an additional candidate expanding to 3.14.

$$\Box\,\imath^*\,x[Ex \wedge @\,Gx]Fx \tag{3.12}$$

$$\Box\,\imath^*\,x[@(Ex \wedge Gx)]Fx \tag{3.13}$$

$$\Box\,\exists^*\,x[@(Ex \wedge Gx) \wedge \forall^*\,y(@(Ey \wedge Gy) \supset x = y) \wedge Fx] \tag{3.14}$$

Formula 3.14 has the reading that in all $\Box$-accessible worlds w_i the object that exists and is uniquely G in the actual world is F in w_i. Finally, existence can be stipulated both in the actual world and in all accessible worlds. This is done in formula 3.15 which expands to 3.16.

$$\Box\,\imath^*\,x[Ex \wedge @(Ex \wedge Gx)]Fx \tag{3.15}$$

$$\Box\,\exists^*\,x[Ex \wedge @(Ex \wedge Gx) \wedge \forall^*\,y((Ey \wedge @(Ey \wedge Gy)) \supset x = y) \wedge Fx] \tag{3.16}$$

This formula has the reading that in all $\Box$-accessible worlds w_i the object that exists in those worlds and in the actual world, and that is uniquely G in the actual world, is F in w_i. The obvious question is now, which version and reading yields the desired rigidified description analysis of proper names.

There is no definite answer to this question, as it depends on whether actualism or possibilism is adopted and which version of rigid designation is purported. Recall that an actualist denies that veridical statements can be made about objects that don't exist. So a strict actualist is likely to favor an analysis like 3.16 or 3.8, where the latter analysis follows (Kri 3). A possibilist, on the other hand, might opt for 3.10 following (Kri 5), but he might also have reasons to endorse any of the other analyses. Since a whole range of alternative definitions of rigid designators can be found in the literature, there are no clear-cut 'intuitions' about the question which of them catches the correct semantics of proper names with respect to metaphysical (alethic) modalities. Perhaps this is rather a question about interpreting metaphysical modalities than a genuinely semantical question. In any case, it can be said that the rigidified description analysis allows us to formally encode various analyses of proper names as rigid designators. It has to be noted, though, that none of the above examples encodes condition (Kri 4), because the global existence presupposition expressed in this condition cannot be expressed as part of the restriction of the iota quantifier.

Let us finally take a look at an example of a rigidified description analysis, where the modest actualist notion of rigidity exemplified by formula 3.8 is presumed. Consider examples 3.3 and 3.4 again.

(3.3) Aristotle might not have been Aristotle.

(3.4) The last great philosopher of antiquity might not have been Aristotle.

These examples are analyzed as 3.17 and 3.18 respectively:

$$\Diamond \imath x [@\, Gx] \imath y [@\, Gy](x \neq y) \tag{3.17}$$

$$\Diamond \imath x [Gx] \imath y [@\, Gy](x \neq y) \tag{3.18}$$

It is easy to see that 3.17 is false in any model with designated evaluation point, whereas 3.18 is true in some such models. The analysis encodes the correct truth-conditions.

The Wide Scope Theory

Wide scope description theory exploits the notion of priority scope. Whenever an expression contains a proper name that is within the scope of modal expressions, the proper name must be analyzed as a definite description that has wide priority scope over the modal expression and therefore is evaluated independently of this expression. An example of such an analysis is illustrated in figure 3.2, where the role of tense is ignored.

As the figure shows, the wide scope theory operates at the level of logical analysis and is in the spirit of Russell's original view on proper names. Expressions in a source language are translated into expressions of the target language, which is a process of philosophical, logical, or semantic analysis. The following formulation makes this explicit.

☆ **WDT 1.** *(Wide Scope Description Theory) Proper names in the source language are analyzed as definite descriptions that have widest possible scope with respect to any modal operators in the corresponding expression of the target language.*

It is possible that Aristotle was fond of dogs.

$$M, g, w \vDash \imath x(Fx)(\Diamond\, Gx)$$

analysis

binding
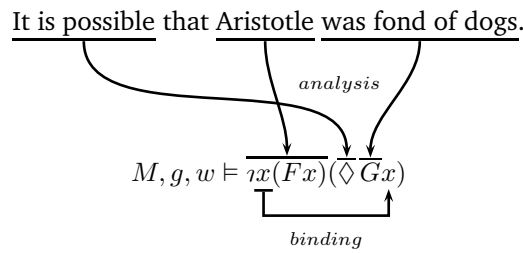
Figure 3.2: Wide scope analysis of an English sentence.

$$\forall^* x\big(t = x \supset \Box(Et \supset t = x)\big)$$

$$\forall^* x\big(\imath y(Gy)(y = x) \supset \imath y(Gy)\Box(Ey \supset y = x)\big)$$
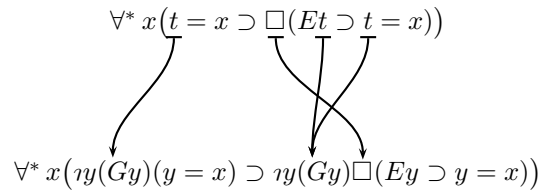
Figure 3.3: Wide scope translation of one expression into another expression of FOML.

In the above example, the source language is English, but it could just as well be any other formal or natural language that contains expressions that may with reasonable justification be called proper names (and the same way for any other kind of rigid expressions that are to be analyzed). The target language can be any language that is deemed adequate for representing the truth-conditional or cognitive content of the whole expression to be analyzed in a philosophically, logically, or semantically satisfying manner. In the example, the target language is FOML, which itself has been given a relational semantics, but it could just as well have been plain set theory or any other kind of sound logical representation. Figure 3.3 illustrates an analysis of a FOML expression containing a supposedly rigid constant t into an expression of the target language FOML itself (some irrelevant mappings are left out). Often—though not in the version of FOML used here—individual constants already are rigid designators, and so mapping them to quantifier expressions with wide scope would be quite pointless. The example is in another sense a redundant application of the wide scope theory. First-order modal logic is already an ideal logical language that can be given various well-defined semantics, and there doesn't seem to be any need to analyze any of its expressions. Nevertheless, figure 3.3 illustrates a correct application of the wide scope theory. It has been deliberately chosen in order to emphasize that the wide scope theory can be regarded a way of analyzing expressions of an arbitrary language by means of wide scope descriptions of another or the same language.

3.4.2   Pro and Contra Modal Description Theory

It has already been acknowledged that the essential property approach isn't a feasible solution without specifying exactly which properties would be likely candidates for rigidifying descriptions. But the wide scope analysis or descriptions rigidified by an actuality operator catch rigid-

ity quite well. However, both theories have been criticized by purporters of the New Theory of Reference. Kripke (1981) himself mounts one of these attacks in his preface to the second edition of *Naming and Necessity*, and Soames (2002, Ch. 2) extends and enriches this critique. It will be argued in the following paragraphs that the main arguments used in criticizing modal description theories don't really grip. However, lack of space prevents to address all arguments that have been mounted in the literature against indirect reference of proper names and other rigid expressions, and only some of them will be discussed in the following paragraphs as examples. The purpose of this procedure is not to finally disprove all conceivable arguments against modal description theories, which would be an infeasible and nonconstructive task, but to make it plausible that modal description theory isn't generally incompatible with the rigidity thesis, as long as the process of logical and semantic analysis is taken seriously.

Two Arguments against the Wide Scope Theory

The first argument to consider is targeted against the wide scope theory and can already be found in (Kripke 1981). Consider examples 3.1 and 3.2 again, here repeated for convenience.

(3.1) Aristotle was fond of dogs.

(3.2) The last great philosopher of antiquity was fond of dogs.

Ignoring the fact that tense is sometimes analyzed as a sort of modality as well, these examples don't contain any modal expressions. Nevertheless, as Kripke claims, «Artistotle» in 3.1 is a rigid designator, whereas the description in 3.2 is non-rigid. If the utterance 3.1 is evaluated with respect to some counterfactual circumstances, «Aristotle» still refers to the actual Aristotle, but if 3.2 is evaluated with respect to some counterfactual circumstances, the description would refer to whoever was the last great philosopher of antiquity under that circumstances. According to Kripke, the notion of scope isn't applicable in this example at all.[28]

Another, more rigorous argument against the wide scope theory can be found, among many others, in (Soames 2002). It is based on the following statements:

> "P1. The proposition that if n is F, then something is both F and G=the proposition that if G is F, then something is both F and G. [...]
>
> P2. The proposition that if the G is F, then something is both F and G is a necessary truth $\Box[((\text{the } x : Gx)Fx) \supset \exists y(Fy\&Gy)]$. [...]
>
> C. The proposition that if n is F, then something is both F and G is a necessary truth $\Box[Fn \supset \exists y(Fy\&Gy)]$. [...]
>
> C'. The G is such that the proposition that if it is F, then something is both F and G is a necessary truth (the $x : Gx)\Box[Fx \supset \exists y(Fy\&Gy)]$." (Soames 2002, p. 29/30)

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[28] See (Kripke 1981, p. 11-2). A similar version of this argument can be found in (Everett 2005, pp· 109-11).

For comparison, here is a formal version of these statements, where only 3.19 is an interpretation and the other formulas are provided by Soames:

$$[Fn \supset \exists x(Fx \wedge Gx)] \equiv [\imath x Gx Fx \supset \exists x(Fx \wedge Gx)] \tag{3.19}$$

$$\Box[\imath x Gx Fx \supset \exists x(Fx \wedge Gx)] \tag{3.20}$$

$$\Box[Fn \supset \exists x(Fx \wedge Gx)] \tag{3.21}$$

$$\imath x Gx \Box[Fx \supset \exists x(Fx \wedge Gx)] \tag{3.22}$$

Soames argues as follows. From premises P1 (3.19) and P2 (3.20) conclusion C (3.21) should follow, but the wide scope analysis only allows conclusion C' (3.22). The wide scope analysis is inadequate, because it mischaracterizes a valid conclusion as an invalid one.

Some Counter-Arguments

Kripke's argument can be refuted by pointing out that it is impossible to evaluate anything with respect to counterfactual circumstances without formulating those counterfactual circumstances, but whenever these circumstances are formulated the notion of scope is applicable. Kripke's position concerning the above argument is incoherent with the way he argues against modal realism, in course of which he emphasizes at various occasions that possible worlds aren't given qualitatively, that we don't find out anything about them like in a scientific discovery, but that they are given by our descriptions of counterfactual circumstances.[29] In fact, the claim that counterfactual circumstances could be given in any other way than by specifying them would be uttermost senseless, since anything that is given in another way than by linguistic description, or at least by intelligible imagination in thinking, must be actually given, and is therefore not counterfactual.[30]

Tackling Soames' argument is more complicated. Sosa (2001) mounts an attack on a variant of the above argument in (Soames 1998). Sosa's attack is based on the observation that the wide scope theory predicts that Soames' informal formulation of premise P2 is systematically ambiguous, and that therefore the conclusion C cannot be drawn in general. However, there is a deeper problem with the argument and similar ones against wide scope theories. Soames doesn't provide any formula representing P1, but gives in his notation (3.20), (3.21), and (3.22). It may be argued that this doesn't matter, as he doesn't provide any formal system anyway, but it is nevertheless revealing. Consider our attempt to give a formal account of P1 in comparison with Soames' informal version of the premise. Unless the square brackets in formula 3.19 are interpreted as operators taking a formula and yielding a proposition (whatever that may be), for which there is no evidence in the use of the other formulas Soames gives, the identity expressed in the informal version P1 has to be interpreted as equivalence. However, if the doctrine of the wide scope analysis is understood properly, it says that proper names *in English or any other*

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[29]See (Kripke 1981, pp. 44; 49-50).

[30]Hereby «intelligible imagination» is understood as some kind of conceiving or imagining in cognition that can in principle—following Wittgenstein's Private Language Argument—be formulated in public language. Perhaps some people have the ability to intellectually apprehend counterfactual situations in a way that cannot be expressed in public language, but such mysticism shall not interest us here any further.

source language under consideration have to be *analyzed as* definite descriptions with wide scope. If n in 3.21 and 3.21 above is part of the language of analysis, then it cannot be a proper name of English, but will presumably be a constant, which could be rigid or non-rigid or something else entirely, depending on the semantics it has been given. The closest equivalent to English proper names that is available in normal modal logic would be a rigid constant.[31] However, if n in the formal part was a rigid constant standing for an English proper name, then the formal argument simply compares rigid constants with wide scope descriptions. The difference between them is known: In order for a wide scope description to denote, there must be exactly one object in the actual world that satisfies some property, whereas a rigid constant denotes this object without the help of such a property. If on the other hand 3.20–3.22 are provided for the purpose of clarification only, and the main argument is based on P1, P2, and the apparently differing conclusions C' and C, then one may ask what exactly propositions and their identity conditions *are,* apart from being formal specifications of semantic content that belong to the target side of the analysis.

So there is a certain discrepancy between informal formulations and their formal counterparts. Soames (2002) generally assumes that propositions are the truth-conditional content of sentences or utterances, but in many of his arguments considers them independently from their specification using set-theory or some logical language.[32] However, consider for example the standard technical notion of propositions as sets of possible worlds. Then, given the presumption that G is true of exactly the same object of the actual world that is also denoted by n, formulas C and C' express the same 'propositions', i.e. are true in the same set of possible worlds.[33] To be fair, there are some indications that Soames' has a particular framework based on Russellian propositions as specifications of semantic content in mind, in which 3.21 and 3.22 might not be equivalent under the assumption that the iota quantifier's restriction determines the same object in the actual world as the rigid constant n does. But Soames seems to suggest that his considerations on propositions are independent of the formal framework used and yet they aren't. Another difference between Soames' and the present approach is in the role given to logical analysis. In the present view, the wide scope theory maps sentences of a natural language that contain proper names into appropriate specifications of their truth-conditional content that don't contain proper names or any other rigid and directly referring expressions, and this analysis takes place *under the assumption that for any object that a proper name denotes, there is a corresponding unique property determining this object in any given context of use of the proper name*. Therefore, in the *analysis* of a sentence, in the way a proposition is specified, a proper name can no longer occur, once the wide scope analysis has been applied. Under a purely Millian view one does not have to make the assumption that there is a unique property, particularly not the one that the descriptivist may presume. But if this assumption was dropped, then the anti-descriptivist argument would become a sort of a petitio principii. The wide scope theorist doesn't deny that the description analysis presumes a unique property of the referent and that the Millian view prima

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[31]Note that 3.21 is not an interpretation, but provided by Soames.
[32]See (Soames 2002, p. 4; 28).
[33]This is proved in Appendix B.I.

facie doesn't have to make such an assumption.[34] The wide scope theorist only claims that a wide scope analysis of proper names can specify the same truth-conditional content as a Millian analysis under this assumption.

An Argument against Rigidified Descriptions

Among others, Soames (2002) gives the following argument against rigidified description theories:

> "P1. It is possible to believe that Aristotle was a philosopher without believing anything about the actual world A_w. [. . .]
>
> P2. Necessarily, one believes that the actual F was a philosopher iff one believes of the actual world, A_w, that the unique thing that was F in it was a philosopher.
>
> C1. It is not the case that, necessarily, one believes that Aristotle was a philosopher iff one believes that the actual F was a philosopher.
>
> P3. If the content of *Aristotle,* as used in a context C, were identical with the content of ***the actual F****,* as used in C, then (i) the contents of (propositions expressed by) ***Aristotle was G*** and ***The actual F was G*** in C would be the same; (ii) the propositions expressed by α ***believes that Aristotle was G*** and α ***believes that the actual F was G***, in C, would be necessarily equivalent; and (iii) C1 would be false.
>
> C2. The content of *Aristotle*, as used in a context, is not the same as the content of ***the actual F*** as used in that context." (Soames 2002, pp. 43-4)

Some Counter-Arguments

First, it should be noted that P2 in Soames' argument above is ambiguous and doesn't hold if it is read as follows: Necessarily(one believes that the actual F was a philosopher iff one believes of the actual world, A_w, that the unique thing that was F in A_w was a philosopher in A_w). This only holds if $F(x)$ implies that x is a philosopher, but doesn't hold in general. Instead, the right hand side must be read in such a way that one believes of the actual world A_w, that the unique thing that was F in A_w was a philosopher in all worlds compatible with the respective person's beliefs. In a footnote, Soames argues that propositions should be thought of as Russellian singular propositions that *contain* the actual world whenever they correspond to a formula containing an actuality operator, and he further stipulates that the believer in such a case must be in direct acquaintance with the actual world.[35] So Soames seems to suggest that in his conception of propositions as representations of truth-conditional and in this case also cognitive

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[34]The Millian cannot deny, however, that if «Aristotle» denotes Aristotle, then there is (or was) someone called «Aristotle», and there are many more trivial unique properties of referents that can be constructed. Therefore the caveat *prima facie*.

[35]See (Soames 2002, pp. 327-30).

content the proposition that Aristotle was a philosopher wouldn't need to contain the actual world, whereas the equivalence in P2 would make sure that the rigidified description analysis would yield a proposition that would contain the actual world and would presume acquaintance with the actual world as an object of belief.

Several objections can be made against this account. First, let us assume that the proposition that represents the object of relational belief indeed contains the actual world, if the sentence embedded by the attitude verb «to believe» contains a description that has been rigidified by an actuality operator. This specification of content is clearly Millian with respect to the actual world. Why then would a descriptivist need to accept this analysis? It seems that, according to the indirect reference theorist, what holds of proper names should also hold of sentential adverbs like «actually» and the actual world can ever only be given by description. Second, it is generally not sensible to assume acquaintance with *any* world and particularly not with the actual world. As opposed to a situation, a world is a maximal truth-maker, the complete state and history of the universe by virtue of which all true non-modal statements are made true. Just as complete acquaintance with a particular empirical object is practically not feasible, because it has infinitely many properties, a fortiori complete acquaintance with the actual world is not feasible. If at all, a person can only be acquainted with a small part of the actual world. So it seems that Soames analysis not only presupposes Millianism, but even presupposes an implausible account of it. Third, Soames argues further that his argument would also go through, if no use was made of a notion of acquaintance with the actual world. Still, it may be objected that a rigidified description only puts part of the semantics of a proper name into the object language that the analysis of a proper name as rigid constant stipulates in the interpretation rules for rigid constants. The constraints expressed by a wide scope description, by a description rigidified by an actuality operator, and by a rigid constant are the same, because the specifications themselves are logically equivalent to each other under the assumption that the unary predicate used in the descriptions actually denotes the same object as the constant.

To illustrate this point further, let us take a look at ways to formalize Soames' argument in the current FOML setting. For simplicity, the role of contexts are ignored in the following example. P1 may be represented as follows, where $\Box_0$ is the S5 modality for metaphysical necessity and $\Box_1$ is used to symbolize the modality for belief in KD45.

$$\text{It is possible that: } M, g, w_0 \vDash \Box_1 \, Pn \text{ and } \neg w_0 R_1 w_0 \tag{3.23}$$

Since the T-principle $\Box p \supset p$ doesn't hold for belief, 3.23 is acceptable and ought to catch Soames' intention, as long as «it is possible that» here is simply understood as the claim that there is a model such that the condition holds. But what about the second premise and the alleged conclusion? Without a notion of believing something of the actual world in the sense of being in direct acquaintance with the actual world (as a whole), which has been rejected above, the second premise cannot be formalized properly. Let us therefore move to the alleged conclusion C1. It seems that this can be given as follows, where this time the iota operator is used (as defined in Appendix A):

$$M, g, w_0 \vDash \neg \Box_0 [\Box_1 \, Pn \equiv \Box_1 \, P(\iota x(@ \, Fx))] \tag{3.24}$$

Just like in a wide scope analysis, there is an additional assumption of the rigidified description analysis that has to be made explicit: that there is a unary property that picks out the semantic referent of a proper name in the actual world. And thus, if n is regarded a rigid constant that is the correct analysis of a proper name in question, the following assumption must hold as well:

$$M, g, w_0 \vDash n = \iota x \, @ \, Fx \qquad\qquad (3.25)$$

Given this assumption and the assumption that n is rigid, 3.24 is a contradiction in the current FOML setting, because any FOML formula containing a rigid constant n is equivalent to the corresponding formula containing a iota term $\iota x \, @ \, Px$ instead of n, as long as $n = \iota x \, @ \, Px$ holds in the actual world.[36] So Soames' argument doesn't apply to the rigidified description analysis presented in section 3.4.1, because under this analysis C1 doesn't follow from P1 and P2.

It is not denied here that Soames' argument may hold for the sorts of propositions he presumes, and on the basis of this view the above attempts to formalize parts of the argument might be considered inadequate. However, it cannot be argued against the rigidified description analysis by arguing that *some* way of providing the formal semantics of rigidified descriptions makes formulas containing them non-equivalent to corresponding formulas containing rigid constants, if there are at the same time more or less standard ways to provide the formal semantics of rigidified descriptions that don't have this undesirable property. Soames would have to show why his way of implementing rigidified descriptions is appropriate and the above one isn't. Since his way doesn't seem to yield the intended truth-conditions, as argued by Soames himself, it is hard to see how this argument could be made.

3.4.3   Further Literature

The literature on the debate between modal descriptivists and Millians is vast and so the reader is referred to the following publications for more information. Early defences of description theory and indirect reference on the basis of his ideal verificationism can be found in the work of Michael Dummett, see for example (Dummett 1981, 1991). Jackson (1998) also defends description theory in general. Recent defences of specific variants of description theory can be found in (Geurts 1997), (Stanley 1999, 2001), (Sosa 2001), (Nelson 2002), and (Hunter 2005). Abbott (2002) challenges some of the linguistic theses defended by Geurts (1997) about the nearness of proper names to definite NPs, who replies to this critique in (Geurts 2002). Arguments against Nelson (2002) and Stanley (2001) supporting Soames (1998, 2002) can be found in (Everett 2005). Other sophisticated arguments against the wide scope analysis can be found in (Caplan 2005).

3.4.4   Concluding Remarks

Although not all of the various arguments against rigidified descriptions could be addressed in the previous sections, it has at least be made plausible that descriptivism can deal with the chal-

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[36]This is proved in Appendix B.II.

lenges raised by Kripke and his successors. However, there's one aspect of Soames' critique that applies to all versions of rigidified descriptions discussed so far. As Soames notes, in versions of description theory based on so-called double-index theories like the *Logic of Demonstratives* of Kaplan (1989) the semantic content of a rigidified description, i.e. its truth-conditional or cognitive content, does no longer contain any descriptive criteria and is therefore Millian in nature.[37] This remark also applies to the ways to rigidify descriptions that have been presented here. Since wide scope descriptions, descriptions rigidified by an actuality operator, and rigid constants in a more or less standard modal logical framework specify the same truth-conditional content, because they are equivalent to each other under the premise that the respective description determines the same referent in the actual world as the respective rigid constant denotes, rigid constants can be used as an alternative way to specify the semantic content of a proper name. But specifications of semantic content that use rigid constants are Millian and don't encode any way in which a referent is being given to a speaker or a thinking person in her cognition. With that regard the conflict between descriptivists and purporters of direct reference is rather artificial. In order to maintain the original motivations for indirect reference, the descriptivist has to loosen rigidity a bit with respect to doxastic modalities, either in the target language or, preferably, in the syntax–semantics interface. This will be the topic of the next chapter.

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[37]See (Soames 2002, pp. 49-50). Double-index theories will be addressed in chapter 6.

Chapter 4

A Description Theory of Reference

4.1   Chapter Overview

In this chapter, a description theory of reference is outlined that preserves the original motivation for indirect reference theory while being compatible with the rigidity thesis. Context-dependence is ignored for the time being; as the subsequent chapters will show it can be added without substantially changing the underlying concept of reference. In order to make the argumentative goals of the subsequent sections clear, an outline of the proposed descriptivist account of reference is first given in section 4.2. Section 4.3 then addresses the meaning theoretical background of the proposal. The main goal of this section is to show that cognitive content is best regarded as the attribution of a de dicto attitude that may be obtained from an utterance by a Kripkean disquotation principle in case of the sender and by assuming acceptance of the utterance in case of a recipient. The consequences of this for the account of speaker reference are discussed in section 4.4, in which arguments for Thesis 1 are given. The resulting account of reference separates definite descriptions encoding speaker reference from definite descriptions encoding semantic reference much in the same way as Neo-Fregeans distinguish between the referent and its mode of being given. As will be argued, descriptions encoding speaker reference and semantic reference by means of a proper name need to have at least one common denominator: the property of being called by that name (Thesis 5). This nominal description theory is defended against the circularity objection, but it is also pointed out, pro Thesis 3 and 4, that other kind of descriptive content can be assumed as the objective, public meaning of a proper name, because semantic reference is the result of an idealization from actual speaker references. In section 4.5 the role of identification criteria for speaker reference will be discussed and the notion of *relativized rigidity* will be introduced to deal with nested modalities. Proper names are rigid with respect to metaphysical modalities, but not rigid with respect to doxastic modalities under de dicto interpretation. Finally, section 4.6 will deal with more formal aspects of the account: How it can be implemented and whether it is compositional. The conclusion at the end of this section will be that a description theory that preserves the original motivations of indirect reference theory and adequately deals with the rigidity thesis can be implemented compositionally in the target language, but that compositionality in this case isn't really desirable.

4.2   Outline of the Proposal

The version of descriptivism that will be argued for boils down to the following claims. A speaker associates two different criteria with a proper name. The first criterion is the property of being called by that name. This property comprises all linguistic conventions governing the use of proper names in general and must be associated by virtue linguistic competence; it is a minimal part of the linguistic meaning of the proper name. In ordinary epistemic situations, this property alone doesn't suffice for the purpose of identifying the semantic referent. The second criterion is the properties that according to the speaker's beliefs determine the purported referent of the proper name. These identification criteria aren't part of the linguistic meaning of a proper name, but can be individual to each speaker. Speaker reference by means of a proper name can be analyzed by the use of a formal definite description ϕ comprising the property of being called by
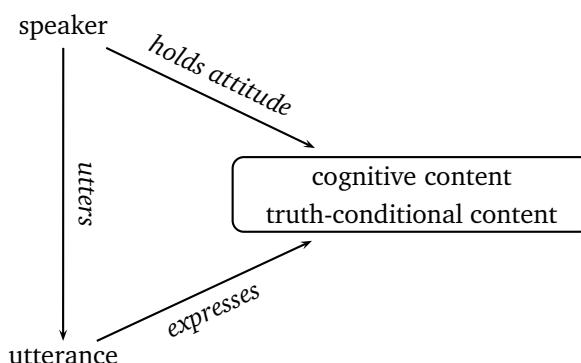
Figure 4.1: A dual aspect theory that identifies cognitive and truth-conditional content.

the respective name and the identification criteria the speaker associates with that name, within a formal attribution of belief to that speaker. This description is rigid in relation to any subsequent modalities but non-rigid with respect to the doxastic modality representing the formal belief attribution. Semantic reference of a proper name can be analyzed by the use of a formal definite description ψ comprising only the property of being called by that name (nominal description theory). Since it is an idealization from actual speaker references, it may be said to additionally comprise certain properties of the semantic referent (external description theory). In both cases, the description must be rigid with respect to doxastic and alethic modalities for the purpose of analyzing semantic reference. Successful identification of the referent of a proper name by a speaker can be formulated as the condition that the semantic referent picked out by ψ is identical to the doxastic referent picked out by ϕ. The formal attributions of belief that are used in the target language for analyzing speaker reference correspond with the result of analyzing de dicto readings of belief ascriptions in the source language, but this correspondence is only an approximation.

4.3 Meaning Theoretical Background

The main purpose of a theory of reference is to give an explanation and description of denotation and speaker reference. In the present case this is done on the background of a dual aspect theory of meaning, where semantic singular reference is related to the truth-conditional role of singular terms and speaker reference is related to the truth-conditional and the cognitive role of singular terms. In the following subsections, the nature of this relation will be clarified.

4.3.1 Genuine Dual Aspect Theories

Consider the Fregean meaning theory depicted in figure 4.1. This is a dual aspect theory in which cognitive and truth-conditional content are represented by the same sort of meaning-constituting

speaker

holds attitude

utters

conveys

cognitive content

utterance

expresses

truth-conditional content
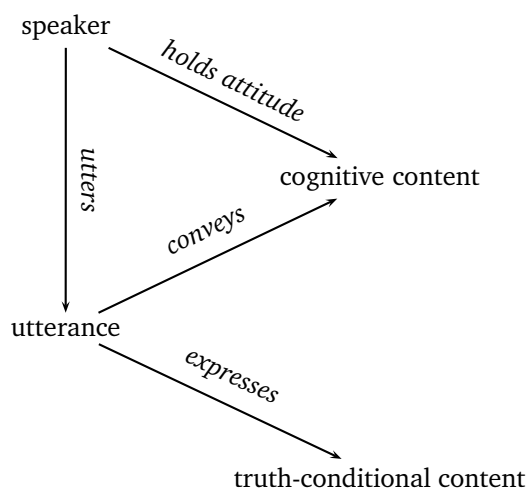
Figure 4.2: A dual aspect theory that separates cognitive from truth-conditional content.

entities. As has been sketched in section 3.3.2 of chapter 3, the direct reference view has problems with such a theory, because it is hard to adequately deal with speaker reference in a purely Millian fashion. As a remedy, dual aspect approaches that separate the truth-conditional role from the cognitive role of expressions have been mentioned briefly in the last chapter. These approaches are illustrated in figure 4.2. Such theories may be called *genuine dual aspect theories* and are also known as *mixed theories*.[1] In this kind of theory the cognitive content of an utterance for the sender or a recipient of the utterance doesn't need to be identical with the truth-conditional content of the utterance. This independent notion of cognitive content then accounts for informativity puzzles, referential opacity, and related phenomena. To explain speaker reference, one may for example assume that the truth-conditional content of a singular term is enriched by a mode of presentation, i.e. specification of the way in which the referent is given to the speaker. Although there doesn't seem to be anything wrong in principle with these approaches, they obfuscate the different nature of the aspects in question. While truth-conditional content is a specification of public, general meaning, cognitive content always depends on a person and her prior beliefs.

4.3.2   The Role of Disquotation

One relatively weak objection to genuine dual aspect theories has some similarities with the circularity objection against Fregean senses mentioned in section 2.2.4 of chapter 2. Consider the cognitive and truth-conditional content of an utterance in comparison with the respective contents of a belief ascription embedding the sentence taken in the same conversational context, as in the following examples.

---

[1]Mixed approaches are for example advocated in (Richard 1990) or (Crimmins 1992).

(4.1) Alice: Bob loves Carol.

(4.2) Alice believes that Bob loves Carol.

We may call the cognitive and truth-conditional content of 4.1 CG_1 and TC_1 respectively, and the contents expressed and conveyed by 4.2 CG_2 and TC_2 respectively. So TC_2 encodes the truth-conditions of the whole utterance of 4.2. These truth-conditions are the conditions under which Alice believes that Bob loves Carol, i.e. they are the state of affairs that have to be the case when Alice holds the attitude of believing towards the love of Bob to Carol, or, to put it simpler, when Alice believes that Bob loves Carol. But then a specification of TC_2 encodes at least to some extent what CG_1 encodes, as long as cognitive content is taken to represent what is relevant for the behavior of a speaker. After all, it is the beliefs and various similar attitudes of a person that are relevant for her behavior. So it seems that CG_1 conveyed by utterance 4.1 corresponds with the state of affairs expressed by 4.2 either taken de re or de dicto. A notion of cognitive content understood in this way would be redundant.

In the above form this argument is weak. A belief ascription taken de dicto is analyzed as a relation between a person and the cognitive content of the embedded sentence, just as in the original Fregean picture a sentence embedded by an attitude verb would have the Fregean sense as its odd reference. But then the truth-conditions of the whole belief ascription, the state of affairs described by the ascription, are more specific than the cognitive content, simply because the cognitive content is a specification of the relatum, of what is sometimes called the 'object of belief', in a relational analysis of the belief ascription in its de dicto reading. Hence, there isn't any mismatch. A special, non-Millian form of content is needed in order to account for the referential opacity of de dicto belief ascriptions, whereas the analysis of the whole ascription makes use of this notion in order to give the truth-conditions for one specific reading of one specific attitude. Understood in this way, cognitive content is simply the relatum of de dicto belief in an ambiguity theory of belief like for example that of Frege, whereas truth-conditional content is the relatum of de re belief. This counter-argument is certainly correct, but then cognitive content cannot be taken to encode any relevance for behavior, since it is only part of the specification of an attitude, but doesn't specify the attitude itself. Cognitive content understood in this way cannot be part of literal meaning either. It is derived by Kripke's famous language-dependent *principle of disquotation* first stated in (Kripke 1979). He formulates it the following way.

☆ **Kri 8** (Principle of Disquotation). *"If a normal English speaker, on reflection, sincerely assents to 'p', then he believes that p." (Kripke 1979, p. 112-3; orig. in double quotes)*

Kripke also discusses the following stronger version of the principle.

☆ **Kri 9** (Strong Principle of Disquotation). *"A normal English speaker who is not reticent will be disposed to sincere reflective assent to 'p' if and only if he believes that p." (Kripke 1979, p. 113)*

At least if the derived belief is taken as de dicto belief these principles are not very controversial.[2] Directly corresponding to disquotation on the side of the recipient is *acceptance*, i.e. the

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[2]Kripke uses them to derive de re belief in order to point out the problems with the Millian view described in the last chapter.

case when a hearer adds the meaning of a given utterance to his belief system, in the simplest case without having to revise or retract other beliefs.[3]

On the basis of the above disquotation principles, one may argue against the notion of cognitive content of a genuine dual aspect theory as follows. Disquotation only works insofar as it is limited to normal, sincere speakers and assertive utterances. There is no reason to assume that an assertive utterance has another literal meaning if it is uttered by a non-normal or lying speaker than it has if it is uttered by a sincere and honest speaker. So a belief derived from an utterance by disquotation isn't conveyed by an utterance in the same way as the utterance expresses a fact or has a certain meaning; it is only conveyed under certain normal conditions. But if cognitive content serves as a relatum in de dicto analyzes of belief ascriptions, a mismatch would arise if a sentence would express cognitive content with respect to a speaker independently of a de dicto belief ascription. For consider utterance 4.3 and 4.4 in the same conversational context.

(4.3) Alice: Bob loves Carol.

(4.4) Alice believes that Bob doesn't love Carol. (de dicto)

Suppose that 4.4 is true. The fact that 4.3 is a lie or at least an attempted lie doesn't affect the literal meaning of 4.3. But then some cognitive content for Alice that can be directly derived from 4.3, from the utterance alone, will be the converse of what Alice actually believes. Examples like this show that cognitive content of utterances is not a feature of literal meaning, but rather must be a pragmatic notion that is based on previous beliefs of the respective discourse participant. For it is not clear what the purpose of some literal cognitive content of 4.3 would be, given that Alice's belief state, part of which is expressed by 4.4, is relevant for her actions and behavioral dispositions and not anything derived from her utterance taken literally.[4] The same applies to the case when the receiver seems to accept the utterance, but doesn't really accept it. The literal meaning of an utterance isn't determined by the sender's or any receiver's attitudes towards the utterance, but the respective behaviorally relevant cognitive content of an utterance must match those attitudes to some degree.

4.3.3 Dual Aspect Theory Revised

The above considerations don't show that genuine dual aspect theories fail, since it is anyway relative to the descriptive goals of the meaning theory what counts as a relevant aspect of meaning. For example, an idiolectal, purely representational, and cognitivist meaning theory will likely be based on a primitive notion of cognitive content and at least prima facie there is no problem with

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[3]Gärdenfors (1988) calls the simplest case that doesn't involve any revision of other beliefs *expansion*. Here the less technical term *acceptance* of the utterance will be used, which comprises silent belief revision/retraction by the recipient, too. Cf. (Gärdenfors 1988, Ch. 3).

[4]Not all, but only *truth-asserting attitudes* allow one to draw a connection between holding the attitude and behavioral dispositions of terms used in ascribing the attitude, as it is done when belief ascriptions are read de dicto. A truth-asserting attitude is one that requires the holder of the attitude to believe that she holds the attitude. Note that this is quite different from saying that the attitude must be reflexive, for example «to doubt» is not reflexive but truth-asserting, and entirely different from saying that a verb is factive, for example «to believe» is not factive but truth-asserting in its de dicto reading. Cf. (Rast 2002, p. 66).

natural-language utterance

Speaker

truth-conditional content

cognitive content
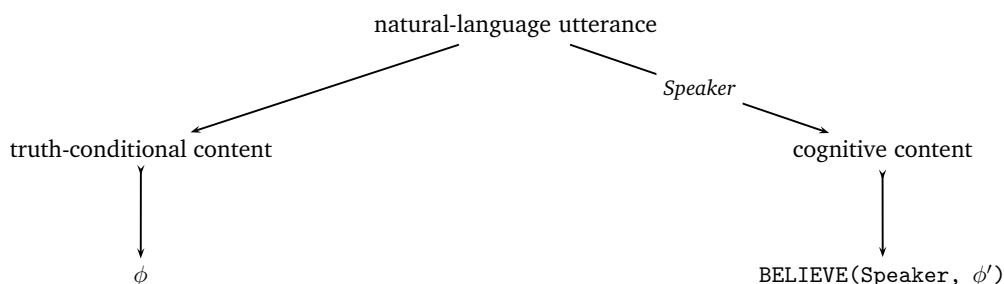
ϕ

`BELIEVE(Speaker, `ϕ'`)`

Figure 4.3: Truth-conditional versus cognitive content in the revised dual aspect theory.

this in general. However, the above considerations show that genuine dual aspect theories are misleading in a truth-conditional setting. The picture drawn in figure 4.2 on page 68 is inadequate, because—trivial as this may sound—cognitive content can only be determined relative to someone interpreting an utterance. Any notion of cognitive content that doesn't depend on a certain person will of course be inadequate for describing an aspect of that person's linguistic or extralinguistic behavior. A more appropriate picture is drawn in figure 4.3. In this picture, `BELIEVE` stands for a belief predicate or operator in some formal language of analysis, but it is left open which language. The target language itself can for example consist of set theoretical expressions that have no further interpretation or of a logical language that is interpreted in some appropriate way. The exact implementation and formal semantics of the belief predicate or operator is dictated by descriptive and explanatory goals of the notion of the cognitive role in the respective meaning theory and possibly other factors. As an approximation that will be assumed from now on, the attitude used to describe the cognitive significance of linguistic material is considered to correspond systematically with the result of analyzing natural language belief ascriptions taken in their de dicto reading. Thus, for example the cognitive significance of 4.3 obtained by disquotation under normal circumstances will formally be specified in the same way as the truth-conditional content of 4.5 in de dicto reading.

(4.5) Alice believes that Bob loves Carol. (de dicto)

The difference between the truth-conditional content of the embedded sentence and the cognitive content of the embedded sentence in 4.5 under this assumption lies in whatever distinguishes the de re analysis of 4.5 from its de dicto analysis. There is an equivocation to watch out for. Suppose the following formula of a putative and unspecified formal target language with respect to some intended model was the result of analyzing 4.5.

(4.6) `BELIEVE(Alice, love(Bob, Carol))`

In the somewhat misleading sense mentioned in the last section, `love(Bob, Carol)`—be it given a proof theoretical or a relational semantics—is a specification of the cognitive content of 4.3 for Alice in intended target language models. In another sense, the whole formula with

respect to the way it is interpreted represents the cognitive content of the utterance, since relevance for Alice's behavior is only encoded if the whole formula is true in the intended target language model.[5] The term *cognitive content* will from now on be used for the whole attitude attribution, i.e. for a specification of semantic content that encodes relevance for behavior. For the relatum of the attitude that is part of this content, the term *partial cognitive content* may be used.

It must be stressed that identifying the belief attribution that encodes cognitive content with the result of analyzing de dicto readings of belief ascriptions may only be a rough approximation and the feasibility of such an identification depends on the philosophical interpretation of de dicto readings and the explanatory role of cognitive content in linguistic theory. De dicto belief indicates utterance dispositions of the believer and therefore is an obvious choice for describing the cognitive significance of linguistic expressions to a speaker that the notion of cognitive content is customarily supposed to encode. Ultimately, this choice depends on the empirical criteria used for determining the cognitive content of utterances as opposed to the empirical criteria used for finding out in which cases de dicto readings of belief ascriptions seem to disallow the substitution of co-referential expressions in the embedded sentence salva veritate. If for example the notion of cognitive content was mainly intended to account for the informativity of utterances, then it would perhaps be more desirable to provide a quotational analysis according to which cognitive content is encoded by a formal attitude attribution with a reading like *utterance u is informative to degree i for speaker a*.[6] The notion of cognitive content and talk about the cognitive significance of expressions comprises different aspects that are all in one way or another relevant for the linguistic behavior of a speaker and explanations thereof, but a more detailed look may reveal that not all of these aspects can be caught by the same kind of attitude involving the same kind of partial cognitive content. Nevertheless, a correspondence of de dicto belief with the attitude used to encode cognitive content will from now on presumed, and in this view partial cognitive content is the object of belief in a relational analysis of de dicto belief ascriptions. By this assumption we restrict the notion of cognitive significance to the kind of relevance of expressions for linguistic behavior that is elicited by de dicto readings of belief ascriptions. One criterion for such readings, and perhaps the only one, is whether the respective believer accepts a certain linguistic expression as purportedly truth-preserving substitute for another expression or not.

4.4   Towards a Theory of Indirect Reference

The discussion of the last section has concerned meaning theory in general. Partial cognitive content is a form of subjective meaning. Mates (1950) discusses attitude ascriptions in which general terms seemingly cannot be substituted salva veritate, even if they are customarily considered being synonymous. Such phenomena are known as *Mates' Puzzle*. They are the general term

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[5]`Alice` in the formal language analysis should be mapped to Alice and not to Bob, Bob to Bob and not to Alice, and so on. In examples like the above it is always assumed that the expressions of the target language have their intended reading.

[6]Cf. section 2.4 of chapter 2.

analogue to what has been discussed under the label of *referential opacity* for singular terms. If in the examples described by Mates (1950) the substitution of synonymous general terms for each other can indeed change the truth-value of the whole belief ascription, which may be called the *semantic view on Mates' puzzle,* then this would justify stipulating a subjective meaning for general terms. It is, however, doubtful whether a fully competent speaker can associate a subjective meaning with a general term without thereby loosing the privilege of being a competent speaker. In the context of a theory of reference, this question can be left open. As far as only reference of singular terms are concerned, the arguments forwarded in the last section lead to a revised picture which will be laid out in the following subsections. The argumentation will proceed as follows. First, it will be argued that the indirect reference view doesn't for itself solve the problem of accounting for the truth-conditional and cognitive content of referential terms. The indirect reference theorist faces basically the same problems as the Millian. It will however turn out that once semantic and speaker reference are properly kept apart from each other, descriptivism becomes a viable alternative to Millian accounts that are 'enhanced' by modes of presentations or similar derivative partial cognitive content. The proposals NDT and EDT to be made in this section will be a bit simplified. The full account will be given in section 4.5.

4.4.1 The Problem of Rigidity for Descriptivism

As has been laid out in chapter 2, the original motivation of the indirect reference theorist is to account for cognitive and epistemic aspects of speaker reference. This approach is based on the assumption that in case identifying reference fails the referent referred to by a speaker and the actual semantic referent differ from each other. The purported entity of which a speaker believes that a proper name or another referential expression refers to will from now on be called *doxastic referent*. Given that, let us return to the issue raised at the end of last chapter. Does the wide scope theory or descriptions rigidified by an actuality operator preserve the original motivation of the indirect reference theorist? As already suggested, the answer is a straightforward: No. The descriptivist endorsing rigidified descriptions faces the same problems as the Millian, if his version of rigidified descriptions yields specifications of semantic content that are equivalent to those of the Millian. Consider 4.7, where $\Box_1$ is interpreted as a doxastic KD45 modality encoding rational belief.

$$M, g, w_0 \vDash \Box_1 \, \iota x[@\, Gx]Fx \tag{4.7}$$

The evaluation of $@\, Gx$ jumps back from all worlds accessible by the R_1 relation to the actual world. It is hard to see how this representation could be read as encoding genuine speaker reference without presuming identifying reference. If a speaker associates a rigidified description with a proper name, then the actuality operator in the description ensures that the description determines the actual referent of that name and not any doxastic referent. Thus, from an epistemic point of view, a speaker cannot 'apply' a rigidified description in order to determine the referent. Anyone who tries to determine an object by means of certain identification criteria will assume that the object actually satisfies those criteria uniquely, but the crucial point is of course that he might be wrong in determining the actual object by means of those criteria at any time.

That identifying reference is not a requirement on behalf of speaker competence has already been shown in section 2.5 of chapter 2.

4.4.2 Referential Multiplicity

Given the possibility that identifying reference can fail, the problem for the indirect reference theorist is basically the same problem as that for the purporter of direct reference. While the direct reference theorist will enrich or replace the truth-conditional content of the proper name, i.e. a Millian specification of the referent itself, by some cognitive content in order to deal adequately with referential opacity, the indirect reference theorist has to change his analysis of proper names as well. The indirect reference theorist is forced to assume two descriptions as analysis of a proper name whenever the result of this analysis occurs within an attitude attribution that corresponds with a natural language attitude ascription that can be taken de re or de dicto, as de dicto readings are the linguistic symptom of failed identifying reference. One description encodes semantic reference and must be rigid, whereas the other description encodes speaker reference and can only be rigid with respect to metaphysical modalities but not with respect to a doxastic modality that encodes an attitude of the respective speaker. A simplified, yet concrete example will illustrate this point of view. Consider 4.8, where tense is ignored.

(4.8) Bob believes that Aristotle was fond of dogs.

The de re reading of this example may be analyzed as 4.7 on page 73. The de dicto reading of the example, on the other hand, may be analyzed as follows.

$$M, g, w_0 \vDash \Box_1 \imath x G x F x \tag{4.9}$$

According to 4.9, «Aristotle» is not rigid with respect to the doxastic modality encoding Bob's rational belief. Both analyses make use of a property that the respective referent must uniquely satisfy, but in case of semantic reference, the descriptive content of the proper name is evaluated independently of Bob's belief, whereas in case of speaker reference it has to depend on his prior beliefs. In the latter case, $\imath x G x$ might determine an object in the worlds that are compatible with Bob's belief that is different from what the same definite description determines if it is evaluated with respect to the actual world. Here is another example based on Frege's morning star–evening star example:[7]

(4.10) Bob believes that Hesperus isn't identical with Phosphorus.

(4.11) Hesperus is identical with Phosphorus.

These sentences may tentatively be analyzed as follows.

$$M, g, w_0 \vDash \Box_1 \imath x[Hx] \imath y[Py](x \neq y) \tag{4.12}$$

$$M, g, w_0 \vDash \Box_1 \imath x[@\, Hx] \imath y[@\, Py](x \neq y) \tag{4.13}$$

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[7]Cf. section 2.4 in chapter 2.

$$M, g, w_0 \vDash \imath x[@\, Hx] \imath y[@\, Py](x = y) \tag{4.14}$$

If 4.11 is mapped to 4.14 and holds in M, then the de re reading 4.13 of 4.10 cannot be true in M.[8] However, the de dicto reading 4.12 may come out true in the same model M, because Bob might believe that the two descriptions determine two different objects. In other words, one object that exists in the actual world is split up into two different objects in the worlds that are compatible with a person's beliefs. Likewise, a person may be uncertain about the identity of Hesperus and Phosphorus, just in case in some belief worlds Hesperus and Phosphorus are identical while in others they aren't. This way of looking at referential opacity goes back to Hintikka (1962), who has coined the term *referential multiplicity* for it.[9]

The Millian can make this analysis by using non-rigid constants, but he looses the epistemic aspects that are encoded by formal definite descriptions. Within the scope of a doxastic modality, the formal definite description corresponding to a proper name represents the properties by means of which the respective attitude holder is enabled to identify the semantic referent of the proper name, if he succeeds to do so. Identifying reference then holds under the following condition.

$$M, g, w_0 \vDash \imath x[@\, Px] \imath y[\Box_1 \, Py](x = y) \tag{4.15}$$

4.4.3 Modeling Speaker Reference with Definite Descriptions

So far, the analysis doesn't catch all of the descriptivist's motivations. According to the view on indirect reference laid out in chapter 2 a speaker associates some meaning with a proper name, but there is no requirement that this meaning must be shared and public. Recall that Frege considered it a desideratum that every speaker associates the same Fregean sense with a disambiguated proper name but conceded that this goal isn't reached by natural languages.[10] Different speakers may associate different descriptions with a proper name, simply because they might have different opinions about the referent of that name. So it must be taken as a simplification that in the examples 4.9 and 4.7 or 4.14 and 4.12 the referent is determined by the respective same unary property.

This leads to the question, whether the descriptions used in analyzing reference of different speakers by means of a proper name must have something in common. This is then the descriptive meaning of that name, as it would occur in the rigidified description determining the name's semantic referent. What, in other words, is the common denominator that all speakers using a certain proper name must associate with that name? Descriptivists have given differing answers to this question leading to various restricted description theories.[11] In the following, two answers will be considered. The first answer is that because of Kripke's epistemic and semantic arguments, which boil down to the claim that a speaker doesn't have to believe of an object to have a certain property just by virtue of using a name that semantically refers to it, only one

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[8] The actuality operator is of course redundant in 4.14, but has been added for reasons of systematicity.

[9] See (Hintikka 1962, pp. 138-141).

[10] See section 2.2.3 of chapter 2.

[11] Cf. section 2.3.2 and the literature mentioned in section 3.4.3.

property can be assumed by virtue of speaker competence: the property of being the bearer of that name. Bach (1981, 1987), who is also one of its most vigorous defenders, calls this *nominal description theory* (NDT).[12] According to this view, a competent speaker$_i$ using «Aristotle» must at least presume silently that whoever this name refers to is called «Aristotle» in his$_i$ speaker community. Users and interpreters of the name «Aristotle» might disagree about almost any other property of Aristotle, but they can hardly disagree about the fact that he is called «Aristotle» in their own speaker community. The second answer is that some criteria have to be presumed as the meaning of a proper name, but that these criteria don't have to be known by speakers by virtue of their competence. This is essentially classical description theory suitably rigidified accompanied by a sort of social externalism, according to which the 'objective' meaning of a proper name that determines its semantic referent may be fixed by experts or social processes. It will from now on be called *external description theory* (EDT). This view must also minimally include the property of being called such-and-such, since implicit knowledge of this property is a requirement by virtue of linguistic competence and it should therefore also enter the description used for semantic reference.

In the light of the last chapter both views seem to be irreconcilable with Kripke's modal, epistemic, and semantic arguments, but this is not the case, since semantic reference is an idealization from actual speaker references. The required degree of this idealization depends not on linguistic factors, but on the purpose of the notion of semantic reference. If one doesn't want to explain identifying reference and failures thereof, epistemic aspects of speaker reference, or referential opacity, one is free to use Millian specifications of truth-conditional content in a single aspect theory. If one wants to assert that there must be some intersubjective criteria determining the semantic referent if the notion of semantic reference is to make sense at all, then he will likely subscribe to the rigidified description view. For a Kripkean can only point out the obvious and trivial fact that a proper name semantically refers to whatever has been given that name, which is completely pointless and unusable for identifying purposes. Required by virtue of speaker competence is only, as smallest common denominator, the property of being called such-and-such.[13] This minimal view on semantic reference propagated by NDT is illustrated in figure 4.4, where $A(x)$ abbreviates the property of *being called «Aristotle»*. This position differs from that in (Bach 1987), because in the current view speaker reference is strictly separated from semantic reference.

4.5 Objections and Refinements

Some issues that have been suppressed in the last section will be addressed now. First it will be briefly pointed out why Kripkean epistemic and semantic arguments don't apply to EDT, then the circularity objection against EDT and NDT will be dismissed by pointing out that being called such-and-such doesn't presuppose a theory of reference, third the role of identification criteria

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[12]See (Bach 1981, p. 371), (Bach 1987, pp. 135). Bach remarks that NDT has first briefly been considered by Russell (1919) and later been revived by Loar (1976). Jacobson (1990, pp. 387-8) also defends NDT.

[13]Bach and other purporters of NDT might disagree, but being called such-and-such and being the bearer of the respective names are in the following considered the same property.
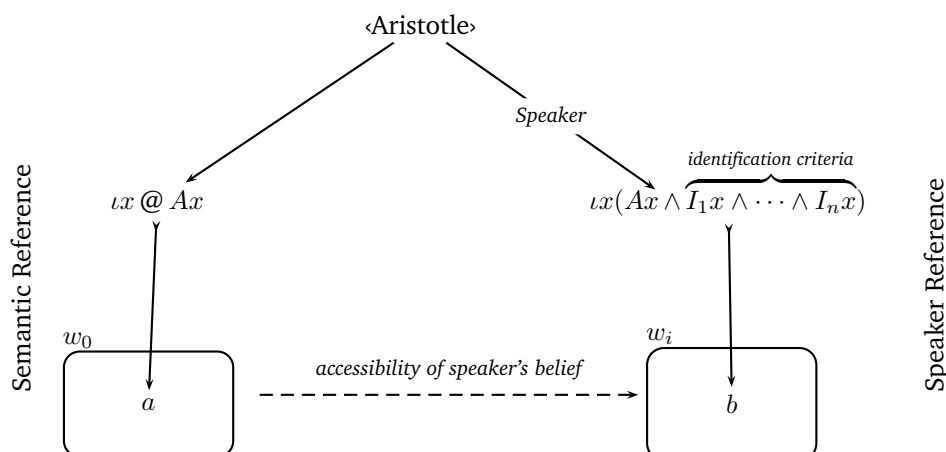
Figure 4.4: Using descriptions to specify semantic reference and speaker reference of someone's use of the name «Aristotle», where $A(x)$ is read as *x is called «Aristotle»*. (simplified view)

will be clarified in section 4.5.4, nested modalities are taken into consideration in section 4.5.5, and a summary of the proposed description account of reference will be given in section 4.5.6.

4.5.1 Defense Against Epistemic and Semantic Arguments

Kripke's epistemic argument can be summarized as follows. Description theory predicts that certain statements are analytic. If further analyticity is conflated with the epistemic notion of a relative apriori, like Kripke and some of his followers do, these statements would also be apriori relative to the language in question. But these predictions, so the argument, are implausible. Kripke's semantic argument is relying on semantic 'intuitions' about the meaning of proper names. It boils down to the claim that speakers often cannot and don't have to be able to provide a definite description as the meaning of a proper name.[14] Given the considerations of the previous sections, none of these arguments is a sound objection to NDT or EDT.

Let us turn to the epistemic argument first. Since EDT comprises NDT, it suffices to show that the argument doesn't apply to EDT. Consider now the following utterance, where tense will be ignored.

(4.16) Aristotle wrote the Nicomachean Ethics.

Suppose, for the sake of argument, that being the writer of the Nicomachean Ethics, $N(x)$, would be the stipulated property for determining semantic reference of «Aristotle» in combination with the property $A(x)$ of being called «Aristotle». The analysis is thus:

$$M, g, w_0 \vDash \iota x \, @ \, (Ax \wedge Nx) Nx \tag{4.17}$$

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[14]See (Kripke 1981, pp. 78-85).

If a person called «Aristotle» has existed and written the Nicomachean Ethics, then 4.17 is indeed analytic.[15] The EDT descriptivist will not consider this implausible, because associating the property N with «Aristotle» in this account isn't required by virtue of linguistic competence, and a speaker referring to Aristotle could assume completely different identification criteria. (Notice that if someone else wrote the Nicomachean Ethics 4.17 was false.) Consider now an analysis of speaker reference by means of «Aristotle», where $\Box_1$ is a doxastic modal operator encoding rational belief and I is the speaker's identification criterion.

$$M, g, w_0 \vDash \Box_1 \, \imath x(Ax \wedge Ix) Ix \qquad\qquad (4.18)$$

If the description indeed denotes in the worlds compatible with the respective speaker's belief, then this speaker indeed believes that the referent of the analyzed proper name satisfies the presumed identification criteria. If for example Bob believes that Aristotle is the greatest philosopher of the Antique, then he will indeed believe that the person called «Aristotle», who is the greatest philosopher of the Antique, is the greatest philosopher of the Antique. Again, the descriptivist will not consider this implausible. Any kind of apriori knowledge can, however, not be derived from such beliefs, because this would require establishing the existence of the semantic referent and identifying reference, neither of which can be done apriori.[16]

The semantic argument, on the other hand, may be a plausible objection to some versions of description theory but doesn't really grip in the present case. The only property that EDT and NDT require by virtue of linguistic competence is the property of being called by the respective name, and it seems quite reasonable to assume that whoever competently uses a proper name like «Aristotle» must associate with that name the property of being called «Aristotle». It is an uttermost trivial requirement on a speaker to implicitly know that the semantic referent of a proper name, if it exists, has the property of being called by that name. Of course, Aristotle is called «Aristotle» in my speaker community—whoever he is. Unless the speaker is also able to identify the semantic referent, this implicit knowledge just amounts to knowing the conventions governing the use of proper names. It could be objected to EDT, though, that if it doesn't require a speaker to associate the stipulated properties with a given proper name by virtue of linguistic competence, then they simply aren't a matter of meaning. To some extent this critique is justified, and NDT is favorable as a minimal theory. On the other hand, the social externalism presumed by EDT seems reasonable at least for some proper names, for example those of famous or well-known people or places. Some experts' identification criteria in this view ideally coincide with the criteria that determine the semantic referent of a proper name, but this is not a general requirement on behalf of any speaker. In this view, the objective meaning of a proper name may remain external to a speaker's cognition.[17]

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[15]There's no knowledge expressed in 4.17 and so an a priori doesn't play a role and implementing a priori versus a posteriori knowledge is far from being trivial. If this is done, then certain statements like 4.16 will be knowable a priori (relative to a language), but there is nothing wrong with that from a descriptivist's point of view.

[16]That is not to say that the existence of any kind of objects must be established a posteriori. The existence of mathematical objects can be established apriori, but «Aristotle» in this case isn't the name of a mathematical object and according to NDT this fact is part of the property of *being called «Aristotle»*.

[17]Cf. (Burge 1979b).

4.5.2 Defense Against the Circularity Objection

Both Kripke and his followers have claimed that NDT violates the circularity prohibition.[18] As the invention of the wheel has shown, circularity is not always a bad thing. However, as Bach argues in (Bach 1981, pp. 379-80) and (Bach 1987, pp. 159-61), nominal description theory isn't circular anyway. Since Bach argues on the background of an intentional, pragmatic theory of reference[19] that is not assumed here, not all of his arguments can be transfered directly to the present case, but his main argument doesn't hinge on the particular theory of reference he defends. Bach points out that NDT simply isn't a theory of reference in the strict sense, but merely a "[...] modest theory of the modest meaning of names." (Bach 1987, p. 161) In his postscript to *Thought and Reference* he further clarifies:

> "I take bearing a certain name to be a matter of convention, rather like having a certain license number. [...We] can immediately understand a sentence containing a name we have never heard before, so that understanding a name as a linguistic item does not require knowing who its (intended) bearer is." (Bach 1994, p. 8)

Except for the appendix "intended", which is important in Bach's intentional framework, this is also the basic defense against the circularity objection to be mounted here. Consider for a moment what it means to be called by a certain name in a speaker community. For a person this can for example mean to react in a certain way to the proper name of which she is the bearer. For example, Alice will recognize the name «Alice» when she hears or reads it and reacts in a way that depends on the situation and the speech act, in which her name was used. She might have been called in the literal sense of the word by someone shouting at her, which in languages like Latin requires the vocative case. As a result of this linguistic action, Alice might turn around. Just as well, Alice might find her full name on a bill and therefore assume that she has to pay it. *Being called by a certain name* in the first instance only means that the bearer of the name is aware of certain linguistic conventions governing the use of proper names and being able to recognize her own name. Furthermore it means that another speaker, say Bob, is also able to understand the property of being called «Alice» in this way, and in fact must be able to do so prior to any competent use of the name. Bob knows by virtue of knowing that «Alice» is a proper name, that whenever he shouts «Alice», Alice will react in a way that will often be different from the way in which other people will react, at least when she has no particular disinterest in meeting Bob. Likewise, Bob knows, by virtue of implicitly knowing that «Alice» is an English proper name, that Alice has to pay a bill if her full name is written at the respective place on the bill and if other non-linguistic conventions are fulfilled. Bob implicitly knows these facts as a competent user of English proper names irrespectively of any identification criteria or other beliefs about the bearer of the proper name.

This way of understanding the property of being called such-and-such neither presupposes semantic reference nor speaker reference, nor does it explain how the reference of a term is fixed

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[18]See 3.2.3 of chapter 3; cf. (Devitt 1981, pp. 21-3).

[19]See (Bach 1987, Ch.3). In particular, his background theory is not compatible with the current considerations because according to him reference is generally a four-place relation including the audience and it is based on a speaker's communicative intentions (Bach 1987, p. 52). Intentions play no role in the current proposal.

in an initial act of baptism. The property is rather understood as a set of general conventions about the use of expressions for naming objects.[20] These conventions comprise ways to react to a name when you're the bearer of that name and ways of labeling objects with a name, for example by printing the name on them or by wearing name tags, or listing names in phone books, yellow pages, or Who's Who dictionaries. Being called such-and-such also comprises morphosyntactic features of a name, for example that it can appear as a grammatical subject, that it is inflected in a certain way, etc., and semanto-pragmatic features, for example that «Alice» is canonically associated with female humans, whereas «A17161781788» doesn't have this association and by default assumption may rather be the proper name of an artifact, that anyone who competently uses the name implicitly knows that it ought to refer to exactly one referent in a given situation of its use, and so on. It is also part of the linguistic competence of the user of a proper name that it is interpreted as a rigid term, i.e. a competent user of a proper name implicitly knows that it must be interpreted independently of a specification of counterfactual circumstances.

Why do Kripke and some of his followers believe that a thorough explanation of the conventions governing the use of names violates the circularity prohibition? Perhaps some of them think, as they focus solely on semantic reference, that implicitly knowing or associating the property of being called such-and-such presumes identifying reference. This is, however, not the case. Conversely, the linguistic conventions that are bundled in the property of being called such-and-such have no significant value in identifying the semantic referent of a name in canonical situations. The fact that a specific proper name like «Alice» refers to its semantic referent Alice in a given conversational context, this very fact itself is not part of the linguistic conventions. It is not part of these conventions in the same way as the truth of a sentence isn't part of its meaning. Besides, if using the property of being called «Alice» violated the circularity prohibition, then it wouldn't be clear why using the proper name «Alice» in a specification of the causal chain that leads back to Alice's initial baptism wouldn't violate this condition either.

So if being called such-and-such is indeed non-circular, then one may ask what else the property comprises. Does it also include a description of the ostensive act that initially fixed the reference of a proper name? The answer is: No. The way in which the semantic reference initially was fixed cannot be part of the linguistic conventions governing the use of the proper name in question, because this way is highly context-dependent and there is no evidence that the definite description or description of the ostensive act used in the initial baptism is transmitted from speaker to speaker as part of learning the use of a proper name. It is not part of the linguistic conventions of the use of «Alice» in general that her mother used the following phrase to name Alice right after her birth: "This newborn baby of mine in front of me shall be called «Alice»."—as opposed to, say, the phrase "She's called «Alice»" or just answering "«Alice»" to the question "What's her name?" It is part of the linguistic conventions governing the use of a proper name that it can and has to be used in a certain way in an act of baptizing but it is not part of those conventions *how* its referent was determined during this act.

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[20]This is also pointed out by (Recanati 1993, pp. 135-67) though on the basis of distinguishing linguistic and psychological modes of presentation.

4.5.3 Defense Against the Church-Langford Translation Test

The Church-Langford translation test has to be mentioned as another possible objection to NDT. Church (1950) originally devised this test against the notion of intensional isomorphy in (Carnap 1947).[21] The test requires that the translation of a sentence into another language has to convey the same meaning as the original sentence. Take the following two sentences.

(4.19) Carol believes that Alice is hungry.

(4.20) Carole croit qu'Alice a faim.

According to NDT, a de dicto analysis of 4.19 makes use of the property of being called «Alice» in the English speaker community, whereas the translation 4.20 of 4.19 into French makes use of the property of being called «Alice» (or «Adelais») in French. The de dicto readings of the two sentences have different truth-conditions and furthermore an attempt to translate the analysis of 4.19 from modal logic to French wouldn't yield 4.20, but something like 4.21.

(4.21) Carole croit que la personne, qui s'appelle «Alice» en Anglais, a faim.

The reply to this argument from an NDT or EDT perspective is that an appropriate analysis of de dicto belief ascriptions may *not* pass the Church-Langford translation test, because the main criterion for ascribing de dicto belief is the utterance dispositions of the speaker of a certain language, which are for example revealed by his acceptance or rejection of co-extensional substitute expressions.[22] So NDT simply rejects the Church-Langford translation test as an adequacy criterion for analyses of de dicto belief ascriptions. In this view, 4.21 is indeed a correct paraphrasing of the de dicto reading of 4.19.

4.5.4 The Role of Identification Criteria

Linguistic conventions governing the use of a proper name barely play a role for identifying reference. Certain heuristic inferences can be drawn from certain kinds of proper names, but these inferences only indicate with some probability that the referent of the proper name has a certain property. For example, many English proper names for persons conventionally convey information about the sex of their referent. Proper names for artifacts, for example serial numbers, can usually not be used as a proper name for a person. German proper names of ships always have the grammatical gender feminine. So for example a speaker of German interpreting «Die Kaiser Wilhelm» will know that this is likely the proper name of a ship, because the partially descriptive proper name «Kaiser Wilhelm» bears the grammatical gender masculine, but the article «die» is feminine. Certain proper names of pets are inappropriate or even prohibited in some countries as proper names for persons. And from the phonological structure of a name, a speaker can make inferences about the ethnic origin of the referent that may be more or less accurate depending on ethnographic factors. Such language-specific inferences one may draw from a proper name are easily exhausted and generally error-prone. In canonical cases they will not suffice to serve as

---

[21]Cf. (Linsky 1983, Ch. 1).
[22]Cf. (Richard 1997, pp. 206-7).

the sole criterion used for identifying the semantic referent in situations that require identifying reference.

From the NDT point of view, the only linguistic requirement on the use of a proper name is the property of being called by that name, which comprises the linguistic conventions governing the use of that name. But for identification purposes, the speaker will usually have to rely on his prior beliefs about the referent of that name in addition to those conventions.[23] That is the reason why a number of identification criteria $I_1 \ldots I_n$ have been stipulated in figure 4.4. These criteria may vary from speaker to speaker and in the descriptive version of indirect reference proposed here they fulfill the role of partial cognitive content. They aren't part of objective meaning, but from an epistemic point of view are the conditions for successfully identifying the semantic referent. So formula 4.15 doesn't indicate the whole picture. Whenever a speaker tries to identify the referent of a proper name like «Aristotle», he associates a property $A(x)$ with the reading *the object called «Aristotle»* by virtue of being a competent speaker but additionally associates whatever criteria he deems sufficient for identifying the referent of the proper name. The conjunction of those criteria is then determining the doxastic referent. The semantic referent, on the other hand, is determined by $\iota x \, @ \, Ax$. The revised condition for identifying reference is thus 4.22.

$$M, g, w_0 \vDash \iota x[@ \, Ax]\iota y[\Box_1 \, Ay \wedge I_1 y \wedge \cdots \wedge I_n y](x = y) \tag{4.22}$$

The condition itself isn't empirical. It is a transcendental condition for identifying reference. However, which identification criteria a speaker uses—consciously or subconsciously, implicitly or explicitly—in a given situation is a wholly empirical matter. One source of unease that philosophers might have with description theory in general is the simplicity of the definite descriptions that are usually assumed in examples. In reality the identification criteria that play a role in a condition like 4.22 may be so complicated that they cannot even be formulated by experts. Consider for example how people recognize human faces. Although advances in automated face recognition have been made, finding the exact conditions for recognizing a person by means of features of her face under varying external conditions is far from being trivial.

4.5.5   The Problem of Nested Modalities

The description analysis of reference given so far is incomplete, because it doesn't take nested modalities into account. In this section, the analysis will be extended to adequately deal with nested modalities. Consider the following rather artificial examples 4.23–4.28.

(4.23) It is necessary that it is necessary that Bob loves Carol.

(4.24) It is necessary that Alice believes that Bob loves Carol.

(4.25) Alice believes that she believes that Bob loves Carol.

(4.26) Alice believes that Bob believes that Alice loves Carol.

(4.27) Alice believes that it is necessary that Bob loves Carol.

---

[23]Only *usually* instead of *always*, because referents are sometimes labeled with a name tag.

(4.28) It is possible that Alice believes that it is necessary that Bob loves Carol.

One thing to note is that there don't seem to be any clear-cut 'intuitions' as to how exactly nested modalities ought to be interpreted. When exactly does a person believe that she believes something? When exactly does a person believe that something is necessarily the case? If it is necessary that it is necessary that something is the case, does it follow then, that this is necessarily the case? Answers to these questions depend on philosophical interpretation rather than on prior semantic competence.

However, certain interpretations of proper names in nested modalities are favorable over others. Kripke's doctrines suggest that a proper name or any other rigid term is always evaluated with respect to the actual world. If on the other hand a doxastic modality representing a de dicto reading is involved, then a term in the priority scope of such a modality is evaluated with respect to the worlds reachable by evaluating the doxastic modality. It further is plausible to assume that this rule is only valid for the first occurrence of a doxastic modal operator, no matter how many metaphysical or doxastic modalities further embed the term. For example, a de dicto reading of the second occurrence of «Alice» in 4.26, according to which the use of that name would have to be interpreted with respect to Bob's belief system, can hardly be constructed. If at all, referential opacity in this example must depend on Alice's speaker reference and not on Bob's. Furthermore, it seems reasonable to assume that «Bob» and «Carol» in examples like 4.27 or 4.28 are rigid with respect to any metaphysical modalities that are themselves embedded into the belief ascription. Otherwise Alice wouldn't interpret them as rigid terms, which might disqualify her as a fully competent speaker. So the interpretation of a proper name that is embedded into a de dicto belief ascription will reflect the respective speaker reference of the respective attitude holder but apart from that will remain rigid with respect to any subsequent metaphysical or doxastic modalities. The analysis of a proper name in a de dicto belief ascription is rigid with respect to the worlds that are accessed by evaluating the first doxastic modality instead of being rigid with respect to the actual world. This behavior of singular terms in de dicto readings will from now on be called *relativized rigidity* and be taken as interpretation guideline for proper names.

4.5.6 Summary

Under the assumption that competent speakers might fail to identify the semantic referent of an expression, but might under usual circumstances not deviate too far in their interpretation of general terms from the public language meaning of these terms, a dual aspect theory only has to consider the cognitive role of referential expressions like proper names in addition to and possibly deviating from the truth-conditional role of natural language expressions. If the notion of cognitive role is intended to comprise an aspect of meaning relevant for behavior and behavioral dispositions and in particular is relevant for dispositions to accept or reject co-referential substitute expression, then the cognitive role of referential terms can be encoded by appropriate formal attitude attributions. It has been stipulated for simplicity that attitude attributions encoding cognitive content after disquotation or acceptance systematically correspond with attitude attributions that result from the analysis of corresponding de dicto readings of attitude ascriptions. The cognitive content of an utterance for a speaker A is then the result of analyzing

the embedding of the utterance into a belief ascription of the form *A believes that* read de dicto. The partial cognitive content of a proper name, on the other hand, is the identification criteria a speaker associates with that name in conjunction with the property of being called by that name. These criteria in a formal belief attribution determine the speaker referent of the corresponding name, which is a doxastic object that might in fact not exist. In contrast to that, the truth-conditional content of a proper name doesn't have to include any identification criteria at all. It may be encoded by a rigidified definite description that only makes use of the property of being called such-and-such, or alternatively may be encoded the Millian way by a rigid constant. The following schemes summarize these positions, where $\odot$ is used to symbolize relativized rigidity and $\Box_1$ is a doxastic modality. A is the property of being called such-and-such and a requirement by linguistic competence, $I_1 \dots I_n$ are identification criteria. $M_1 \wedge M_k$ symbolize some ideal, objective meaning. (Dependency on the conversational context is ignored.)

☆ **Ref 18** (NDT Scheme)**.**
  Semantic Reference: $\dots \iota x \,@\, Ax \dots$
  Speaker Reference: $\Box_1 \dots \iota x \,\circledcirc (Ax \wedge I_1 x \wedge \cdots \wedge I_n x) \dots$

☆ **Ref 19** (EDT Scheme)**.**
  Semantic Reference: $\dots \iota x \,@\, (Ax \wedge M_1 x \wedge \cdots \wedge M_k x) \dots$
  Speaker Reference: $\Box_1 \dots \iota x \,\circledcirc (Ax \wedge I_1 x \wedge \cdots \wedge I_n x) \dots$

In dependence of varying degrees of idealization and given an intended interpretation of the properties involved, NDT and EDT are descriptively and explanatory adequate theories of reference. However, from a technical point of view $M_1, \dots M_k$ and $I_1, \dots, I_n$ are dispensable, because the interpretation of A can be chosen such that it expresses a complex property that comprises these criteria outside and inside the scope of a doxastic modality respectively in addition to the property of being called such and such. This allows for a simplified view, according to which speaker reference boils down to $\Box_1 \dots \iota x \odot Ax \dots$ and semantic reference boils down to $\dots \iota x \,@\, Ax \dots$ for both NDT and EDT. This view is descriptively adequate, but not fully explanatory adequate, because it doesn't explicitly discern the components that constitute the complex property used in determining the referent. Taking the taxonomy of section 2.3.2 in chapter 2, NDT and EDT are varying, non-matching, non-identifying, restricted description theories of speaker reference. To this in later chapters context-dependency will be added and the simplified view will be adopted. Although there are many differences as well, this view has some similarities with the restricted-variable/retrieval view of Castañeda (1990b). In Castañeda's theory, proper names are sortal variables of quantification, working as follows:

> "The sort determined by a proper name is a nominalistic sort of the type being called such and such. The central roles of proper names are their pragmatic and semiotic roles of organizing beliefs and causing revisions, expansions and combinations of memory files. They are used in the retrieval of believed information." (Castañeda 1990b, p. 37)

A similar idea underlies the above branches of description theory. A speaker using or interpreting a proper name will consider, on the basis of his previous beliefs, the (doxastic) referent

of that name to have certain properties, some of which he might use as identification criteria in case the situation supports and demands identifying reference. A speaker's attempt to identify the semantic referent of the proper name in a given conversational context is always made by means of the properties that the referent is purported to have in the speaker's opinion. In contrast to Castañeda's theory, in the present view the property of being called such and such must already ensure uniqueness of the semantic referent within a given conversational context and names are analyzed by means of iota expressions instead of being free variables of quantification sorted by the property of being called such and such.[24]

Some remarks are also in place about what has *not* been argued for. It has not been argued for the claim that genuine dual aspect theories are inadequate for principal reasons. It has also not been argued for the claim that modal logic is the recommended tool for providing the semantics of attitude ascriptions. Limited expressivity, the problem of logical omniscience, and over- and undergeneration make normal modal logics undesirable for this task, unless only highly idealized, rational belief and knowledge is considered.[25] Furthermore, the talk about 'associating' identification criteria or a definite description with a proper name must not be taken too literally. The empirical process of conceiving something (or nothing) as something with such-and-such properties is a matter of physics, psychology, and neurophysiology, but no doxastic object can be conceived as having no property at all. Identification criteria must be thought of as being part of a transcendental condition for identifying reference and the talk about associating them must not be understood as a cognitive process a speaker is aware of. They may be implicit and become only explicit, once a speaker becomes aware of them, is able to express them linguistically, and also has a reason to do so. This sets apart the present view from what Castañeda (1990b) calls the *Formulable Local Description View*, according to which a speaker referring to an object by means of a proper name must always be able to produce an appropriate source language definite description on demand.[26] The utterance dispositions that are at the core of referential opacity are only encoded indirectly in the present account, insofar as a speaker may sometimes be able to make the identification criteria he associates with a proper name explicit. This can for example happen when a speaker realizes that two co-referential proper names are indeed co-referential or when he believes that some proper name is referentially under- or oversaturated and demands clarification. Moreover, it has not been argued for the view that constants should be discarded in general or that proper names cannot be analyzed as rigid constants. In fact, the NDT analysis of semantic reference of a proper name spells out in the object language what a Millian analy-

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[24]In Castañeda's view, proper names are count nouns and singular reference is entirely a pragmatic phenomenon. Given that many names are ambiguous or rather equivocal, this seems on one hand justified. On the other hand, many apparent counter-examples to assuming uniqueness of semantic reference, like "Some Greta Bergmans are excellent business women" (Castañeda 1990b, p. 28) or "Are you *the* Castañeda?" (Castañeda 1990b, p. 33), can be analyzed in the present view as well, as long as a proper distinction between these descriptive uses and the normal naming uses of proper names is made by the syntax–semantics interface. This can for example be done by having separate lexicon entries or by binding the description only by a iota quantifier when there is no other quantifier/determiner in the NP.

[25]See (Robbins 2004) for a concise summary of the main problems. Cf. section 8.3.4 of chapter 8. It must be mentioned, though, that in the present view rational KD45 belief *is* an adequate notion of belief for epistemological and other ideal-language centered purposes, and that most of its purported deficiencies are in fact desirable features, but this is just the author's personal opinion and will not be backed up here.

[26]See (Castañeda 1990b, p. 39).

sis assumes by the interpretation rules for rigid constants in the meta language. Millianism is descriptively adequate with respect to semantic reference. Finally, the question whether EDT or NDT should be adopted will be left open. Given the idealized nature of semantic reference it seems that this question cannot be given any decisive answer.

4.6   Implementing Description Theory

In this section, ways to implement the proposed theory of reference in normal first-order modal logic will be outlined. Only NDT will be assumed in the following, but the proposals work the same way with EDT. As before, for the sake of simplicity first-order modal logic is used for illustration. In a more realistic semantic framework, higher-order logic or frameworks with similar expressivity are nearly unavoidable and using a syntactic formalism other than the simple phrase-structure grammar below is unavoidable.[27] For merely showing that description theories of reference can be implemented, the technical machinery used in this section will be more than enough.

The remainder of this section is structured as follows. First, ways to implement the given approach including relativized rigidity will be discussed in section 4.6.1. Then it will be shown in section 4.6.2 that this analysis is prima facie not compositional, that it can be made compositional, but that making it compositional isn't desirable.

4.6.1   Implementing Relativized Rigidity

Implementing relativized rigidity in first-order modal logic poses no special problems. Analyses with relativized rigid terms can be expressed by giving iota quantifiers the appropriate scope, by borrowing some operators from hybrid logic (HYL), or by defining a special relativized actuality operator. It must be kept in mind, though, that whatever trickery is done in normal first-order modal logic can also be done in first-order predicate logic with explicit quantification over worlds and each predicate having an additional argument for a world variable or constant. Since there is no general difference in expressivity between first-order modal logic and first-order predicate logic, the above mentioned operators are nothing more than notational tools.

The examples in the following sections will make use of some conventions. The unary properties A, B, C are used to express the property of being called «Alice», «Bob», and «Carol» respectively. I_B^A will be used for the identification criteria Alice associates with the proper name «Bob», and so on for other combinations of speakers and names.

Some Changes to FOML

Some minor changes to the fairly standard formulation of constant domain first-order modal logic of Appendix A will be convenient.

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[27]The latter is unavoidable since Shieber (1985) has shown that some languages such as Swiss German and Dutch are mildly context-sensitive. The former is nearly unavoidable, since there are natural higher-order quantifiers like «most» and since formalizing higher-order talk in a first-order language generally requires heavy reification that is hard to justify.

First, the logic is made four-sorted in order to facilitate the definitions in the following examples. Instead of one set of variables and one set of constants, we now use the sets DVAR, SVAR, NVAR, WVAR containing variables for ordinary objects, speakers, source language names, and worlds respectively. Likewise, DCON, SCON, NCON, WCON contain constants for ordinary objects, speakers, source language names, and worlds. Variables or constants for source language names bear the superscript n, those for speakers bear superscript s, those for worlds bear superscript w, and those for other objects bear the superscript d. Furthermore, DTERM = DVAR $\cup$ DCON and likewise for the other sorts. The domain D of a model $M = \langle W, R, D, [\![.]\!] \rangle$ is then partitioned into three subsets,

$$D = D_s \cup D_n \cup D_d \tag{4.29}$$

The set D_s is a set of speakers or agents, D_n is a set of names of the source language, whose purpose will be explained below in the section on compositionality, and D_d is a set of objects other than speakers. The set of possible worlds is already given in the model as W. All of these sets have to be non-empty, but their elements will only be specified in examples when variables of the respective kind are in fact used. Since all of the examples of the following paragraphs will be about speakers, the superscript of variables for speakers may be left out. Metavariables are written in the same way as before by using the names of the sets containing instances of the respective expressions. The following must then hold for any assignment g:

$$g(\text{WVAR}) \in W \tag{4.30}$$
$$g(\text{SVAR}) \in D_s \tag{4.31}$$
$$g(\text{NVAR}) \in D_n \tag{4.32}$$
$$g(\text{DVAR}) \in D_d \tag{4.33}$$

It is further assumed that constants are sorted in the same way, and that, if $FOML_\iota$ is used as a basis, any iota term has the same sort as the variable that it binds. So for example STERM stands for any term that will denote an element in D_s, if it denotes at all.

Second, we will from now on assume that doxastic modalities are based on triadic instead of dyadic accessibility relations. In addition to a modality index, doxastic modal operators will from now on also have an argument place for a singular term. Therefore, the set of accessibility relations R in a model will from now on consist of two different sets of accessibility relations.

$$R = R^{mod} \cup R^{dox} \tag{4.34}$$
$$R^{mod} \subseteq \wp(W \times W) \tag{4.35}$$
$$R^{dox} \subseteq \wp(W \times W \times S) \tag{4.36}$$

The revised syntax and semantics of a doxastic modal operator is then given by the following rules, where MID stands for a modality index (see Appendix A).

$$\text{WFF} := \square_{\text{STERM,MID}} \text{WFF} \tag{4.37}$$

$$
\llbracket \Box_{\mathrm{STERM,MID}} \mathrm{WFF} \rrbracket_g^M (w) =
\begin{cases}
1 \text{ if for } R_{\mathrm{MID}}^{dox} \in R^{dox} \text{ in all } u \in W \text{ such that} \\
\quad R_{\mathrm{MID}}^{dox}(w, u, \llbracket \mathrm{STERM} \rrbracket_g^M (w)) : \\
\quad \llbracket \mathrm{WFF} \rrbracket_g^M (u) = 1 \\
0 \text{ otherwise}
\end{cases}
\tag{4.38}
$$

The definitions for other modalities remain the same and modal indices number both kinds of modalities consecutively. If only one kind of doxastic modality per speaker is relevant, the modal index will be left out completely. This definition has to be adjusted accordingly if the underlying logic allows non-denoting terms, as in $FOML_\iota$ in Appendix A. In case $\llbracket \mathrm{STERM} \rrbracket_g^M (w)$ is undefined in such a system the whole belief attribution must be false. Triadic doxastic modalities make examples more compositional and thus more realistic, since they allow us to drop the rather artificial assumption that a matrix sentence of the form *A believes that. . .* is just mapped to one operator simpliciter. The subject-NP of such sentences now explicitly appears in the corresponding expression of the target language.

Relativized Rigidity Using HYL Operators

The syntax of FOML is augmented by the following rule.

$$
\mathrm{WFF} := \downarrow \mathrm{WVAR} \; \mathrm{WFF} \mid @_{\mathrm{WTERM}} \mathrm{WFF}
\tag{4.39}
$$

These operators have the following semantics.

$$
\llbracket \downarrow \mathrm{WVAR} \; \mathrm{WFF} \rrbracket_g^M (w) = \llbracket \mathrm{WFF} \rrbracket_h^M (w),
\tag{4.40}
$$

where $h \approx_{\mathrm{WVAR}} g$ such that $h(\mathrm{WVAR}) = w$

$$
\llbracket @_{\mathrm{WTERM}} \mathrm{WFF} \rrbracket_g^M (w) = \llbracket \mathrm{WFF} \rrbracket_g^M (\llbracket \mathrm{WTERM} \rrbracket_g^M (w))
\tag{4.41}
$$

Given these two operators, the downarrow binder and the at-operator, it is easy to express relativized rigidity. Consider one of the examples given for nested modalities.

(4.27) Alice believes that it is necessary that Bob loves Carol.

Formula 4.42 expresses the de dicto reading of this belief ascription in some model. For comparison, the de re reading is given in formula 4.43, where @ without subscript is just the ordinary actuality operator assuming the model is augmented by a designated actual world w_0.

$$
M, g, w_0 \vDash \imath x[@ \, Ax] \, \Box_x \downarrow x^w \, \Box_0 \, \imath y[@_{x^w}(By \wedge I_B^A y)]
\tag{4.42}
$$
$$
\imath z[@_{x^w}(Cz \wedge I_C^A z)] P(y, z)
$$
$$
M, g, w_0 \vDash \imath x[@ \, Ax] \, \Box_x \, \Box_0 \, \imath y[@ \, By] \imath z[@ \, Cz] P(y, z)
\tag{4.43}
$$

Relativized Rigidity and the Wide Scope Theory

Just like it was feasible to express non-relativized rigidity by wide scope descriptions without any need for an actuality operator, relativized rigidity can be expressed in first-order modal logic

without any need for additional modifications. In this respect, the operators introduced above are redundant. It suffices to adjust the wide scope interpretation rule for proper names. According to (WDT 1) on page 55 of the last chapter the wide scope theory says that proper names of the source language are analyzed as formal definite descriptions that have widest possible scope over any modal operators in the target language. This definition has to be adjusted in order to account for relativized rigidity.

✩ **WDT 2.** *(Relativized Wide Scope Description Theory) A proper name n in the source language is analyzed as a definite description that (a) is within the priority scope of the leftmost doxastic modal operator $\square$ with de dicto interpretation if n occurs in the sentence embedded by the natural language expression that corresponds to $\square$, and (b) has widest possible scope with respect to any other modal operator and without violating condition (a).*

This rule only accounts for natural language expressions containing modal operators and belief ascriptions, but of course the derivation of attitude ascriptions by disquotation or under the assumption of utterance acceptance works analogously. We simply give any proper name whose subjective meaning we are interested in an interpretation that is enriched by the respective person's identification criteria for the name and ensure that the resulting definite description has widest scope up to the doxastic modality expressing that person's belief or similar attitude. Following this doctrine the de dicto reading of example 4.27 can simply be written down as formula 4.44:

$$M, g, w \vDash \imath x[Ax] \, \square_x \, \imath y[By \wedge I_B^A y] \imath z[Cz \wedge I_C^A z] \, \square_0 \, P(y, z) \tag{4.44}$$

Relativized Rigidity Using a Relativized Actuality Operator

The wide scope approach seems to have a major drawback. Like the non-relativized wide scope analysis it introduces a positional dependency that has no equivalent in the surface syntax of the corresponding natural language expressions. English proper names simply occur where they are required to occur by the syntax of the embedded sentence. Likewise, when using hybrid logic operators we have to 'mark' the first occurrence of a doxastic modality with the downarrow binder. These features of the analyses can complicate the syntax–semantics interface in a formal grammar. As it seems, the burden on the syntax–semantics interface can be lowered by defining a relativized actuality operator and suitably redefining doxastic modal operators. It will later be argued that the gain in utility by introducing such an operator is only marginal, but it is helpful to see why. The definition of a relativized actuality operator is straightforward and has a dynamic flavor. A storage parameter ν is used that behaves as follows. At the start of evaluating each formula, a special value *undefined* is assigned to the storage. Later during evaluation a conditional value assignment operator $\leftarrow$ can be used to update the value once as follows.

$$\nu \leftarrow w = \begin{cases} w \text{ if } \nu = \textit{undefined} \\ \nu \text{ otherwise} \end{cases} \tag{4.45}$$

Truth in a model is relativized to ν and we use the assignment operator to store any dependence on the first doxastic modal operator as follows.

$$[\![\Box_{\mathrm{STERM,MID}} \, \mathrm{WFF}]\!]^M_{g,\nu}(w) = \begin{cases} 1 \text{ if for } R^{dox}_{\mathrm{MID}} \in R^{dox} \text{ in all } u \in W \text{ such that} \\ \quad R^{dox}_{\mathrm{MID}}(w, u, [\![\mathrm{STERM}]\!]^M_{g,\nu}(w)) : \\ \quad [\![\mathrm{WFF}]\!]^M_{g,\nu'}(u) = 1, \\ \quad \text{ where } \nu' = \nu \leftarrow u \\ 0 \text{ otherwise} \end{cases} \qquad (4.46)$$

Given these preliminaries, defining a relativized actuality operator is straightforward. The following definition assumes that models are augmented by a designated actual world w_0.

$$\text{Syntax. WFF} := \odot \, \mathrm{WFF} \qquad (4.47)$$

$$\text{Semantics. } [\![\odot \, \mathrm{WFF}]\!]^M_{g,\nu}(w) = \begin{cases} [\![\mathrm{WFF}]\!]^M_{g,\nu}(w_0) \text{ if } \nu = undefined \\ [\![\mathrm{WFF}]\!]^M_{g,\nu}(\nu) \text{ otherwise} \end{cases} \qquad (4.48)$$

Strictly speaking, this apparatus requires truth in a model to be reformulated in a dynamic way, similar to formulations of truth-functional connectives in dynamic predicate logic. Evaluation must strictly proceed from left to right, but since this is the default way in which logical formalisms are read, a suitable reformulation of the definitions in Appendix A will from now on be assumed.[28] Using the above operator, formula 4.49 expresses the de dicto reading of 4.27 using the iota quantifier and formula 4.50 does the same using the iota operator.

$$M, g, w_0, \nu \vDash \imath x[\odot \, Ax] \, \Box_x \, \Box_0 \, \imath y[\odot (By \wedge I^A_B y)] \imath z[\odot (Cz \wedge I^A_C z)] P(y, z) \qquad (4.49)$$

$$M, g, w_0, \nu \vDash \Box_{\iota x \odot Ax} \, \Box_0 \, P(\iota y[\odot (By \wedge I^A_B y)], \iota z[\odot (Cz \wedge I^A_C z)]) \qquad (4.50)$$

4.6.2 Compositionality

One objection that may be raised against the proposed analysis is that it is not compositional. Whether this is a sound and strong objection depends on the presumed kind of compositionality and of course also on the foundational question whether compositionality always should hold or not. These questions will be briefly addressed in the following paragraphs. The purpose of the following discussion is to point out in which sense the suggested analysis is compositional and in which sense it is not. An exhaustive discussion of compositionality is beyond the scope of the following sections and can for example be found in (Janssen 1986, 1996), (Partee 1984), or (Blackburn 2001).

Characterization of Compositionality

Compositionality has also been called the *Frege Principle* and already been formulated as (Fre 1.2) on page 23. Compared to recent accounts of compositionality, (Fre 1.2) is quite liberal; it only

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[28]How this can be done formally is exemplified by the 'dynamic' variant of first-order predicate logic in chapter 7.

says that the senses of subexpressions are combined in a regular manner to form the sense of a whole expression. It is hard to extract more on that matter from Frege's work and it has in fact been argued that Frege might never have endorsed compositionality as it has been understood more recently.[29] Contemporary characterizations of compositionality can be found in the literature in almost identical formulations like the following one.

☆ **PCF 1.** *The meaning of a complex expression is a function of the meanings of its parts and its syntactic mode of composition.*[30]

This adds the syntactic mode of composition to (Fre 1.2). Compositionality understood in this way concerns the relation between some concrete specification of the syntax of the source language and some concrete specification of the way in which semantic content is composed. To get the highest degree of precision, a purely formal compositionality principle has been formulated first by Montague (1974b) and since then various algebraic formulations of compositionality have been proposed.[31] For current purposes, the above characterization will do, as long as it is accompanied by the following informal test for non-compositionality.

☆ **PCF 2.** *The relation between syntactic combination and semantic composition is non-compositional when two expressions with the same meaning "[. . .] nevertheless yield results with different meanings when a particular syntactic operation is applied to them." (Westerståhl 1998, p. 636)*

Evaluation of the Proposal

The theory of indirect reference with relativized rigidity proposed above consists of two major parts and it is helpful to consider them separately. The first part is the implementation of relativized rigidity itself, whereas the second part is the identification criteria with which the analysis of proper names is supplemented in de dicto belief attributions. For the time being, let us consider only the first part and compare the following analyses of example 4.27.

$$M, g, w_0 \vDash \imath x[@\ Ax]\,\Box_x \downarrow x^w\,\Box_0\, \imath y[@_{x^w}\ By]\imath z[@_{x^w}\ Cz]P(y, z) \tag{4.51}$$

$$M, g, w_0 \vDash \imath x Ax\,\Box_x\, \imath y By \imath z Cz\,\Box_0\, P(y, z) \tag{4.52}$$

$$M, g, w_0, \nu \vDash \imath x \odot Ax\,\Box_x\,\Box_0\, \imath y \odot By \imath z \odot Cz P(y, z) \tag{4.53}$$

They are the hybrid logic operator, wide scope, and relativized actuality operator analyses respectively taken without identification criteria. Now consider the context-free grammar in figure 4.5, but ignore the semantic construction rules (I1)–(I8) for the time being. Among infinitely many other sentences this grammar generates example 4.27, here repeated for convenience:

(4.27) Alice believes that it is necessary that Bob loves Carol.

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[29] See (Janssen 1986, 1996, 2001).
[30] See (Pagin 2003, p. 291), (Partee 1984, p. 281), (Pagin and Westerståhl 2001, p. 1), (Pelletier 2003, p. 153).
[31] See for example (Janssen 1986), (Janssen 1996), (Hendriks 2001).

(S1)	S	$\rightarrow$	NP VP $\mid$ VC0 CP
(I1)	$[\![S]\!]$	$=$	$[\![NP]\!]([\![VP]\!]) \mid [\![VC0]\!]([\![CP]\!])$
(S2)	CP	$\rightarrow$	C S
(I2)	$[\![CP]\!]$	$=$	$[\![C]\!]([\![S]\!])$
(S3)	VP	$\rightarrow$	V2 NP $\mid$ VC CP
(I3)	$[\![VP]\!]$	$=$	$[\![NP]\!]([\![V2]\!]) \mid [\![VC]\!]([\![CP]\!])$
(S4)	VC0	$\rightarrow$	it is necessary
(I4)	$[\![VC0]\!]$	$=$	$\langle \text{①}. \Box_0\, \text{①} \rangle$
(S5)	VC	$\rightarrow$	believes
(I5)	$[\![VC]\!]$	$=$	$\langle \text{①}.\langle \text{②}. \Box_{\text{②}}\, \text{①} \rangle \rangle$
(S6)	V2	$\rightarrow$	loves
(I6)	$[\![V2]\!]$	$=$	$\langle \text{①}.\langle \text{②}.P(\text{②},\text{①}) \rangle \rangle$
(S7)	NP	$\rightarrow$	Alice $\mid$ Bob $\mid$ Carol
(I7)	$[\![NP]\!]$	$=$	$\langle \text{①}.\imath x \odot Ax\, \text{①}(x) \rangle \mid \langle \text{①}.\imath y \odot By\, \text{①}(y) \rangle \mid \langle \text{①}.\imath z \odot Az\, \text{①}(z) \rangle$
(S8)	C	$\rightarrow$	that
(I8)	$[\![C]\!]$	$=$	$\langle \text{①}.\text{①} \rangle$

Figure 4.5: A context-free toy grammar with semantic construction.

If we assume a mode of semantic composition that corresponds directly with the syntax rules in figure 4.5, then the first two approaches aren't compositional. Analysis 4.51 isn't compositional, because the meaning of the proper names within the scope of the belief operator depends on the world variable x^w introduced by the downarrow operator. If on the other hand only rule S $\rightarrow$ VC0 CP is applied to analyze a simpler sentence like «it is necessary that Bob loves Carol» , then rule VP $\rightarrow$ VC CP plays no role in derivation. Consequently, the meaning of an embedded proper name would have to depend on the actual world to account for rigidity, either by binding it using the downarrow operator or by using the ordinary @ operator. But then the same syntactic construction rules in the derivation of the embedded sentence yield different semantic content of proper names in these two cases, which is non-compositional according to (PCF 2). Likewise, the scope of the iota quantifiers for «Bob» and «Carol» in formula 4.52 is determined in dependence of the de dicto belief ascriptions in which the source language names occur. If the same proper names would be nested into two belief ascriptions, their meaning ought only depend on the first one, but the second belief ascription would be composed in correspondence to the same syntactic rule VP $\rightarrow$ VC CP. This again would be a case that falls prey to (PCF 2). Analysis 4.53 taken as it stands is compositional, though. To see this, consider the semantic construction rules (I1)–(I8) given below each phrase structure rule in figure 4.5. These rules can be interpreted as applications of a simple rewrite system. Let $A[n/B]$ be the formula obtained from A by substituting all occurrences of the circled number n by the formula or term B. A simple

rewrite operation $\dashrightarrow$ is then defined by the following rule.

$$\langle n.A\rangle(B) \dashrightarrow A[n/B] \tag{4.54}$$

To see how this rule works in combination with the grammar in figure 4.5, take a look at a derivation of the following utterance.

(4.55) Alice loves Bob.

The syntactic derivation tree results from application of rules (S1a), (S3a) and lexical insertion rules (S6), (S7a), and (S7b). The corresponding semantic construction is computed as follows. Formula 4.57 is obtained from 4.56 by (I1a), 4.58 by (I3a), and 4.59 by lexical insertion (I7a/b) and (I6). The rest is applications of rewrite rule 4.54 as the arrows indicate.

$$S \tag{4.56}$$

$$[\![NP]\!]([\![VP]\!]) \tag{4.57}$$

$$[\![NP]\!]([\![NP]\!]([\![V2]\!])) \tag{4.58}$$

$$\langle ①.\imath x \odot Ax①(x)\rangle\big(\langle ①.\imath y \odot By①(y)\rangle\big(\langle ①.\langle ②.P(②,①)\rangle\rangle\big)\big) \tag{4.59}$$

$$\dashrightarrow \imath x \odot Ax\langle ①.\imath y \odot By①(y)\rangle\big(\langle ①.\langle ②.P(②,①)\rangle\rangle\big)(x) \tag{4.60}$$

$$\dashrightarrow \imath x \odot Ax\imath y \odot By\langle ①.\langle ②.P(②,①)\rangle\rangle(y)(x) \tag{4.61}$$

$$\dashrightarrow \imath x \odot Ax\imath y \odot By\langle ②.P(②,y)\rangle(x) \tag{4.62}$$

$$\dashrightarrow \imath x \odot Ax\imath y \odot ByP(x,y) \tag{4.63}$$

Figure 4.6 depicts the derivation and semantic construction of example 4.27 with nested modalities. The relation between syntax rules and semantic construction is compositional in this grammar because to each syntax rule corresponds a semantic derivation step that combines only the partial meaning schemes of the respective subexpressions. Although the whole grammar is a rather primitive affair, the derivation tree in 4.6 has some interesting features that should be mentioned for clarity.

[1] The complementizer «that» is analyzed as meaningless expression. Although this expression would probably have some meaning in a more elaborate grammar based on a real-world grammar formalism—for example it could be an operator that changes the semantic type of its argument—meaningless expressions don't violate and shouldn't violate compositionality. Otherwise the grammarian would be prohibited to analyze the syntax of expressions that have no truth-conditional content.

[2] The phrase «it is necessary» is not analyzed further. As a general rule, compositionality isn't violated if some syntactically compound expression is not given any internal syntactic structure, as long as the way in which the corresponding meaning constituting entities are constructed doesn't make use of any internal structure either. There are boundaries to the usefulness of such
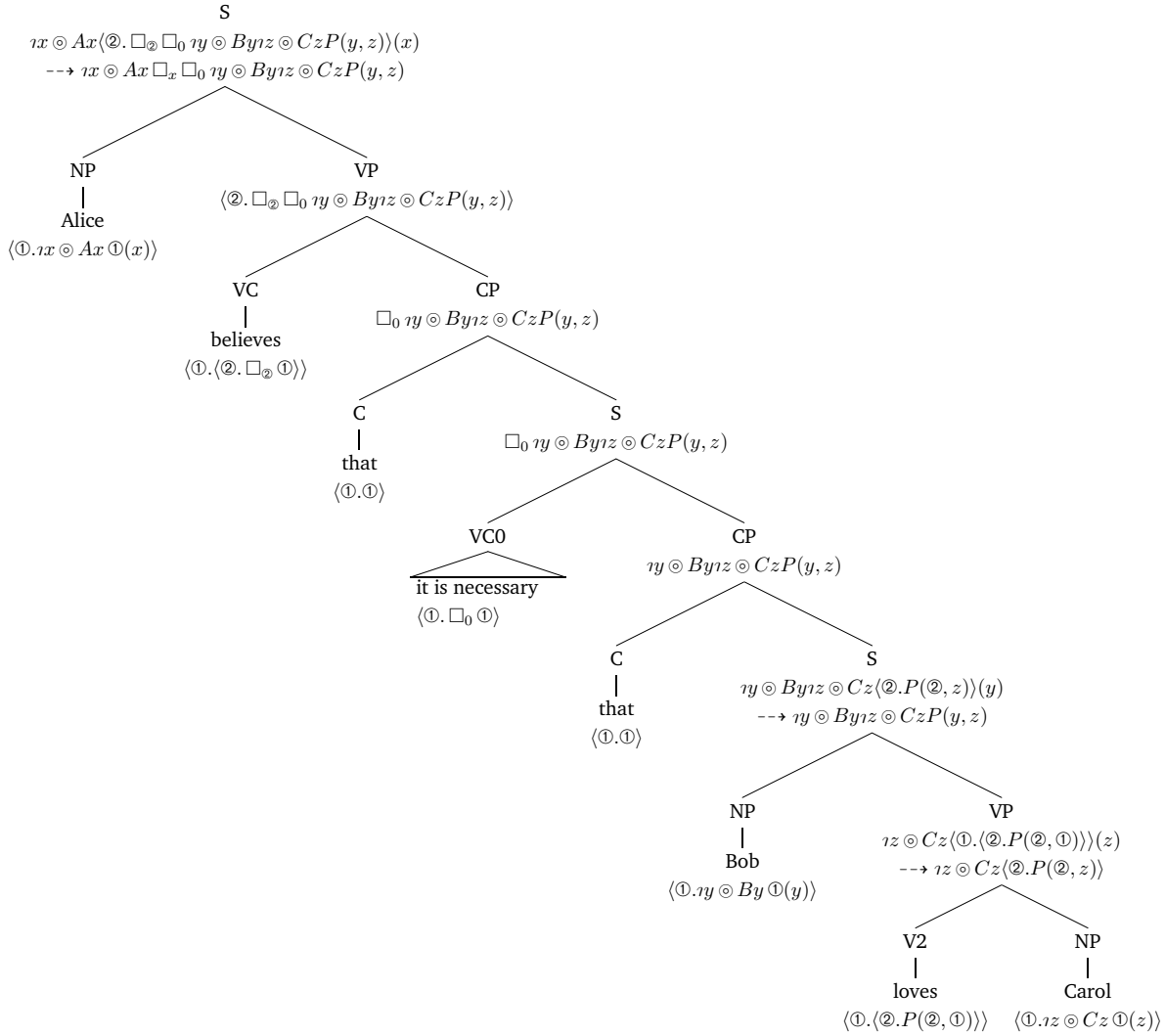
Figure 4.6: An example derivation tree with semantic construction.

procedure that are dictated both by the goals of the syntactician and the goals of the semanticist. A theory that just enumerates sentences and their meaning would be useless, although it may be considered compositional. There is no doubt that in a real-world grammar an expletive use of «it» like in «it is necessary that Bob loves Carol» ought to be given internal structure and correspondingly be given some meaning.[32] But phraseologisms like «it is raining cats and dogs» still ought to be allowed in the grammar without violating compositionality.

[3] The example shows that the syntactic head may deviate from the semantic head without violating compositionality. In the example, the direct object NP is 'applied' to the V2, i.e. in this case the semantic scheme of the V2 fills the argument slot of the semantic scheme of the NP, although according to the traditional syntactic analysis the verb is the syntactic head of the verb phrase, as the category names V2 and VP in the example suggest.[33]

It is now time to ask why the analysis using the relativized actuality operator appears to be more compositional than the other analyses. The reason is obviously that the semantics of the operator has been defined in a way that the same meaning scheme can be given for a proper name outside a de dicto belief ascription as inside of it without having to tweak the syntax. This is, however, partly a Pyrrhic victory. Since all approaches analyze a proper name that occurs in a de re belief ascription differently from the same proper name if it occurs in a de dicto ascription, semantic construction involving a proper name always depends on the question whether this name occurs inside a de re or inside a de dicto belief ascription. Without further modifications to the grammar or the way truth-conditional content is constructed, the complete proposal is therefore non-compositional, although the above partial analysis is compositional. Furthermore, if identification criteria are taken into account as well, the resulting analysis will be non-compositional with respect to canonical grammars for basically the same reasons. The analysis of a proper name in the proposed account not only depends on the kind of belief ascription in which they occur, if they occur in one, but also on the respective believer. Writing complex predicates as I_B^A, I_B^C, and so on, has not been more than a notational shortcut. Fully implemented, an analysis of a proper name reflecting a speaker reference by means of that name has to be a function from the set of speakers and the set of rigid terms of the source language into expressions of the target language. The two dependencies that obstruct compositionality are illustrated in figure 4.7.

Assuming only de dicto readings of attitude ascriptions and ignoring identification criteria can make sense, though. As mentioned before, an analysis based on terms like $\iota x \odot Ax$ is descriptively adequate for dicto belief ascriptions, though not fully explanatory adequate. As an example, suppose Alice believes (de dicto) that Hesperus is not identical with Phosphorus. This can be analyzed as follows.

$$M, g, w_0 \vDash \iota x[\odot Ax]\,\square_{x,1}\,\iota y[\odot Hy]\iota z[\odot Pz](y \neq z) \tag{4.64}$$

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[32]Meaning not necessarily as an entity on its own, but rather similar to the way anaphoric expressions have a meaning. The result of the construction should amount to the result of the semantic construction of the base case «that Bob loves Carol is necessary».

[33]That is not to say that it isn't desirable to hold syntactic and semantic head as much as possible in parallel. But such a desideratum doesn't result from compositionality itself.
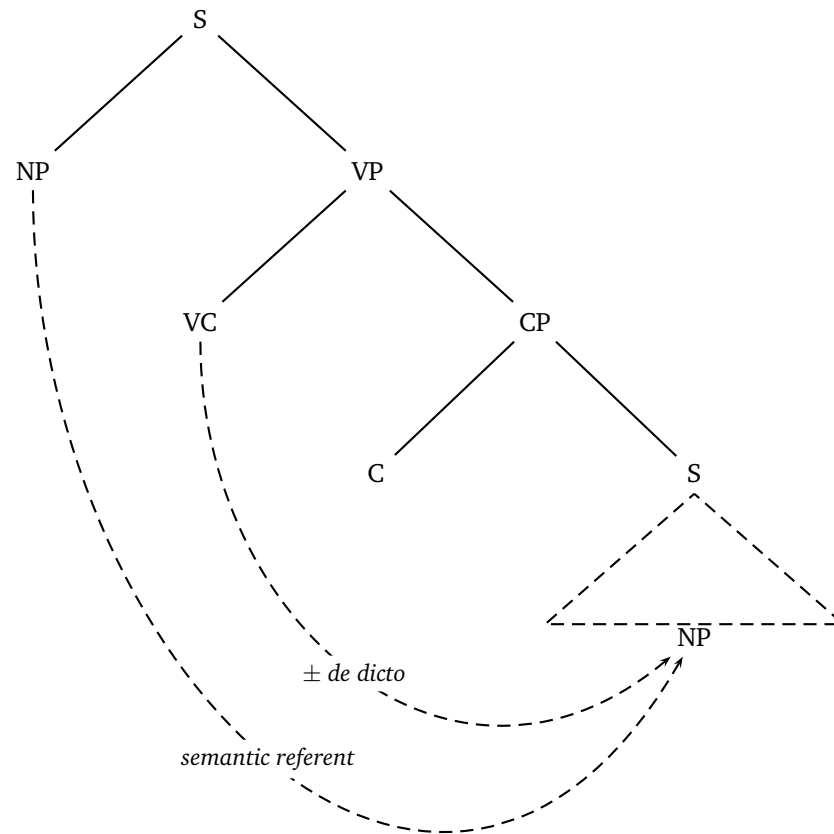
Figure 4.7: Dependencies of the full analysis of attitude ascriptions.

Suppose we have the following partial specification of a model.

$$M = \langle W, R, D, [\![.]\!], w_0 \rangle \tag{4.65}$$

$$W = \{w_0, w_1\} \tag{4.66}$$

$$D = \{a, b, c, d\} \tag{4.67}$$

$$[\![A]\!]_g^M (w_0) = \{a\} \tag{4.68}$$

$$[\![H]\!]_g^M (w_0) = [\![P]\!]_g^M (w_0) = \{b\} \tag{4.69}$$

$$[\![H]\!]_g^M (w_1) = \{c\} \tag{4.70}$$

$$[\![P]\!]_g^M (w_1) = \{d\} \tag{4.71}$$

$$\langle w_0, w_1, a \rangle \in R_1^{dox} \tag{4.72}$$

Then formula 4.64 is true in that model even though Hesperus and Phosphorus are identical, and the analysis is compositional with respect to reasonable modes of syntactic and semantic composition. Finally it must be mentioned that the proposed view of cognitive content as de dicto belief attributions is prima facie non-compositional in a trivial way, since it depends on the application of a disquotation principle or on the assumption of acceptance. Neither the sender nor the recipient of an utterance nor any of their beliefs are part of the literal meaning of an utterance, and of course the cognitive content of an utterance with respect to one speaker can differ from the cognitive content of the same utterance with respect to another speaker. Thus, insofar as cognitive content is—incorrectly—regarded as the cognitive content of an utterance simpliciter, it is of course highly non-compositional. But it has already been argued in section 4.3 that cognitive content is not an aspect of utterances simpliciter. How could it be if cognitive content is always the content of someone thinking?

Making the Analysis Compositional

Compositionality is a means to keep syntax and semantics in parallel and therefore has great potential to facilitate semantic construction and to enhance the maintainability of formal grammars. There can hardly be any doubt that compositionality is in general desirable. The question is, however, whether this also means that it is desirable in every particular case. As will be argued, the present example shows that maintaining compositionality at any price can complicate the semantics without bringing any significant benefits. In order to make this point, a compositional version of the proposed analysis first has to be given. In order to find a compositional version, it is helpful to recall why the proposed analysis is by default non-compositional. Semantic construction of meaning constituting entities in the analysis depends on linguistic material that isn't part of the constituent structure determined by syntactic construction rules at that point in the derivation, but is located at a higher node in the derivation tree. This case is illustrated in general in figure 4.8. Suppose B in the tree contributes an entity f to the semantic composition of D and E, but a replacement node B' of B in the otherwise same configuration contributes an entity g to the semantic composition of D and E, such that the semantic values of C are different in each case. Then semantic construction is non-compositional in relation to the derivation tree, since the syntactic mode of composition in both cases maps D and E to the same node C. Janssen
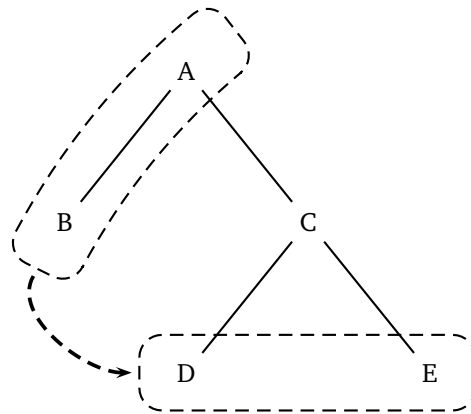
Figure 4.8: A derivational configuration leading to non-compositionality when D or E semantically depend on A or B.

(1996) mentions several strategies to turn a non-compositional analysis into a compositional one.[34] One of them is to introduce new meanings, and this method works in a situation like the one depicted in figure 4.8, as long as the linear precedence of the nodes is preserved to some extent by target language syntax and semantic evaluation, i.e. as long as the meaning-constituting entity corresponding to B precedes that of C and semantic evaluation is from left to right. Given that, the truth-conditional content of B, D, E has to be modified such that the entity f introduced by B becomes a parameter according to which the truth-conditional content of D and E is evaluated. As a result, the whole derivation becomes compositional, since the parameter is now part of the meaning of both D and E. This method may be called *parameterization*.

This technique can be applied to the dependency of de dicto belief ascriptions on the attitude holder. For simplicity, the other dependency on the feature $\pm$de dicto is ignored and only de dicto readings of attitude ascriptions are assumed, as it can be analyzed in a similar fashion. The desired compositionalization requires a lot of additional technical apparatus. For clarity, let SRC be the set of expressions of the source language and TRG be the set of terms or formulas of the target language. Recall that the set of speakers D_s and the set of proper names D_n of the source language are subsets of a domain of a target language model. For the proper names we have $D_n \subset \mathrm{SRC}$ and $D_n \subset D$, i.e. they are syntactic objects of the source language and semantic objects of the target language. Let now $\mathrm{F} \subset \mathrm{TRG}$ be a set of open formulas of the target language, in which the only free variable is x. A naming function $f_n : D_s \times D_n \to F$ is then defined. This function yields an open formula for a given speaker and source language name, and this formula will be used in forming the definite description that the speaker associates with a given source language name. Notice that by the sorting convention introduced at the

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[34]See (Janssen 1996, p. 20-1).

beginning of this section, there's a set $\text{NCON} \subset \text{TRG}$ of constants of the target language that denote elements in D_n. It is further stipulated that there is a special alien element $nature \in D_s$, whose purpose will be laid out below. The syntax of the target language FOML is then enriched by the following operator:

$$\text{WFF} := \theta \text{SVAR}(\text{NCON}) \tag{4.73}$$

This θ-operator takes a speaker variable and a constant denoting a source language name and yields an open formula. In addition to the use of ν for the relativized actuality operator, truth in a model is relativized to another storage variable s that holds a speaker in D_s. At the beginning of evaluation of a formula that corresponds to a natural language sentence, the special value $nature$ is assigned to s. A conditional assignment operation is then defined on s that works as follows.

$$s \hookleftarrow a = \begin{cases} a \text{ if } s = nature \\ s \text{ otherwise} \end{cases} \tag{4.74}$$

Analogous to the way the relativized actuality operator has been defined, the idea behind the above definition is that the speaker bound to the person argument place of the first occurrence of a doxastic modal operator will be assigned to s, but any subsequent assignment will have no effect. The semantics of θ-expressions and a suitably revised interpretation of doxastic modal operators is given by the following rules.

$$\llbracket \theta \text{SVAR}(\text{NCON}) \rrbracket_{g,\nu,s}^M (w) = \begin{cases} 1 \text{ if for } A := f_n\big(s, \llbracket \text{NCON} \rrbracket_{g,\nu,s}^M (w)\big)[x/\text{SVAR}] : \\ \quad \llbracket A \rrbracket_{g,\nu,s}^M (w) = 1 \\ 0 \text{ otherwise} \end{cases} \tag{4.75}$$

$$\llbracket \Box_{\text{STERM,MID}} \text{WFF} \rrbracket_{g,\nu,s}^M (w) = \begin{cases} 1 \text{ if for } s' = s \hookleftarrow \llbracket \text{STERM} \rrbracket_{g,\nu,s}^M (w), \nu' = \nu \leftarrow w, \\ \quad \text{and } R_{\text{MID}}^{dox} \in R^{dox} \text{ in all } u \in W \text{ such that} \\ \quad R_{\text{MID}}^{dox}(w,u) : \llbracket \text{WFF} \rrbracket_{g,\nu',s'}^M (u) = 1 \\ 0 \text{ otherwise} \end{cases} \tag{4.76}$$

Once again, if non-denoting terms are allowed appropriate precautions have to be taken, but this case will be ignored here for the sake if simplicity. Like in the previous example of the relativized actuality operator, evaluation order matters and the definition of truth in a model must be dynamic. To see how the parameterized analysis works, let us take a look at an example. To make it more readable, $\ulcorner Alice \urcorner$, $\ulcorner Bob \urcorner$, and $\ulcorner Carol \urcorner$ are used as mnemonic constant symbols that are elements of NCON. In the lexicon of the toy grammar, the entries for proper names have to be changed as follows.

(4.77) $\quad \begin{array}{lcl} \text{NP} & \rightarrow & \text{Alice} \\ \llbracket \text{NP} \rrbracket & = & \langle \text{①}.\imath x \theta x (\ulcorner Alice \urcorner) \text{①}(x) \rangle \end{array}$

(4.78) $\quad \begin{array}{lcl} \text{NP} & \rightarrow & \text{Bob} \\ \llbracket \text{NP} \rrbracket & = & \langle \text{①}.\imath y \theta y (\ulcorner Bob \urcorner) \text{①}(y) \rangle \end{array}$

(4.79)
$$\begin{array}{rcl} \text{NP} & \to & \text{Carol} \\ [\![\text{NP}]\!] & = & \langle \text{①}.\imath z\theta z(\ulcorner Carol \urcorner)\text{①}(z)\rangle \end{array}$$

In each case, the name function f_n during evaluation of the θ operator yields the identification criteria that the respective attitude holder (or nature itself) stored in s associates with the corresponding English proper name.[35] Now suppose the following intended interpretations and definitions of the naming function f_n, where irrelevant parameters are left out and only the part of f_n is specified that is relevant for the example.

$$[\![\iota x \,@\, Ax]\!]_g^M = a \tag{4.80}$$

$$[\![\ulcorner Alice \urcorner]\!]^M = \text{«}Alice\text{»} \tag{4.81}$$

$$[\![\ulcorner Bob \urcorner]\!]^M = \text{«}Bob\text{»} \tag{4.82}$$

$$[\![\ulcorner Carol \urcorner]\!]^M = \text{«}Carol\text{»} \tag{4.83}$$

$$f_n(nature, \text{«}Alice\text{»}) = @\, Ax \tag{4.84}$$

$$f_n(a, \text{«}Alice\text{»}) = \odot(Ax \wedge I_A^A x) \tag{4.85}$$

$$f_n(a, \text{«}Bob\text{»}) = \odot(Bx \wedge I_B^A x) \tag{4.86}$$

$$f_n(a, \text{«}Carol\text{»}) = \odot(Cx \wedge I_C^A x) \tag{4.87}$$

Consider now example 4.27 again, which is repeated here for convenience.

(4.27) Alice believes that it is necessary that Bob loves Carol.

Using the toy grammar with the revised lexicon, the derivation tree will look the same as the one in figure 4.6 except for changes due to the entries for proper names. The result of semantic construction is the following formula.

$$\imath x\theta x(\ulcorner Alice \urcorner) \,\square_x\, \square_0\, \imath y\theta y(\ulcorner Bob \urcorner)\imath z\theta z(\ulcorner Carol \urcorner)P(y,z) \tag{4.88}$$

Given the definitions above and a domain $D = \{a,b,c\}$ consisting of Alice, Bob, and Carol, this formula will in the intended model be equivalent to the following desired formula.

$$\imath x[@\, Ax] \,\square_x\, \square_0\, \imath y[\odot(Ay \wedge I_B^A y)]\imath z[\odot(Cz \wedge I_C^A z)]P(y,z) \tag{4.89}$$

As long as the s parameter is considered part of the meaning, the analysis is compositional at all stages. If on the other hand s wasn't considered part of the meaning, then any other parameter couldn't be considered part of the meaning either. Then natural languages would be non-compositional, because the analysis of context-dependency of indexicals requires context parameters and the modal index is a parameter as well. The parameterization technique can be generalized to work on any number of dependencies like the above ones by increasing the number of parameters and defining suitable operators that store and retrieve values.

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[35]Notice that instead of using target language constants like $\ulcorner Alice \urcorner$ the definitions could be modified to use definite descriptions, but this is not necessary, because θ-expressions simply yield open formulas that represent part of the conditions of a speaker's reference without encoding any cognitive processes or making any claim about how a speaker would 'associate' a definite description with a proper name. Bear in mind that we are using the target language to describe and explain speaker reference by means of expressions of the source language.

Is Compositionality Needed?

A striking feature of the above compositional analysis is that it is ugly without offering any advantages. It is a typical example of abusing logical formalism. The only reason why it has been provided was to make the following points clear. First, the claim that a certain analysis is non-compositional is nonsense unless it is accompanied by a concrete specification of a formal grammar *and* the corresponding meaning-constituting entities *and* the corresponding semantic construction method. Second, with respect to a grammar that generates crude but acceptable syntactic structures like the one in figure 4.6, de dicto attitude ascriptions can be analyzed compositionally in accordance with the proposed description theory of reference. From a logical point of view, on the other hand, the wide scope theory is sufficient and desirable for analyzing de dicto readings of belief ascriptions. Taken from a logical and ideal language perspective, it seems even more desirable to adopt the pragmatic view on attitude ascriptions and not to consider referential opacity relevant for truth or falsity of attitude ascriptions at all. This seemingly radical position is not further defended here and the simplified NDT view is assumed from now on, but in chapter 8 it will be argued in favor of adopting a pragmatic view on de se attitudes. Third, proviso the fact that syntax is autonomous and cannot be changed arbitrarily, making an analysis compositional at any price can be done by tweaking the semantics—as exemplified by the parameterization technique—, but the resulting formalism doesn't need to have any advantages. In light of the previous examples, it seems better to deal with such semantic construction issues at the level of the source language grammar than to tweak the target language used to specify meaning-constituting entities or these entities themselves. Compositionality is neither needed nor desirable in the present case. It should also be noticed that strict compositionality of the above kind isn't a pressing issue in unification-based grammar formalisms, because in these formalisms features can be 'passed up' to delay final semantic composition until all the necessary information is available.

Part II

Indexicality

Chapter 5

Indexicals

5.1   Chapter Overview

So far all phenomena of context-dependence have deliberately been excluded. Now it is time to address them. In this chapter, indexical reference is investigated and compared with reference by means of non-indexical expressions such as proper names and definite descriptions. According to the terminology to be introduced in section 5.2.1 the class of indexicals comprises indicators such as «I», «now», and «here» and demonstratives such as «this» and «that». After a concise summary of the research on indexicals in section 5.2.2 and the exclusion of certain phenomena in section 5.2.3, an overview of indexicals and their dimensions is given in section 5.3. The dimension are: person, i.e. the role of discourse participants, space, time, modality, and others. On the basis of examples, indexical reference will then be described informally in a large section 5.4. Description theory can deal nicely with indexicals, because many if not most of them have a lot of descriptive content. Special features that set indexicals apart from non-indexical expressions are their token-reflexivity and, connected with this, their egocentricity or at least object-centricity. Ways to formulate informal token-reflexive and egocentric reference rules and the problematic features of such reference rules will be discussed in sections 5.4.1, 5.4.2, and 5.4.3. It will then be argued in section 5.4.4 that two different notions of context have to be distinguished. The context of utterance determines the semantic reference of indexicals, whereas the conversational context is crucial for fixing ambiguity, vagueness, and broad versus narrow readings in dependence of the background assumptions of the discourse participants. The behavior of indexicals with respect to modal expressions is investigated in section 5.4.5, and, following Kaplan (1989) and others, indexicals will be categorized as rigid expressions, with only few potential exceptions. This, it is argued, is a consequence of their token-reflexivity. Finally, indexical and non-indexical reference are compared in section 5.4.8. This will provide the basis for their formal treatment. The examples given in this chapter suffice to confirm Thesis 6.

5.2   Introduction

5.2.1   Terminology

There is no generally agreed upon taxonomy of indexical expressions. In the philosophical literature, the term *indexicals* is commonly used for expressions like «I», «you», «here», or «now», whose referent depends on features of the context of utterance.[1] The term *demonstratives* is commonly used for expressions like «t̲h̲i̲s̲→» or «t̲h̲a̲t̲→», whose semantic referent isn't fixed by their utterance alone but who additionally require an accompanying pointing gesture or a similar way of determining their semantic referent by non-verbal means. The terminology found in the literature varies: Kaplan (1989) mainly uses *demonstratives*,[2] Russell (1966) talks about *egocentric particulars*, other authors like Kamlah and Lorenzen (1973) or Goodman (1967) prefer *indicators*, Reichenbach (1947) calls indexicals and demonstratives *token reflexive words*, Jespersen

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[1]According to Perry (2005, p. 314-5), the term *index* is used by Peirce, but not in the sense presumed here.

[2]He considers the terminological choice to use *demonstratives* in a general sense "poor usage", though (Kaplan 1989, p. 489).

(1922) and Jacobson (1990) call them *shifters*, Bar-Hillel (1954) talks of *indexical expressions*, whereas Bühler (1934), Fillmore (1997), and many contemporary linguists speak of *deictica* and *deictics*. Expressions that depend on the inner-linguistic (endophoric) context, i.e. on what has been said so far, are called *anaphora* if they depend on an antecedent in the discourse context and *cataphora* if they depend on the subsequent inner-linguistic context, i.e. what will be said.

The following taxonomy will from now on be used as a working basis. Indicators such as «I», «now», or «here» are egocentric or object-centric expressions whose semantic referent can only be determined by taking extralinguistic features of the context of utterance into account. Demonstratives are egocentric expressions whose semantic referent can only be determined by taking an extralinguistic pointing gesture into account.[3] Anaphora are expressions whose semantic referent can only be determined by taking into account their antecedent, i.e. an expression uttered in the discourse before, whereas cataphora are expressions whose semantic referent can only be determined by taking into account their subsequent, i.e. an expression that will be uttered. Both indicators and demonstratives will be called *indexicals*, and both anaphora (in the narrow sense) and cataphora will in a sloppy way be called *anaphoric expressions* when the differences don't matter. This taxonomy is a trade-off between exactness and common usage. The term «indexicals» is commonly used in the philosophical literature for indicators, but since «deictica» would be misleading as a generic name for indicators and demonstratives alike, as this term has a strong demonstrative connotation, indexicals are taken to subsume indicators and demonstratives.[4] Notice that sometimes the adjective *indexical* is used for the property of being an indicator and sometimes it is used for the property of being an indexical expression in general. This unfortunate equivocation can hardly be avoided, because *indicative* is already in use for the indicative mood. The term *deixis* is here understood as the demonstrative use of expressions and as the use of a pointing gesture in particular, whereas indexicality is understood as the general phenomenon of egocentric or object-centric context-dependence that will be laid out below.[5] As opposed to common practice, anaphoric expressions will not be considered indexical, although they are mentioned and discussed in relation to them whenever this deems appropriate. It will be argued in section 5.4.4 that the endophoric context involved in the resolution of anaphoric expressions is conceptually different from the exophoric context of utterance according to which the referents of indexical expressions are fixed.

Here are a few English examples to illustrate the above distinctions.

Indicators

(5.1) *I* am here now.

(5.2) *You* are drunk.

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[3]Cf. (Kaplan 1989, pp. 490-1).

[4]Ancient Greek (grc) `deiknymi`: *I show, point, point out*.

[5]One may object that this makes Thesis 6 true by definition, but that's a bit picky. To content the purist, we may say that Thesis 6 holds for what is commonly called indexicals, no matter how they are characterized here. The point is just that egocentricity/centricity is a better criterion for deciding indexicals from non-indexical expressions than context-dependency alone.

(5.3) *We* are drunk.

(5.4) *Yesterday* it *has* rain*ed* and *tomorrow* it *will* rain as well.

(5.5) To the *left you^{pl}* see the Dome.

Notational convention: Syntactic or semantic features like the plural form in 5.5 are sometimes indicated by superscripts.

Demonstratives

(5.6) *This⃗* is Alice.

(5.7) *This⃗*$_1$ is different from *that⃗*, but *this⃗*$_2$ isn't.

(5.8) A: Where is the station? B: *Overthere⃗*.

Notational convention: Demonstrative uses of expressions are marked with an arrow. Different occurrences (tokens) of the same expression are marked by numeric indices.

Anaphoric Expressions

(5.9) Alice loves Bob$_i$, but *he*$_i$ loves Carol$_j$. *She*$_j$ loves *him*$_i$, too. (anaphora)

(5.10) *It*$_i$ is sad [that it rains]$_i$. (cataphora)

(5.11) Although *she*$_i$ doesn't know yet, Alice$_i$ will win the lottery. (cataphora)

Notational convention: Anaphoric expressions bear the same letter index as their antecedent or subsequent.

5.2.2   Brief Historical Overview

There are at least two traditions of research on indexical expressions that until recently have remained relatively independent of each other. Works like (Brugmann 1904, 1909, 1917), (Jespersen 1922), and (Bühler 1934) exemplify a linguistic tradition, where early publications like that of Brugmann only deal with indexicals in Indo-European languages from a diachronic perspective. Bühler (1934), one of the founders of modern cognitive linguistics, provides a systematic treatment of indexicals and argues on the basis of his organon model of language that by their appellative function they draw the attention of the recipient to the referent in relation to the deictic center *I–here–now*.[6] The corresponding concepts of egocentricity and centricity in general are relevant for truth-conditional treatments of indexicals and set indexical expressions apart from other context-dependent expressions. More recent general discussions of indexical expressions can be found in (Fillmore 1972), Lyons (1977), and Levinson (1983). In combination with data in the typological literature the linguistic line of research discusses a vast variety

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[6]See (Bühler 1965, p. 28; pp. 102-20).

of uses of indexicals and shows that languages can realize various non-obvious semantic features like spatial proximity or the social status of discourse participants in a language's inventory of indexical expressions.

A second research tradition, that for contingent historical reasons has mostly been centered on the English language, goes back to a general philosophical interest in the context-dependency of indexical expressions as in (Russell 1966), (Bar-Hillel 1954), and (Reichenbach 1947). These approaches to indexicality have as their primary goal to restrict the use of context-dependent expressions to few occasions, for example when they are used to refer directly to sense data, or to completely eliminate the need for indexicals in an ideal language that can serve as the proper foundation of all sciences. Two main problems evolve out of this tradition: (1) Is an ideal language feasible that doesn't contain any indexicals, i.e. are indexicals in principle dispensable? (2) Is there some designated mode of demonstrative or indexical reference that is guaranteed to denote? A general shift from the ideal language perspective to an empirical perspective on natural languages in the second half of 20th Century has led to a third problem introduced by Castañeda (1967) and Perry (1977, 1979): (3) Are there indexical expressions that are irreducible, i.e. that cannot be substituted with other expressions like proper names or definite descriptions salva veritate or without loosing expressive power? This problem, which Perry (1979) suggestively coined the *Problem of the Essential Indexical*, must be considered on the background of an affirmative answer to problem (2) and the then just evolving direct reference view. In the meantime, the problem how to formalize context-dependency of indexicals was tackled by using so-called double-index or two-dimensional modal logics, in which truth in a model is relativized to two indices, the context of utterance and the circumstances of evaluation, instead of just the latter. The intensional Logic of Demonstratives of Kaplan (1989) has become a de facto standard for logically analyzing indexical expressions long before its final publication. Following Kripke (1972), it was soon recognized as an offshot of the general debate about direct reference that Millian analyses of indexical expressions in two-dimensional modal logics like Kaplan's Logic of Demonstratives lead to similar or the same problems with cognitive content and attitude ascriptions as Millian analyses of proper names. Arguments for the rigidity of indexicals in Kaplan (1989) have thus intertwined the discussion of the philosophical problems concerning indexicals just mentioned with the general logical problems how to account for the cognitive role of referential expressions in the direct reference view and how to model belief. Possible solutions have been proposed, for example property-ascription theory of attitudes in (Lewis 1979), structured propositions in (von Stechow 1982), (Cresswell 1985), accounts based on diagonalization in (Stalnaker 1978), (Stalnaker 1981) (and many papers following Stalnaker more or less loosely), and alternative logical foundations like Castañeda's version of trope theory in (Castañeda 1982), (Castañeda 1989), or situation theory in (Barwise and Perry 1983)—just to mention a few. In the course of these developments, the linguistic and philosophical research traditions have come closer together and are hardly separable by now. Recent work on indexicals focuses on various issues on the borderline between semantics and the philosophy of language, for example: the (re-)discovery of context-shifting indexicals on the basis of typological data by Schlenker (2000, 2002, 2003), Perry's distinction between forms of utterance-based semantic content and cognitive aspects thereof in a continu-

ous series of papers (Perry 1996, 1997b, a, 1998, 2000, 2001, 2005), critique on token- and utterance-based approaches in (Predelli 2003, 2005), and the dynamic approach of (Stojanovic 2002, 2005) based on updating information states. A related debate, that has partly evolved from philosopher's interest in indexicals, concerns the notion of *what is said* and the question how pervasive context-dependency is in general. See for example the lively debate in (Recanati 1993, 2004, 2006) versus (Cappelen and Lepore 2005, 2006).

5.2.3 More Terminology and Exclusion of Some Phenomena

Before going into the details, some terminology has to be introduced and some pragmatic phenomena have to be excluded from this investigation, because they are beyond its scope.

Mixed Uses

There is a distinction between mixed and non-mixed uses of indicators and demonstratives. So far, only examples of non-mixed uses have been given. Consider now the following utterances.

(5.12) *That man* has stolen my purse.

(5.13) *Overthere behind the mountains* is a nuclear power plant.

(5.14) *We humans* are carbon-based.

(5.15) *You bastard* have betrayed *us good willing-people*.

(5.16) *Three hours from now* we will be in Greece.

(5.17) *Exactly now in two days* will the plane arrive.

These examples contain demonstratives and indicators in more complex phrases, and indexicals that are syntactically complex in this way will be called *compound indexicals*. In case of demonstratives the additional descriptive component further restricts the semantic referent. It is not any person pointed to that has stolen my purse, but the man pointed to. The power plant is not anywhere overthere, but behind the mountains, which implicates that the power plant is not visible from here. In case of indicators, the additional descriptive condition may either restrict the range of possible referents like in examples 5.14 and 5.15 or determine the referent in relation to the referent of the embedded indexical. The latter is the case in examples 5.16, in which the semantic referent is determined as a point in the future that lies three hours from the speech time at which the utterance has occurred, and 5.17, in which the same time of the day of the utterance is taken two days in the future. Uses of compound indicators or demonstratives of the first kind may be called *restrictive mixed uses*, whereas the latter use of indicators may be called *context-relative mixed uses*. This distinction should not be mixed up with another distinction that is sometimes made between *determinative* and *independent* demonstratives; determinatives need to be combined with a noun and independent demonstratives can or need to stand alone as a noun phrase for syntactical reasons. For example Japanese (jpn) «kono», «sono», «ano» require a subsequent noun, whereas «kore», «sore», «are» are noun phrases on their own. Furthermore,

the term *complex indexicals* will be reserved for indexicals whose meaning is in a given analysis composed out of several meanings usually in dependence of the deictic center.

Pure Versus Impure Uses

Another important distinction is between *pure* and *impure uses* of indexical expressions.[7] It could be objected to the taxonomy in section 5.2.1 that it doesn't seem to be clearcut. Consider for example the following utterances.

(5.18) You, you, but not you, are dismissed. (Levinson 1983, p. 66)

(5.19) *Looking at the mess in the staff canteen*: This is a shame!

(5.20) Alice waits here, while we go there.

(5.21) Don't do it now, but NOW! (Levinson 1983, p. 66)

In example 5.18, the indicator «you» is used with accompanying pointing gestures in order to single out different addressees. The exclamation in example 5.19 is made without using a pointing gesture. Fillmore (1997, pp. 62-3) and Levinson (1983, pp. 65-6) call these uses *gestural* and *symbolic use* respectively. Instead of following this terminology, in the following a distinction is made between demonstrative and indexical *uses* of an expression as opposed to a general classification of expressions as indicators and demonstratives according to the way they are used canonically. For example, in utterance 5.20 the indicator «here» is used to refer demonstratively to a place in the proximity of the place of utterance, although the expression itself is classified as an indicator, and the same applies to «now» in example 5.21, where the temporal sequence of uttering parts of speech and stress acts like a pointing gesture. These uses are instances of *impure uses*. Such uses do not defy the distinction between demonstratives and indicators in general, because they rely on a particular instead of an arbitrary situation of use. Consider in contrast examples of pure uses in 5.1–5.8. In pure uses of indicators no pointing gesture is required at all, although even an utterance of «I» *may* be accompanied by a pointing gesture, and, vice versa, the pure use of a demonstrative *requires* a pointing gesture. In a pure use of an indicator its referent is fully determined even if the utterance is taken out if its particular context and just considered in an arbitrary, generic context, whereas in an impure use of an indicator its referent can either not be fully determined relative to an arbitrary, generic context, or it has to be interpreted canonically, i.e. as a pure use, in such a context. Correspondingly, a competent speaker by default has to presume that the use of a demonstrative is accompanied by a pointing gesture (in a broad sense of «gesture»), whereas the impure use can only be interpreted by exploiting features of the particular, concrete context of utterance. Consider a single utterance of an indexical and a demonstrative respectively, as in the following examples of pure uses.

(5.2) You are drunk.

(5.6) This is Alice.

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[7]Cf. (Perry 1997a, pp. 395-6), (Lyons 2002, p. 307).

Without knowing anything about the context of utterance, a competent speaker is able to tell that the indicator in 5.2 refers to one or more persons that the speaker addresses in the context of utterance. There is a *reference rule* associated with «you», according to which this indicator semantically refers to the person addressed or, if it is a plural form, to the group addressed by the speaker in the context of its utterance. In contrast to this, a competent speaker will not be able to tell what the speaker refers to when using «this→» in example 5.6 without knowing more about the context of utterance and the accompanying pointing gesture in particular.

Derived Uses

Apart from impure uses, there is a number of other phenomena that seem to defy a simple and straightforward analysis of indexical expressions. First of all, there are phenomena of speaking on behalf of someone and speaking in a narrative context. A use of «I» in example 5.22 only refers to the actress herself in an indirect way; it rather refers to Celia, a fictional person that comes to a living during the play.[8]

(5.22) *Actress playing Celia*: I like this place and willingly could waste my time in it.
        (Shakespeare, *As You Like It*, Act II, Scene IV)

Of course, in many narrative contexts, indicators like «I» or «you» don't refer to the speaker or addressee taken as bare objects, but rather to the persons of the narrated story. Likewise, if General Jackson utters 5.23, his use of «I» might not refer to himself but to the troops he commands.

(5.23) *General Jackson pointing on the map*: I am right here→. (Smith 1989)

The use of «here» in this example is impure and draws from conventions about map reading that form a semiotic system on their own, and the use of «I» in this example is derived. Like in the impure uses mentioned before, the fact that these examples are derived can easily be seen by taking the utterances out of their context. A speaker that interprets them without knowing the details of their context of utterance can only assume a canonical interpretation, according to which «I» in both 5.22 and 5.23 refers to the speaker of the utterance. Related to special narrative contexts or shifts of conventions is what Lyons (1977) calls *deictic projection*. He discusses the following example and variations thereof:

(5.24) We are coming there next week. (Lyons 1977, p. 579)

As Lyons notes, although «there» is interpreted in contrast to the spatial location of the speaker, i.e. the *here* of the original deictic center, the deictic center of the addressee is assumed in the use of «coming».

Other uses are metaphoric, figurative, or, as Bühler puts it, involve *Deixis am Phantasma*.[9] These uses can be subsumed under the label *discourse deixis*, i.e. cases in which an expression

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[8]And «this place» does of course not denote the theater, but a fictional place.
[9]See (Bühler 1965, pp. 121-40).

refers to a state of affairs talked about earlier or has a larger discourse fragment as antecedent—as opposed to anaphora, whose antecedent is a single sentence-level constituent. For example, spatial indicators like «here» or demonstratives like «there⃗» can be used discourse-deictically to indicate points in narrative space, as in 5.25 and 5.26.

(5.25) Here we have an interesting argument.

(5.26) There we have a conclusion that doesn't hold.

(5.27) This is a good point.

Another derived use is a metonymy (in a broad sense) and has been discussed as *deferred ostension* by Quine (1971).[10] Here is an example of such a use:

(5.28) *Waitress pointing to a ham sandwich*: He⃗'s sitting at table 20. (Miller 1982, p. 68)[11]

On the basis of world-knowledge and complex conventions about serving food in restaurants, the actual referent of the demonstrative in this case is determined by pointing to an object that stands for the actual referent.

Excluded Phenomena

In the following sections mixed uses will be taken into account, but only insofar as it deems appropriate. Impure and derived uses will in the following mostly be ignored, but in chapter 7 some way to deal with them to some extent will be implemented. Mostly ignoring these phenomena isn't meant to indicate that they are not important. In the contrary, narrative use of expressions, speaking on behalf of someone, figurative speech, and other pragmatically derived uses occur frequently in daily written or spoken texts. They are merely excluded, because they require an additional analysis *on top of the existing analysis of canonical uses*. The reference of derived cases crucially depends on factors like the given conversational context, the topic of the conversation, the discourse type, and so on. For example, in cases of narrative talk or speaking on behalf of someone, the narrative context as in 5.22 could be introduced by embedding all utterances into a modality that encodes the narrative context based on a reading like *being compatible with the story told in Shakespeare's 'As You Like It'*, but relative to this freshly created intensional context indexical expressions would work like in non-derived cases. Likewise, the discourse-deictic and metonymic uses discussed in the last section depend on the broader conversational context. In any such cases, no general linguistic rule can be given that would fix the reference independently of the broader context that is introduced by the whole background story, be it explicitly written down or presumed by the recipients of the text. There are two different contexts at play that will be addressed in more detail in section 5.4.4. In non-derived, canonical uses of indexical expressions it is possible to give the reference rule of an indicator qua type without taking any

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[10]Cf. (Nunberg 1977, 1993, 2004), (Miller 1982).

[11]According to Miller, the example is originally from (Nunberg 1977). Unfortunately, Nunberg's doctoral thesis was not available for the present study.

particular context of utterance into account, and the canonical use of a demonstrative has a de-
termined referent only with respect to some pointing gesture. These uses are the guideline for
finding out how indexicals work.

5.3   Dimensions of Indexicality

Indicators and demonstratives refer to objects in various dimensions. The basic dimensions are
person, space, and time, and the origin (0-point) of these dimensions is the deictic center *I–here–
now* (Bühler 1934). Other dimensions have been suggested in addition, for example the modal
dimension, the discourse or textual dimension, and social status. In the following sections, an
overview of lexicalized indexicals in these dimensions in particular languages will be given. This
overview is not systematic and the examples are chosen arbitrarily; its purpose is to show the
variety of uses of indexicals and their meanings in natural languages. The main lesson to be
drawn from this overview is that indexicals generally have a rich descriptive meaning.

5.3.1   The Person Dimension

One of the basic dimensions of indexicality is the discourse participants in the broad sense that
is grammaticalized in the person category. In English and other Indo-European languages this
category is distinguished into first, second, and third person. Taken in a broad sense, this dimen-
sion also includes distinctions by numerus and features like being more or less animate. As Lyons
(1977, p. 638-9) emphasizes, the third person is with many respects different from the first and
second person and defined negatively as neither speaker nor addressee. It may be further dis-
tinguished into 3rd person for discourse participants and a 4th person for mere bystanders, for
example in Samal.[12] Since there can be many objects and persons that are merely talked about
but are not discourse participants and might not be present, third person pronouns cannot be
used as pure indicators, but have to be used demonstratively or anaphorically. The examples of
the following paragraphs will give a cursory overview of indexicality in the person domain.

In English, the indicator «I» refers to the speaker of the utterance, «you» to the addressee,
«you[pl]» to the the addressees, i.e. a group of people not including the speaker. Notice that
there is also a generic use of «you», for example in «You always ought to pay your debts» the
second person pronoun can be interpreted generically. Generic uses of pronouns like «you» or
«one» are neither indexical nor referential. The personal pronouns «he», «she», «it» can be used
anaphorically or demonstratively. «We» comes in two readings that in languages like Malay,
Tagalog, and Dieri are lexicalized separately.[13] Inclusive «we» denotes a group consisting of the
speaker and the persons addressed by the speaker. Exclusive «we» denotes the speaker and his

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[12]According to (Fillmore 1997, pp. 65-6). Samal (sml) is a Malayo-Polynesian language spoken by roughly 90,000
speakers on the Philippines (Gordon 2005).

[13]Malay (mly) and Tagalog (tgl) are Malayo-Polynesian languages, the former spoken in Malaysia with a population of
roughly 7 million speakers, the latter spoken on "Manila, most of Luzon, and Mindoro" with a large population of about
14 million speakers, Dieri (Diyari; dif) is a now extinct Australian language (Gordon 2005).

group, but not any addressees. Which reading is salient in an English utterance depends on the conversational context, as exemplified by utterances 5.29 and 5.30.

(5.29) *Situation: A company CEO negotiating the pricing of products needed for production, talking to representatives of the delivering company.*
We cannot afford your offer. (exclusive reading)

(5.30) *Alice to Bob*: We have to wait for Carol. (inclusive reading salient)

There is also a common use of «we» that excludes the speaker, for example when a teacher speaks to his scholars in an old-fashioned, authoritarian manner like in 5.31.

(5.31) If we don't do our homework assignments, we will likely fail the examination. (derived speaker-exclusive use)

In such examples only the particular conversational context makes it clear, on the basis of world knowledge about teacher-pupil relations, that the teacher himself isn't intending to do any homework assignments. So this is a derived use. Finally, like in the singular case, English plural pronouns like «they» can only be used anaphorically or demonstratively.

Notice that in English the singular third person pronouns are marked for grammatical gender. This provides additional selectional restrictions that can be used for anaphora resolution, i.e. finding the antecedent or subsequent of anaphoric expressions, and for additional identification criteria in their demonstrative use, but in the latter case only if the referent has natural gender, since otherwise the grammatical gender is idiosyncratic.[14]

The deictic center of indexical expressions in the person dimension generally is the speaker who makes the utterance, but Schlenker (2000, 2002, 2003) presents some data on the basis of which he argues that there are languages in which indexicals can be evaluated with respect to the context of a reported speech act when they occur within the complement of a verb of indirect speech. The following examples of Amharic utterances are taken from (Schlenker 2003), where in the first one the 1st person pronoun and in the second one the 2nd person pronoun is shifted.[15]

(5.32) ǰon   ǰəgna   nə-ññ   yɨl-all
        John   hero   be.PF-1SO   3M.*say*-AUX.3M
        'John says that he is a hero.'
        (Schlenker 2003, p. 68)

(5.33) mɨn   amt'-a   ɨnd-al-ə-ññ   al-səmma-hu-mm
        what   bring.IMPER-2M   COMP-*say*.PF-3M-1SO   NEG-*hear*.PF-1S-NEG
        'I didn't hear what he told me to bring.'
        (lit. I didn't hear that he said to me bring what.)
        (Schlenker 2003, p. 68)

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[14]This means that grammatical gender in languages like English or German is not a semantic, but really a grammatical feature, as the name implies. Like in the case of proper names, grammatical features may sometimes be used heuristically for identification purposes, although they don't stand for properties of the referents in all cases.

[15]Amharic (amh) is an Afro-Asiatic language spoken mainly in Ethiopia by a total population of roughly 17.5 million speakers (Gordon 2005).

Schlenker takes 5.33 as evidence that no quoting is involved: "If the embedded clause had been quoted, the original discourse should have been of the form: 'bring what!'. But as the translation shows, this is not the correct reading (in fact, such a direct discourse would presumably be meaningless.)" (Schlenker 2003, p. 69) Outside the scope of verbs of saying, the Amharic first person yields the speaker of the current context of utterance, but in the scope of such verbs it yields the speaker of the context of the reported speech act. Such indexicals will from now on be called *context-shifting indexicals* or short *shifters*. They have been present in the typological literature for some time, but the changes they require to logical analysis have first been pointed out by (Schlenker 2000, 2003) and will be addressed in the next two chapters.

5.3.2 The Spatial Dimension

Another basic dimension of indexicals is space. This is here understood as the 3-dimensional space in which canonical utterances in face-to-face communication take place. The sentence adverb «here» denotes the place of utterance, which depending on the conversational context can range from the very place the speaker occupies to the whole universe, as the following examples show.

(5.34) *Alice standing in the water*: Here I can stand. (narrow interpretation)

(5.35) Here the laws of nature hold, but in the divine realm they are of no significance. (broad interpretation)

«Here» can also be vague in the sense that there is not always a clear guideline from the context of utterance that would allow one to determine the boundaries of the place of utterance. Here is a typical example of such a case.

(5.36) It's nice weather here.

Special or artificial features of the place of utterance can give grounds to a salient interpretation according to which the boundaries are clear, but narrow or broader interpretations are still possible. Consider the following example.

(5.37) *Sitting in the office in winter*: It's cold here.

The office or the institute or the city or country of the institute might provide more or less clear boundaries to the interpretation of ‹here› in this example, although it is still a matter of the conversational context which of these interpretations is most salient. Opposed to «here» is the demonstrative «there», which in the same context of utterance denotes a place that is in the distance of the place denoted by «here». The English demonstratives «this» and «that» are also opposed to each other, though less strictly. The demonstrative «this» denotes an object in the proximity of the speaker, «that» denotes an object in the proximity of the addressee, and «yonder» is used for a distant object that is neither in the proximity of the speaker or the addressee. This is similar to the 3-way system of spatial demonstratives in Japanese: «kore» (*this* in proximity of speaker), «sore» (*that* in proximity of addressee), «are» (*that* neither in proximity of speaker nor

Eipo	Gloss	Eipo	Gloss
a-	*here*	da-	*here (wider area around speaker and addressee, here and there)*
ei-	*up there*	dei-	*very far up there*
ou-	*down there*	dou-	*very far down there*
or-	*across there*	dor-	*very far across there*

Table 5.1: Eipo spatial demonstrative prefixes according to (Heeschen 1982, pp. 84-88).

addressee), and their adjective variants «kono͢», «sono͢», «ano͢». In other languages, more fine grained spatial distinctions are made, for example Eipo has a cross-categorial prefix system plus additional prefix modifier «d-» as illustrated in table 5.1.[16] In some languages spatial restrictions of demonstratives can be readily combined with other restrictions. For example, Mosel (1982) summarizes Tolai spatial demonstratives as follows:[17]

> "The Tolai local deictics are not only distinctive for the contrast 'here' and 'there', but can also be marked for:
>
> 1. the level at which the indicated place is located relative to the speaker's position, for instance, whether it is located upwards or downwards;
>
> 2. whether the indicated place is:
>   (a) a place at which an action takes place (e.g. 'they danced there'),
>   (b) a place where something or somebody is found (e.g. 'he is there'),
>   (c) the goal of an action (e.g. 'he came from there'),
>   (d) the source of an action (e.g. 'he came from there');
>
> 3. whether or not the place pointed at is known to the hearer." (Mosel 1982, p. 111)

Here is a Tolai demonstrative with its glossing:

(5.38) *a   -ba   -r   -a*
      LOC -known-to-the-hearer -there -down
      'down there at a place near you, or that you know' (Mosel 1982, p. 127)

Such examples show that there is a reference rule associated with spatial indicators and demonstratives that restricts the location of the object referred to or the place of the situation (state of affair) expressed by the utterance at sentence-level. In the examples discussed so far,

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[16]Eipo (eip) is a Papuan (Trans-New Guinean) language with a population of only 3,000 speakers as of 1987 (Gordon 2005).

[17]According to SIL, the correct name of the language (ksd) is Kuanua, whereas "'Tolai' is the name of the people." (Gordon 2005, entry for ksd). It is a Malayo-Polynesian language of Papua New Guinea with about 61,000 speakers as of 1991 (Gordon 2005).

this restriction is relative to the place of the speaker who utters the respective sentence, i.e. the expressions discussed so far are *egocentric*. In the spatial domain, there are, however, also *object-centric* indicators or readings thereof and different interpretations of such indicators can lead to ambiguities. This is the case with many compound indicators that specify relations between objects in one of the three primordial spatial axes up/down, front/back, left/right (in order of general importance for humans).[18] Take for example the the following utterances.

(5.39) *Talking about a car*: The right front tire is flat. (object-centric reading)

(5.40) Raise your left arm! (object-centric or egocentric reading)

(5.41) What's that shiny object over there, just to the left of the cypress tree? (Fillmore 1997, p. 28) (egocentric reading)

(5.42) Alice: The cat is behind the tree. (egocentric reading)

In 5.39 the right tire isn't the tire that is located to the right of the speaker, but the tire located to the right of the left/right axis of the car that origins from a metaphor between the car's appearance and the appearance of the human body and the human face in particular.[19] Some authors like Fillmore (1997) classify these uses as non-deictic. In the present terminology they are not considered indexical in the strict sense either, but still discussed and categorized under this label taken in a broader sense. This is admittedly fuzzy terminology; it is however justified, given that their deictic center is an object but they otherwise work analogously to egocentric expressions. There are many relational expressions that are object-centric in that sense: «at», «in», «on», «below», «over», «under», «beneath», «end», «edge», «corner», «top», «bottom», «upper», «lower», «front», etc.[20] Example 5.40, on the other hand, is ambiguous between an egocentric reading according to which the arm of the addressee that is left to the speaker is the referent of ‹your left arm›, and the preferred object-centric reading, according to which the left arm is picked out from the addressee's own perspective. When an object has no intrinsic axis, for example a ball, the potentially object-centric indicator-expressions «up» and «down», «left» and «right», or «front» and «back» may still be usable, but are then interpreted according to the *observer axis*, i.e. the direction into which both speaker and addressees look.[21] This is the case in example 5.41 and 5.42.[22] These readings are egocentric, but if speaker and addressee don't look into the same direction or are located far apart from each other and the referents in question have no intrinsic axis, then the use of certain indexical expressions like «in front of» can become unacceptable or they may be too ambiguous for successful communication. If in turn there is an observer axis, then there are several possible interpretation strategies; for example, the objects may be regarded as facing at the observers, or the objects may be regarded as being aligned with the direction the observers look, i.e. facing away from the observers. Hill

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[18]See (Fillmore 1997, pp. 32ff.). Cf. (Lakoff and Johnson 1980) on the importance and ranking of the body axes and the pervasiveness of spatial metaphors in everyday speech.

[19]See (Fillmore 1997, p. 35-6).

[20]Cf. Fillmore (1997, pp. 27–44).

[21]See (Hill 1982, p. 16).

[22]Cf. (Fillmore 1997, p. 66ff.).

(1982) shows by comparing Hausa with English indexical expressions that the order in which speakers prefer aligned to facing reading isn't universal.[23] It must finally be remarked that spatial indexicality is also realized by case systems of various languages that are otherwise not related to each other, for example in Hopi and Finnish.[24]

What do these more or less arbitrarily-chosen examples indicate? First, the spatial domain is, by virtue of its topology, more complex than other domains. A certain degree of vagueness is always present in the meaning of spatial indicators, and many relational indicators are ambiguous between object-centric and egocentric readings and facing versus aligned perspective. Second, semantic oppositions like the one between «here» and «there» must be interpreted with respect to a context of utterance and the broader, conversational context. For example, the place denoted by «there» is always in a certain distance from the place denoted by «here», but the actual distance between the two places depends on the size of the place denoted by «here», and this size can vary to a high degree. Third, spatial indicators and demonstratives have a reference rule that depends on the respective deictic center, i.e. either the location of the speaker or of another object. This reference rule can involve various spatial and non-spatial restrictions. Fourth, indexical expressions can be realized in various different ways and different languages grammaticalize and lexicalize different spatial distinctions to a varying degree. Proximity to speaker, addressee, or being distal to both are features common to many languages, though, and any semantic distinction that isn't lexicalized in a language can of course still be expressed by forming a compound indexical.

5.3.3 The Temporal Dimension

The third of the basic dimensions is time and the time axis is here to be understood as a linear axis ordered by an earlier/later than relation.[25] Time plays a crucial role in everyday activities and conversations and most languages offer a broad range of temporal indicators, but there are no non-derived, non-figurative temporal demonstratives for the obvious reason that time is abstract and cannot be observed directly. Time is measured based on conventionalized and culture-dependent scales that are usually based on external factors like day/nighttime shift, moon-phases, seasons, and partitionings of these into units that arise out of practical or religious needs. *Unit indicators* operate on these units relative to the time of utterance, for example «yesterday» and «tomorrow».[26] Conversely, *non-unit indicators* such as «soon» or «then» don't specify an interval in a measurable time unit. Tenses are determinative non-unit indicators, insofar as they specify temporal relations between events in relation to the time of utterance.

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[23]Hausa (hau) is an African language spoken in Nigeria and other countries by roughly 24 million speakers (Gordon 2005).

[24]See on Hopi (hop) (Malotki 1982, pp. 226-32), on Finnish (fin) (Fillmore 1997, p. 30). Hopi is a well-known Uto-Aztecan language of native North Americans with around 5,000 speakers but only 40 monolinguals as of 1990, Finnish (Suomi) is a Finno-Ugric language spoken primarily in Finland by around 5 million people (Gordon 2005).

[25]See (Fillmore 1997, p. 47). Many of the following distinctions are also based (Fillmore 1997, pp. 45–57).

[26]See (Fillmore 1997, p. 48).

The deictic center in the temporal domain is denoted by the non-unit indicator «now», and like in the spatial dimension the extension of this expression can vary from one conversational context to another, as the following examples show.

(5.43) Alice: What time is it? Bob: It is now 12 o'clock. (narrow reading)

(5.44) Salaries are higher now than 30 years ago. (broad reading)

In the first example, «now» refers to a vague time interval stretching around the exact time of utterance, but whose actual length depends on possibly extralinguistic factors such as the purpose for which Alice wants to know what time it is. The interval denoted by ‹now› in 5.44 must be taken much larger than that denoted in 5.43, because average salaries aren't measured every few seconds and change only in discrete units of weeks or months.[27] It is often possible to specify the range of a reading by using compound indicators, for example German «jetzt gerade», «jetzt eben», «gerade eben» have narrow reading denoting time intervals that start just before the utterance, whereas «jetzt sofort», and «jetzt gleich» have narrow reading denoting intervals that start during or just after the time of utterance.[28]

Common English unit indicators are for example «today», «tomorrow», «yesterday», «week», «year», «decade», or «century». Unit indicators are not very vague in the modern unit systems that are widely in use nowadays and defined by experts. However, there is a certain ambiguity caused by lazy versus pedantic reading of unit indicators. For example, four minutes past midnight a speaker might use «today» in communication to refer to yesterday and «yesterday» to refer to the day before yesterday. Though quite natural, these readings are derived and based on ad hoc unit boundaries; speakers might need to correct themselves in such cases when someone scrutinizes further. Unit indicators can also evoke systematic ambiguities. A typical example is English expressions like «next Thursday» in 5.45.

(5.45) We'll meet next Thursday.

If this sentence is uttered on Monday the meeting is meant to take place on Thursday of the same week, whereas the salient reading of «next Thursday» refers to the Thursday of the following week when the same sentence is uttered on Wednesday. But as Fillmore (1997) remarks, the "[...] use of the words 'next' and 'last' with the positional calendric terms has speakers of English divided into an uncountable number of subdialects, and I believe the best thing is to leave this subject untouched." (Fillmore 1997, p. 73)

Another important distinction made by Fillmore is between *calendric* versus *non-calendric* uses of unit indicators.[29] The following utterances exemplify this distinction.

(5.46) Last year it has in total rained less than this year. (calendric)

(5.47) I've been in Denmark for one year. (non-calendric)

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[27]One may, from an ideal language perspective, insist on a narrow reading of «now» 5.44 and point out that 5.44 is imprecise, because data about salaries is measured in larger intervals. However, such an interpretation is very restrictive; it would favor a reading that violates pragmatic constraints like Grice's Cooperative Principle.

[28]These examples were taken from (Hundt 2004).
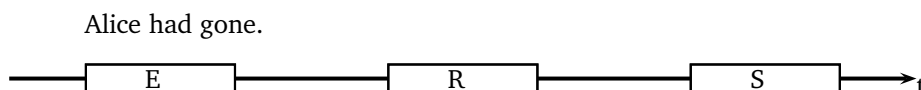
[29]See (Fillmore 1997, p. 49-50).

Alice had gone.

Figure 5.1: An analysis of tense according to Reichenbach's S-R-E scheme

In the first example, the interval denoted by «last year» is determined with respect to the conventional starting and endpoints given by the calendar, whereas the prepositional phrase «for one year» of the second example denotes the interval that stretches back a year from the context of utterance. Both uses are egocentric, the non-calendric uses in combination with tense, whereas calendric uses also depend on the origin of the respective coordinate system, i.e. the 0-point of the Gregorian, the Hebrew, the Islamic, or whatever else calendar is in use.[30] Sometimes it is unclear which underlying unit system is used and then ambiguities arise, for example when distinctions aren't made explicit between fiscal and calendric year and month, astronomic versus sidereal versus solar day, Newtonian versus relativistic time, and so on.

Tense determines the time interval at which the event talked about takes place in relation to the context of utterance, some contextually determined reference time, or some narrated chain of events. Reichenbach (1947) proposes an influential analysis of tenses, without taking aspect into account, by distinguishing three points in linear time: the point of speech (S), point of the event (E), and the point of reference (R).[31] Figure 5.1 depicts an analysis of English pluperfect according to Reichenbach's scheme. In relation to the time of utterance S, a reference time interval R is specified, and in turn the time interval E of the event talked about is determined with respect to R. Comrie (1985) extends Reichenbach's analysis on the basis of typological data from various languages. Table 5.2 lists some common tenses according to Comrie. Deviating from Comrie (1985), conjunctive and disjunctive formulations like $(E < R) \wedge (S < R)$ and $(E = S) \vee (E > S)$ are used in this list, where Comrie would write "E *before* R *after* S" and "E *not-before* S" respectively.[32] He also discusses cases in which more than one reference time R is needed, the presuppositions of some tenses in some languages, and a vast range of typological data that cannot be addressed here. Important for the present purpose is the fact that according to his analysis some tenses determine the event time in relation to the context of utterance, whereas *relative tenses* specify the event time in relation to the reference time R that is provided by the conversational context and may but doesn't have to be linked directly to the time of utterance. Ultimately, even relative tenses have to be anchored either in the time of utterance, for example when R is determined in relation to E of a main clause, or in the narrative time

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[30] Cf. (Fillmore 1997, pp. 52-3).

[31] See (Reichenbach 1966, p. 288).

[32] He chooses his notation because it provides "...unified representation for this grammatical category" (Comrie 1985, p. 127) and "...a disjunctive definition effectively denies the unity of representation of a single grammatical category..." (Comrie 1985, p. 124). It is not clear what exactly Comrie means by that, though, as the respective conjunctive and disjunctive notations express exactly the same constraints, but are less ambiguous.

Tense	Analysis
present	$E = S$
past	$E < S$
future	$E > S$
relative present	$E = R$
relative past	$E < R$
relative future	$E > R$
pluperfect	$(E < R) \wedge (R < S)$
future perfect	$(E < R) \wedge (R > S)$
future in the future	$(E > R) \wedge (R > S)$
future in the past	$(E > R) \wedge (R < S)$

Table 5.2: Some tenses after (Comrie 1985, Ch. 6), where $=$ expresses simultaneity, $<$ temporal precedence and $>$ its converse.

introduced by previous discourse. So both kinds of tenses are indexical, but relative tenses may be considered object-centric. Lyons (1977) notes that from a cognitive or conceptual point of view the future is different from the past: "Futurity is never a purely temporal concept; it necessarily includes an element of prediction or some related modal notion..." (Lyons 1977, p. 677) From a truth-conditional perspective, a modal component can however be separated from purely temporal aspects of verb meaning, because tense analyses like that of Comrie (1985) can be combined with an analysis of mood even if the two components cannot be distinguished clearly from each other by morphosyntactic criteria.[33]

According to Schlenker (2003) and von Stechow (2003) there are context-shifters in the temporal domain. Schlenker gives the following English example.

(5.48)   a. John has told me repeatedly over the years that he was sick two days ago.

         b. # John has told me repeatedly over the years that he was sick the day before
            yesterday. (Schlenker 2003, p. 64)

In this example, «two days ago» is ambiguous between a non-shifting reading according to which John was sick two days ago from the calender day of utterance every year, for example every year two days before Christmas Eve, and a shifting reading according to which he was sick every year two days before the day at which he uttered «I was sick two days ago». Other examples of shifting temporal indexicals can for example be found in French «il y a deux jours» and «dans deux jours», the Russian present tense, and Dimli.[34] Moreover, it is possible to combine the

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[33]Lyons (1977, 1982) holds the opposite opinion, but, apart from favoring Priorean tense logic, he merely seems to suggest in (Lyons 1977, pp. 809–823) that a Reichenbach-style tense analysis may sometimes have to be mixed with an analysis of mood. This can be agreed upon, but still the two phenomena can be considered separately, especially in their formal analysis.

[34]See (Schlenker 2003), (von Stechow 2003), and (Anand and Nevins 2003, 2004). Dimli (diq) is also called Zazaki, an Indo-Iranian language of Turkey spoken by around 1.5–2.5 million people (Gordon 2005).

analogue of «now» with a past tense in some languages, for example «jetzt» in German can be read as an object-centric expression in 5.49 and 5.52 below. Even though English «now» can be used with the past tense if it is used in some narrative context, i.e. when a past story is being told, it doesn't seem to have a reading as a shifter in 5.53.[35]

(5.49) Alice war jetzt wütend.

(5.50) Alice was angry now.

(5.51) Alice was angry then.

(5.52) Alice hat Bob über die Jahre wiederholt gesagt, dass es jetzt an der Zeit sei umzuziehen.

(5.53) #? Alice has told Bob repeatedly over the years that it was now time to move.

(5.54) # Alice has told Bob repeatedly over the years that it was then time to move.

To summarize, the denotation of temporal indicators is determined with respect to the context of utterance, some narrative time that has to be introduced by other means like the use of calendric expressions, or the context of some reported speech act in indirect discourse in case of shifters. Like spatial demonstratives, temporal indicators can be vague, ambiguous, and oppositions like that between «now» and «then» have to be interpreted in a specific context on the basis of the interpretation of «now» in that context. The linear structure of time and the lack of temporal demonstratives seem to make the time dimension a bit less complicated than space. This apparent simplicity quickly vanishes, though, once the interplay with non-indexical expressions operating on the time axis, for example with temporal quantifiers like «every Christmas», or with verbal aspect is also taken into consideration. In formal analysis a good deal of simplification and idealization will be necessary to keep the whole machinery within reasonable bounds.

5.3.4   The Modal Dimension

The modal dimension is one of the less traditional and more stipulative dimensions of indexicality. The deictic center in the modal dimension is often assumed to be the actual world that is denoted by the English sentence adverb «actually» and by adverbial phrases like «in fact» or «in reality». At least in counterfactual conditionals like 5.55, «actually» indeed seems to switch evaluation to the actual world.

(5.55) If the men that have actually been to the moon never had been there, the Russians would have given up their space program.

One problem of this view is that the contrast between counterfactuality and factuality is already expressed by grammatical mood, for example in 5.55 by the present perfect indicative versus the pluperfect subjunctive. A variety of ways to express mood in natural languages and

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[35]One informant judged both 5.53 and 5.54 almost unacceptable, especially not if one tries to give them a shifter reading. The same informant considered both 5.50 and 5.51 acceptable within some context introducing the past tense. In any case, «now» and «then» are not in complementary distribution.

corresponding types of modalities have been identified, for example conditional, imperative, jussive, indicative, negative, optative, potential, or subjunctive.[36] If some of them are considered indexical, then because of their logical *analysis* according to which they specify some possible worlds or situations in relation to the actual world or factual situation in which the utterance takes place. Unlike person, space, and time, modality is not a real dimension, but rather a heterogeneous theoretical construct resulting from formal analysis. This can be seen from the fact that tenses can formally be analyzed as modal operators in tense logic, but operate on the time dimension, and from the fact that there is talk about metaphysical necessity, possibility as conceivability, physical or nomological possibility, possible worlds as epistemic alternatives, and so on, and all these different notions have been considered modalities. The modal dimension is further set apart by the fact that the deictic center of the modal domain never changes, i.e. the modal parameter of the context of utterance is always the actual world and doesn't change from context of utterance to context of utterance.[37] These differences set the modal dimension apart from person (role of discourse participants), space, and time. Given these caveats about the modal dimension, there is a reading of «actually» or «in fact» as an indexical, according to which it has to be analyzed as an actuality operator. Here are some examples in addition to 5.55:

(5.56) The alleged policeman was actually an impostor.

(5.57) All people that are actually rich could be poor.

(5.58) Alice believes that Bob loves Carol but in fact he doesn't love her.

In the first example, the intensional adjective «alleged» may be analyzed as a modal operator, such that the impostor is a policeman in all worlds that are compatible with his swindle, and, so it is asserted, the actual world is not among these worlds. The modality in question is a theoretical construct resulting from the impostor's pretending to be such and such. In the second example, the people that are rich in the actual world are poor in other possible worlds. The modality in question is a theoretical construct resulting from philosophers' musings about metaphysical possibility or about what is conceivable. In the third example, Bob loves Carol in all worlds that are compatible with Alice's belief, but the actual world isn't among them. The modality in question is a doxastic modality resulting from the use of modal logic to analyze belief ascriptions under the assumption of idealized, rational belief. There are other uses of «actually» that don't seem to have anything to do with modality in the above sense. Consider for example the following utterance.

(5.59) Alice is actually rather drunk.

The function of «actually» in this example is pragmatic, contrasting differing standards of drunkenness that are presumed and not made explicit. In section 7.3.4 of chapter 7 it will be analyzed as a sort of modal operator, but not one that operates on alethic modalities. The modal

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[36]See (Palmer 2001) for a seminal cross-linguistic overview.

[37]This is not to say that it wasn't feasible to have a logic that explicitly allows reasoning about fictional utterances. However, possibly changing both language and circumstances of evaluation at the same time is of limited use, since we usually are interested in semantically analyzing utterances of one and the same source language.

dimension is by far the most abstract and technical of the dimensions discussed so far and subject to philosophical interpretation from an ideal-language perspective.

5.3.5 Other Dimensions

Levinson (1983) discusses two further dimensions of indexicality: the discourse or text and the social status of discourse participants. Discourse deixis has already been excluded in section 5.2.3. What Levinson calls *social deixis*, on the other hand, is the dependence of the meaning of expressions on the social identity or status of discourse participants in relation to the speaker's status. A familiar example for this is the lexical choice between two different pronouns for addressing people in many Indo-European languages (except English), such as the choice between «Du» and «Sie» in German (deu) or between «tu» and «vous» in French (fra). Singular forms like «Du» and «tu» are informal and the originally plural pronouns «Sie» and «vous» are formal, where the actual politeness level expressed respectively depends on the social context. Levinson (1983) takes social deixis as a dimension of its own and not part of the person dimension, because many languages such as Japanese, Korean, or Javanese have sophisticated built-in levels of politeness and formality that are grammaticalized or realized by lexical choice.[38] For example traditional Japanese distinguishes pronouns "[. . .] also with respect to sex of speaker, social status of referent and degree of intimacy with referent [. . .] and village Tamil has up to six singular second person pronouns according to the degree of relative rank between speaker and addressee (Brown & Levinson, 1978: 206)." (Levinson 1983, pp. 69-70) As Levinson points out, there are honorifics that (a) express respect for a speaker or referent (referent honorifics), (b) honorifics whose choice depends on the social situation as a whole (formality levels), (c) honorifics for bystanders, and (d) honorifics like the Japanese «-go» and «o-» that honor the addressee but occur in expressions that refer to something else.[39] This indicates that social status is indeed a dimension on its own. The deictic center in this case is the social status of the speaker in the given social context of the utterance. However, social deixis doesn't concern the truth-conditions of what is said literally and can therefore be excluded from truth-conditional analysis.

5.4 Indexical Reference

After the general overview of the last section, it is now time to investigate the referential properties of indexical expressions.

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[38] Japanese (jpn) has a population of over 122 million speakers as of 1985, Korean (kor) a language isolate (or Altaic language; the family classification is controversial) mainly spoken in both parts of Korea by around 67 million speakers, and Javanese (jav) is a Malayo-Polynesian language mainly spoken in Indonesia in many varieties with a total population of around 75 million speakers (Gordon 2005).

[39] See (Levinson 1983, p. 90). It is perhaps more accurate to say that by honoring an object using «o-» or «-go» you express your respect towards its owner, thereby being polite.

5.4.1 Token-Reflexivity

One feature of indexicals is their token-reflexivity, which sets them apart from proper names or descriptions and has sometimes been taken as their main characteristic.[40] Token-reflexive expressions are expressions whose semantic referent is determined by features of their physical realization. This individual physical realization is called *token* and the same expression taken as an abstract symbol is called *type*.[41] For example, 5.60 taken as a sentence, as a linguistic symbol as opposed to an individual physical imprint on the paper with such-and-such shape, it is an abstract linguistic object. This type can be realized in various ways: spoken by a person, written on paper, sprayed as a graffiti on the wall, stored in electronic form. Each of these individual realizations of the sentence is a token.

(5.60) I'm here.

No type comes without a token and no token comes without a type in some given language, and so the question how to define one by the other or vice versa is similar to the question what came first: the chicken or the egg. The type-token distinction poses some semiotic riddles, but these don't have to be solved in order to make use of the distinction. The ability to recognize a linguistic token as belonging to its type is a precondition for being able to use and understand representational symbolic systems like natural languages. There is also no fundamental problems in mentioning linguistic expressions as types one time and as tokens another time. For example, in 5.61 the definite description «in sentence 5.60 on page 126» refers to 5.60 as a token (or to the collection of all tokens at the place 5.60, page 126, in all prints of this text) and that the use of «sentence» in this context is a bit sloppy, because talking of an utterance or token would be more accurate. Likewise, it is sufficiently clear that in 5.62 sentence 5.60 is taken as a type.

(5.61) In sentence 5.60 on page 126, the last letter of the last word is printed in another font.

(5.62) Sentence 5.60 only has a fixed truth-value when it is uttered.

These examples make it clear that the ability to distinguish between type and token can be presumed and isn't problematic per se. Still some notational subtleties must be paid attention to. When mentioning tokens in examples there can be several levels of abstraction involved. Sometimes written examples like 5.60 stand for concrete spoken utterances in some imaginary canonical situation of utterance. Single-quoted expressions for mentioning tokens, for example ‹here›, can thus be proper names for partial tokens of either the example sentence itself qua token, for example for a part of 5.60 taken as a token, or proper names for partial tokens of the sentence *as if actually uttered* in the imaginary utterance situation described. What is meant should be clear from the context and example numbers given, and in case of mentioning several tokens of the same type indices are used with the token-quote operator to resolve ambiguities. For example, ‹this›$_2$ refers to the second occurrence of «this» in an imaginary utterance made by Alice and characterized by 5.63.

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[40]See for example (Reichenbach 1947) and (Bar-Hillel 1954).

[41]The expression «expression» itself is used for both types and tokens. The use of «type» here is equivocal with other non-related uses such as types in categorial grammar or type in the sense of *sort*.

(5.63) *Alice*: This$_1$ is different from this$_2$.

It is crucial in such examples that even imaginary utterances have to be considered as possible actual utterances, i.e. as if they were actually uttered, and not as utterances made under arbitrary counterfactual circumstances. The latter could be utterances made in a completely different language that is accidentally homophonic to the actual source language under consideration, but we are interested in the meaning of the actual source language only. Imaginary utterances in examples have to be taken as being uttered in a context whose world is the actual world, since otherwise the use of examples would be vain. It is easy to conceive situations in which «Alice» denotes «Bob» instead of Alice, «Bob» denotes a round square, «blue» means *red*, or even «and» is interpreted as disjunction and «or» as conjunction, but these are not situations illuminating the meaning of English expressions. Implicit changing of language can sometimes be admissible to express a form of subjective meaning, for example in the use of diagonalization in the next chapter, in the specification of de dicto content of indexicals of chapter 8, and to some extent also when derived uses in narrative contexts are to be analyzed, but it is not admissible for the purpose of characterizing canonical, public language meaning.

Consider now *reference rules* for indicators like the following one.

(5.64) A token of «I» denotes the speaker who has uttered the token.

This reference rules determines the semantic referent of each token of «I» in each context of utterance. Hence, the indicator is token-reflexive. An example illustrates such an explicitly token-reflexive analysis.

(5.65) *Alice*: I am hungry.

Let the name of the token that Alice utters be u. Then 5.64 can be instantiated as follows.

(5.66) Token ‹I› in u denotes the speaker of u.

Since the speaker of u is Alice, the token ‹I› uttered by Alice denotes Alice. Notice that 5.66 contains no indexical expression (apart from present tense), as ‹I› is a token-quote that must be understood as a proper name for the token of «I» that is part of u. Following Reichenbach (1947) and Burks (1949), Perry has emphasized the importance of token-reflexive reference rules and the corresponding reflexive truth-conditions in publications like (Perry 2001, 2005).

5.4.2 Utterance-based Reference Rules

One problem with an explicitly token-reflexive analysis like 5.64 is that tokens are persistent and reusable in some communicative medias.[42] For example, a written note on an office door saying 5.67 can be used by person a to convey the information that a is not at his office p at time t, but may of course be reused by b to convey the information that b is not at her office p' at time t'.

(5.67) *Sign*: I'm not here now.

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[42] Sidelle (1991) calls this the *Answering Machine Paradox*.

Predelli (1998) takes examples like this as a reason to decide context of utterance from the context of interpretation intended by the speaker. Another solution is to understand utterances in the sense that each use of the persistent token 5.67 is an utterance of its own. In this view, an utterance is the use of a token for communicative purposes.[43] Informal reference rules can then be given as follows.

(5.68) An utterance of «I» denotes the speaker of the utterance.

(5.69) An utterance of «now» denotes a time interval during which the utterance has been made.

(5.70) An utterance of «here» denotes a place in the proximity of the speaker of the utterance.

Similar formulations of reference rules can be found in nearly all the literature on indicators.[44] There is a few clarifications in place about utterance-based reference rules.

[1] The above rules are implicitly token-reflexive, insofar as an utterance involves the use of a token, but each person's reuse of a token for communicative purposes is counted as a separate utterance. The interpretation of each of these reference rules depends on conventions that may vary with the media in which the token is realized. Some examples illustrate this. «I» on a sign pinned to the office door usually will refer to the inhabitant of the office regardless of who has put the sign on the door, since 5.67 would be false if I'm at my office if a now absent colleague had put the sign on my office door three hours ago. If it is, on the other hand, a message by someone else for the inhabitant of the office, the usual convention is to sign it, but this may vary from office to office community; for example, by convention blue signs could used by people from the office and yellow sticky notes for messages by other people to the inhabitants of the office. Similar to signs on doors, «I» in a message on an answering machine will usually refer to the inhabitant of the apartment where the machine is located even if the message is taken from a recording of answering machine messages spoken by other persons. «I» as an electronic sign on the computer can refer to the original speaker as in email, audio, movie messages, to the sloppy programmer as in «I'm sorry about this bug, but your computer has just crashed», to the individual implementation of a program, to the machine, etc. Thus, the speaker of the utterance in a reference rule like 5.68 is not just the producer of the token, but the person or object that by convention uses the token for communication. The same applies to other egocentric reference rules. Sometimes the conventions governing the use of persistent tokens can allow for conflicting interpretations. As Perry (2005) points out in reply to Predelli (1998), when persistent tokens are used on answering machines, postcards, or notes, the time and place of utterance is sometimes interpreted as the time and place of token-perception instead of token-production.[45]

[2] If indexicality is just taken as context-dependence, then one might argue that reference rules like 5.68–5.70 themselves are indexical. This is not a problem, though. Reference rules are ex-

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[43] Cf. (Perry 1997a, pp. 592-3), (Perry 2005, p. 317-8).

[44] See for example (Kaplan 1989) and (Perry 1977, 1979, 1997a).

[45] See (Perry 2005, p. 328-33).

plications of the linguistic meaning of indicators as far as their truth-conditional content is concerned, i.e. in the case of singular indicators their semantic referent. Whether anything that can be said with indexicals can also be said by means of context-independent expressions is a fundamental epistemic question that has nothing to do with reference rules. All the context-dependent reference rule of an egocentric indicator does is to spell out the indicator's egocentricity and its dependence on the context of utterance by exploiting objective properties of the respective token used: its speaker, i.e. the person using it for communicative purposes, and its temporal and spatial location. An *instantiated* reference rule is neither egocentric nor itself token-reflexive. For example, as already noted, 5.66 doesn't contain any indexicals or token-reflexive expressions. The same applies to an implicitly token-reflexive analysis, which only replaces the notion of a token by the notion of an utterance of a token. From a realist point of view the semantic referent of an indexical is fully determined by its instantiated reference rule in a given context of utterance independently of any speaker's attempt to identify its semantic referent.

[3] The rule for «I» is usually not vague, because the speaker of an utterance is determined by linguistic conventions in a sufficiently clear way. The rules for «now» and «here», on the other hand, only use descriptions, but not definite descriptions in order to account for the fact that their semantic referents are systematically vague. It doesn't really make sense to presume exactly one place or exactly one time interval as the respective referent of an utterance of «here» and «now», although this can be stipulated for technical reasons. Formally, indicators may be analyzed in various ways, for example as descriptions, as operators, or as open variables. However, when an informal rule is given the use of a definite description would be misleading, since there may be infinitely many time intervals and places that differ only slightly from each other. This is not to say that a formal definite description can't be used as a technical tool, but then vagueness has either been excluded in the first place or has been incorporated into the notion of places itself. In a technical sense, one may say that each use of «here» refers to one and only one fuzzy or vague place, but in informal reference rules this ought to be avoided, because it only shifts the problem from a formulation of the rule to the specification of the semantic referent.

[4] Neither explicit nor implicit token-reflexivity presumes that an indicator token semantically refers to itself or to any other token whatsoever. Tokens of «I», «here», «now», and other indexicals refer to the person that uses them for communication, their place and time of utterance, and so on. It is the reference rules of indicators qua type, i.e. their linguistic meaning, that fix the semantic referent of each use of the indicator on the basis of properties of the token used. This clarification rules out certain objections like those in (Smith 1986), that are based on the presumption that in a token-reflexive analysis the semantic referent of an indicator is determined by another token-reflexive substitute expression taken as if it was uttered in the same context. It is important to realize that implicit reference to a token in reference rules like the 5.68–5.70 may be context-dependent, but doesn't have to be more context-dependent than any other reference by means of definite descriptions like «the token 5.67 on page 127» or names like «5.67».

[5] Strict token-reflexivity mainly occurs in canonical situations of utterance. In other cases the reference rules are modified or enriched. In case of narrative contexts or speaking on behalf of someone the context of the actual utterance plays a subsidiary role, and indexicals in the utterance must be evaluated with respect to another context of utterance introduced in dependence of the broader conversational context. Still, indexicals in many such derived uses remain implicitly token-reflexive. For example, a speaker interpreting ‹I› in an utterance made by an actor in a play must first determine the actor, i.e. the actual speaker of the actual deictic center, and *on the basis of this knowledge* can determine the character played by the actor as the speaker of the constructed, *narrated context of utterance*.

Given these caveats, utterance-based reference rules of indicators can be characterized as follows.

☆ **Ind 1** (Utterance). *An utterance is the use of a linguistic token for the purpose of communicating a message. Time, place, and speaker of an utterance are determined by conventions in relation to the media used. In canonical utterance situations of face-to-face communication these are the location of the token producer, the time of token production, and the producer himself.*

☆ **Ind 2** (Reference Rule of an Indicator). *An indicator's reference rule is a formulation of its lexical meaning according to which the semantic referent of an utterance of the indicator is determined.*

Following Kaplan (1989) demonstratives can be analyzed in an analogous way, if the pointing gesture is considered to provide restrictions of a reference rule, such that the resulting constructed reference rule is sufficiently complete to determine the referent of the demonstrative. In other words, the extralinguistic pointing gesture as a type is added to the analysis in the target language. So for example, to describe the truth-conditional content of an utterance like 5.71, the pointing gesture accompanying ‹this› would be analyzed as a restriction in the target language that is strong enough to uniquely determine the referent of the token.

(5.71) This̱ is Bob.
         →

This is an acceptable idealization, since it only rests on the assumption that pointing gestures are *intelligible*, i.e. that they could in principle be expressed by linguistic means. There doesn't seem to be any principal reason why this shouldn't be possible, and conversely it could be argued that if there were any such principal reason, then pointing gestures couldn't be subjected to scientific investigation at all—and without some foundational backup this would be an absurd claim. So stipulating some properties in the target language that uniquely determine the semantic referent of a demonstrative in the target language is justified, as long as the extralinguistic pointing gesture uniquely determines a semantic referent. Kaplan revises this externalist view in *Afterthoughts* in favor of an intention-based theory of demonstrative reference:

> "I am now inclined to regard the directing intention, at least in the case of perceptual demonstratives, as criterial, and to regard the demonstration as a mere *externalization* of this inner intention." (Kaplan 1989, p. 582)

This change is motivated by a desire to explain Donnellan's referential uses of definite descriptions in the same uniform way by a speaker's intentions, even if the actual description fails to denote.[46] Attempted lies show that this view is implausible. Consider the following use of a demonstrative.

(5.72) *Situation: Alice, Bob, and Carol are on a mountain trekking tour. Alice intends to point to the Mount Everest, but in fact points to the K2. She wants to deceive Bob and Carol.* Alice: This is the K2.
$\overrightarrow{\text{This}}$

Alice's use of «this» semantically refers to the K2, because she points to it. There is no way to understand such examples in a way that the demonstrative would semantically refer to the intentional object Mount Everest.[47] Liars can be competent speakers just as anyone else, and words do not change their meaning when they are used in an attempt to lie. So Kaplan's earlier proposal is more convincing and it will be adopted from now on:

☆ **Ind 3** (Reference Rule of a Demonstrative).
A demonstrative's reference rule comprises two parts:

1. *a formulation of its lexical meaning, and*

2. *a formulation of the pointing gesture accompanying its use.*

Since a pointing gesture from a cognitive point of view is an extralinguistic means to draw the attention of the recipient to some object, it can be less explicit and less determinate the more one object in the given context of utterance is more salient to sender and receiver than others. This is why sometimes pointing gestures can be left out almost completely, except for alignment of sight, but then these salience criteria have to be taken as part of the reference rule. A demonstrative given qua type is an abstraction from an actual utterance of a respective demonstrative token.

5.4.3 On the Content of Reference Rules

One problem of formulating reference rules is to find out which aspects of the meaning of an indexical qua type in a particular language is relevant for the truth-conditional content of its utterance. The data of the last section suggests that a lot of semantic features can play a role in the use of an indexical. Some of these features are troublesome for truth-conditional method in general and elicit the amount of idealization that is presumed in generalizing speaker references to semantic reference. Consider for example the role of animacy in the lexical choice of demonstrative pronouns in Yidiny described by Comrie (1981):

> "One reflection of animacy [in Yidiny] is in the choice of demonstrative pronouns,
> where for instance 'that' is more likely to appear as ŋunʸdʸu- with noun phrases

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[46]See (Kaplan 1989, pp. 582-4); cf. section 2.5, chapter 2.

[47]The intentional object is still needed to identify the speech act as an attempt to lie. One may try to fix the account by stipulating the intentional object to be the K2 and the doxastic object to be the Mount Everest, but *this* kind of transcendent intentional object is a residue of phenomenalist perceptual anti-realism that is of doubtful value within a realist framework.

higher in animacy, and is obligatory in this form with human noun phrases, but as
ŋuŋgu- with noun phrases of lower animacy." (Comrie 1981, p. 38)

This suggests that, vice versa, a use of ŋunʸdʸu- indicates that its referent has a higher degree
of animacy than a use of ŋuŋgu- would indicate in the same context of utterance. But what
happens if the obligatory rule is ignored and ŋuŋgu- is used in combination with a term denoting
a person? Does the utterance become unacceptable up to being non-true or might it be perfectly
true but highly suboptimal? In case of Yidiny this question will be hard to answer, because the
question is to a large extent empirical and Yidiny is practically extinct as of the time of this
writing.[48] But the problem is of general nature. Truth-conditional method links lack of semanto-
pragmatic acceptability with non-truth (falsity or truth-value gap), but this link can under certain
circumstances turn out to be too coarse-grained. Consider, as a second example, grammatical
gender of English pronouns in the following utterance.

(5.73) *Bob*: S̲h̲e̲→ is looking for the canteen.

In case there are several possible semantic referents in the given context of utterance that are
located in the direction at which Bob points and have natural gender, the grammatical gender
feminine can be used for identification purposes, since it presupposes that the referent has corre-
sponding natural gender if it has natural gender at all.[49] However, if the person Bob is pointing
to turns out to be a man at closer inspection, it is doubtful whether the original utterance is to be
judged false. The actual grade of unacceptability judged by speakers when such presupposition
violations occur presumably depends on many empirical factors like the conversational context,
the discourse type, success or failure of communication, and so on, up to the personal attitudes of
discourse participants. The notion of truth-conditional role does, however, require a theoretical
decision to either consider a given feature truth-conditionally relevant or not. In case of refer-
ential undersaturation it is clear that an utterance must be non-true, but in other cases this is
not clear. The problem is well-known in the literature on presuppositions and the debate on the
semantic versus the pragmatic nature of presuppositions is yet unresolved, although there seems
to be a certain trend towards the pragmatic direction. In the pragmatic view a presupposition
by definition has to be cancelable, and a typical cancellation test would for example be given as
follows.

(5.74) *Bob*: S̲h̲e̲→ is looking for the canteen, but in fact it's a he.

There can hardly ever be any final criterion as to whether and to what extent such a cancel-
lation is acceptable, though, and in reality acceptability judgements come in a degree that varies
depending on the speaker, the context in which an example is presented, and the exact formu-
lation of the example. The problem is that, as opposed to the more clearcut syntactic domain,
semanto-pragmatic acceptability is always the result of active interpretation by a speaker, who

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[48]Yidiny (yii) is an Australian (Pama-Nyungan) language that with only 12 native speakers as of 1981 is classified as
nearly extinct in (Gordon 2005).

[49]Feminine pronouns are in English also used for ships, planes, motorcycles and sometimes even for cars, weapons,
and tools.

may take all available information into account she deems significant. This information is likely to include extralinguistic features of the context of utterance, the conversational context, general world-knowledge, and the speaker's beliefs and inferences thereof. Moreover, evaluation of semantic reference in retrospective must be kept apart from mutually agreeing speaker reference that is beforehand the prerequisite to successful communication. Apart from this problem, some features of demonstratives in particular languages—like proximity to speaker or addressee, being located at a certain place, or animacy—don't seem to be cancelable at all and can therefore not be regarded being presuppositional. Concerning the formulation of reference rules this causes a dilemma. On one hand, semantic features of indexicals from a strictly truth-conditional point of view might not enter truth-conditional content. That for example the referent of «this⃗» is in the proximity of the speaker whereas the referent of «that⃗» is in the proximity of the addressee might not be relevant for the truth-conditions of the whole utterance. On the other hand, a speaker referring by means of an indexical may make use of any extralinguistic and linguistic features of the utterance for the purpose of identifying the semantic referent, and among those will be grammaticalized and lexicalized features of the indexical used. The problem what feature to include into a reference rule is further aggravated by the fact that by virtue of linguistic competence speakers do have to associate features such as proximity to speaker or addressee, or animacy in Yidiny, with an indexical, even if these features turn out to be marginal for truth-conditional content. For example, a Japanese speaker that doesn't make any distinction in the use of «kore», «sore», and «are», or an English speaker that always uses «he», no matter whom he is referring to, isn't fully competent—and this lack of competence must be understood as a lack of implicit knowledge of the conditions of use of linguistic expressions.

How to tackle this problem? First of all, in some cases a clear line can be drawn between aspects of meaning that concern and those that don't concern the truth-conditions of an utterance. For example, if an utterance is marked for politeness it is not what an assertive utterance expresses, i.e. some state of affairs, that is more or less polite, but rather the assertive speech act used in expressing it. Therefore, politeness features don't enter the truth-conditions of an utterance. Following (Potts 2004), they are conventional implicatures on a level of meaning independent from what is said. More problematic are features like animacy or spatial proximity, as these features express properties of the referent. If such a feature can be cancelled, the kind of meaning involved is presuppositional. If it cannot be cancelled, the kind of meaning involved is either part of literal meaning or a conventional implicature. But in all three cases one has to decide how truth-conditional analysis should proceed if the referent doesn't satisfy the condition expressed by the feature. One way to tackle this problem is to distinguish several levels of truth-conditional content, as for example Perry (1997a, 2005) proposes. This is legitimate, since the notion of truth-conditions itself is vague, but then the question will arise what sort of content represents public language meaning, i.e. what is said. Discussing the notion of what is said and the related controversy between contextualism and semantic minimalism would lead too far apart here and is generally not very fruitful, since the level of idealization to adopt depends on the overall explanatory goal of the theory. Regarding indexicals, however, it can at least be said that there is good reasons to include as many features as possible into reference rules. In comparison to the elusive nature of semantic features of proper names, bundled in the property

of being called such and such discussed in 4.5.4 of the last chapter, it is striking that the various criteria associated with many indexicals and particularly demonstratives cannot only be used for identification purposes, but even have evolved as part of lexical meaning for exactly that purpose. Whereas a speaker in case of proper names rests on subjective, speaker-individual criteria for identifying the referent, a speaker using an indexical will generally have a number of criteria at disposal that are provided by lexical meaning. The fact that selectional features of indexicals bear an important role for identifying reference can thus be taken as an argument for including them into the reference rule. Of course, as the discussion of proper names in previous chapters has shown, it is always possible to dispense with descriptive meaning for dealing with semantic reference by simply presuming a higher level of idealization. This also holds for indexicals. If for example each context of utterance was considered to have a speaker, then «I» could be analyzed to denote this speaker directly referential without taking the reference rule into account at all. Likewise, each communicative use of a demonstrative could just be numbered and for each context c a referent r_i could be stipulated.[50] However, such an account doesn't illuminate what a speaker has to implicitly know when using or interpreting an indexical. On one hand, the question whether a given semantic feature is relevant for semantic reference must be decided on the basis of acceptability judgements about cases in which the purported referent doesn't satisfy the feature and is therefore empirical. On the other hand, there is a certain theoretical freedom of including more or less features into such rules, since semantic reference is constructed theoretically ex negativo as the ideal corrigens to individual speaker references that have gone astray. From a description-theoretic point of view it makes sense to include as much descriptive meaning of indexicals into their reference rules as is needed to explain speaker reference by means of indexicals in the simplified view, i.e. without assuming additional identificational criteria.[51]

5.4.4 The Varieties of Contexts

As mentioned earlier, not only indexicals but also proper names and definite descriptions can be context-dependent. When comparing proper names with demonstratives, there is, however, a crucial difference in the kinds of contexts involved that has so far been presumed without further explanation. The context according to which the referent of an indexical is fixed has been called *context of utterance*, whereas the context in relation to which proper names and definite descriptions are interpreted has been called *conversational context*. These two contexts are different from each other, as for examples the following party-chitchat shows.

(5.75) Alice: Has Carol been promoted?
    By the way, I've seen Carol at the cinema yesterday.

(5.76) Alice: Have you been promoted?
    By the way, I've seen you at the cinema yesterday.

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[50]This account of demonstratives is discussed and rejected by Kaplan (1989).

[51]The corresponding subjective interpretations of indexicals, which have no direct natural language counterpart, will be discussed in chapter 8.

There is a notable difference between these two pieces of discourse. In 5.75, the two occurrences of «Carol» in canonical circumstances must denote the same person, whereas the two tokens of «you» in 5.76 can denote different addressees. The same applies to larger pieces of discourse: Within a part of discourse, the same proper name always has to denote the same object, or the change in reference has to be marked explicitly, for example by using an expression like «the other Carol» or a pointing gesture if applicable. The converse holds for indexicals. It is the *purpose* of the indicator «you» to denote whoever is addressed in the given context of utterance, and the referent can change from utterance to utterance or even within the same utterance as in the example of an impure use like 5.18 on page 111.[52] What holds for proper names also holds for definite descriptions:

(5.77) Alice: Has the woman wearing the blue dress been promoted?
        By the way, I've seen the woman wearing the blue dress at the cinema yesterday.

Apart from being marked, because an anaphora would be preferable in this example for reasons of economy, it is clear that the second use of the definite description in canonical circumstances cannot be read as denoting another person than the first one unless it is accompanied by an additional pointing gesture. If the situation in 5.76 is analyzed in more detail, the respective addressee is picked out in two different extralinguistic ways, which could be taken to complement the indicator's reference rule in the given context of utterance just like has been proposed as the general way to deal with demonstratives following Kaplan (1989). It is feasible to have differing referents in 5.75 and 5.77 as well, though, if an additional pointing gesture is assumed or the possibility of referents changing becomes salient by feature of the context of utterance and background knowledge of the discourse participants. Say, for example, the second Carol is well-known to everyone and she catches the discourse participants' attention by entering the room. On the basis of such examples it could be argued that the ambiguity of proper names is also fixed by the context of utterance. Although this may sometimes happen, the conventions underlying the use of proper names and definite descriptions differ from those underlying indicators and demonstratives. Crucial about the above examples is: It is part of the linguistic conventions of using indexicals that they denote different semantic referents who may change within the same conversational context, whereas it is part of the conventions of the use of proper names that they always denote the same object in the same conversational context. Definite description are in between the two cases, insofar that they can be used referentially or attributively, and can but don't have to be egocentric compound indexicals. In non-narrative conversational contexts indexical reference *always* requires the speaker to take into account concrete features of the context of utterance, whereas non-indexical reference requires the speaker to take into account such features only in situations in which identifying reference is expected by other discourse participants.

The context of utterance can change—paradox as it may sound—even within an utterance, because it must be understood as the context in which an indexical token is uttered, i.e. the concrete situation in which it is used for communication. As examples with persistent tokens have shown, this context may be further divided into a context of token-production and a context of interpretation, though this is normally not necessary. The conversational context, on the other

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[52]Cf. (Perry 1997b, p. 10).

hand, is much broader than any context of utterance and active during a larger piece of discourse. When it changes in a way that is relevant to the interpretation of linguistic expressions during the conversation, this change must be marked appropriately. This happens in the following example.

(5.78) Alice: Has Carol been promoted?
    By the way, I've seen the other Carol—the one wearing the blue dress—at the cinema yesterday.

Once a fundamental difference between the two notions of contexts involved is granted, it can be observed that certain context-dependencies of indexicals are fixed by the conversational context. Consider for example the following utterances.

(5.79) Alice: It's hot here.
    And there are too many people here.

The spatial range of the second token ‹here› cannot change arbitrarily. Readings of 5.79 as 5.80 or 5.81 aren't possible, because the range of an indexical within one piece of discourse cannot change arbitrarily once it has been fixed.

(5.80) It is hot in this room.
    And there are too many people living in California.

(5.81) The climate is hot in California.
    And there are too many people in this room

Still it can change if presuppositions or world-knowledge allow so, as in the following example:

(5.82) Alice: It is hot here.
    How long have you been living here?

If Alice and the addressee know that the addressee is not living at the place of the party, then a more general reading as in *here in this city* will be triggered as the default assumption for *to live at some place*. Such inferences depend on the *common ground* (Stalnaker 1978, 2002), i.e. the set of assumptions mutually shared by the discourse participants, in combination with general world-knowledge. Likewise, the range of ‹now› in 5.83 is determined by the conversational context depending on the norms of exactness that obtain from Grice's Cooperative Principle in dependence of the topic of the conversation, the common ground, and varying social conventions.

(5.83) Alice: When does Carol's talk start?
    Bob: Now.

If Alice and Bob are supervising a TV broadcast, ‹now› might have to be given a narrow reading, because the discourse participants agree that in TV production time is measured in seconds and fractions thereof. In a conversation on the university campus, on the other hand, ‹now› might be given a broad reading according to which Carol's talk will start in around 5 minutes or has already started for 5 minutes. These examples motivate the following characterizations.

✩ **Ind 4** (Context of Utterance). *The context of utterance determines the deictic center in the respective dimension of an indexical.*

✩ **Ind 5** (Conversational Context). *The conversational context determines the range of an indexical in accordance with its reference rule and with respect to the deictic center fixed by the context of utterance.*

(Ind 4) characterizes what Perry (1997a) calls *narrow context*, consisting of speaker, time, and place of utterance, that every utterance has. But the context of utterance is here also considered to comprise other factors like pointing gestures. These are part of what Perry (1997a) calls *wide context*, which consists of the narrow context plus additional factors. Since these factors might both be concrete, perceivable features of the utterance situation or non-perceivable, non-concrete factors like linguistic and social conventions, the wide versus narrow context distinction must be kept apart from the above one. The context of utterance, as it is understood here, comprises only features of a concrete situation of utterance that can in principle be perceived or measured. This includes pointing gestures and other means of non-verbal communication. In contrast to this, the conversational context is here understood as a heterogeneous mix consisting of linguistic and social conventions, what has been said before, and the background knowledge and assumptions of the discourse participants. On the basis of this distinction, anaphora are not indexical expressions, because their reference depends on the conversational context and they aren't egocentric.

5.4.5 Indexicals and Rigidity

Following Kaplan (1989) indexicals are sometimes flatly assumed to be rigid, but as the discussion in the last chapters has shown rigidity should always be considered in relation to the sort of modality in question. Alethic modalities are a good starting point, as Kripke (1972) devised the original rigidity thesis for them. The following utterance is an example of an indicator embedded into such a modality.

(5.84) Alice: It is possible that I weren't here now.

Conceivably, this utterance can become true, as it can be understood in the sense that Alice might under some counterfactual circumstances not be located at the time and place of the utterance. Still, «I» denotes Alice, «now» the time of utterance, and «here» the place of utterance in 5.84. Thus, these indicators are rigid with respect to the alethic modality, and likewise may be argued for other indicators. There are, however, non-rigid uses of «now», «jetzt», and Danish «nu» with respect to alethic modalities that some speakers deem acceptable at least to some extent. Here is a German example of a counterfactual conditional that has been judged unacceptable by some but acceptable by other informants.

(5.85) *Situation: It is 1 P.M. and the journey has just ended.*

> *Wenn der Reifen nicht geplatzt wäre, dann wäre es jetzt 12 Uhr.*
> if the tire not blown would-be then would-be it now 12 o'clock
> 'If the tire hadn't blown, it would now be 12 o'clock.'

It isn't acceptable to use «here» in a similar way, and the above use of «now» seems to be derived, standing as a shortcut for the endpoint of the counterfactual sequence of events in comparison to the utterance time as the endpoint of the actual sequence of events. A way to analyze such uses will be addressed in chapter 8, but given that they are highly marked, examples like the above one are not taken to falsify the thesis that «now» is generally rigid.

Regarding other modalities, it at least hard if not impossible to quench some non-rigid readings out of the indicators in utterances like the following ones:

(5.86) Every time Alice meets Bob now, she is angry.

(5.87) Anywhere Alice goes, she likes it more than here.

In order to retain egocentricity and rigidity of «now», a very broad reading of it is triggered in 5.86, according to which the time intervals quantified over by «every time» all occur within the time denoted by ‹now›. So this reading remains rigid, whereas the shifter readings in 5.49 and 5.50 mentioned above are non-rigid with respect to other temporal expressions. The lesson to be drawn from these examples is that indicators are generally rigid with respect to temporal and spatial modalities, unless another reading like that as a shifter is confirmed.

What about doxastic modalities? It can be shown by way of examples that, as opposed to proper names, indicators cannot be given a referentially opaque reading indicating the respective attitude holder's speaker reference by means of the indicator. For example, in the following utterance none of the indicators can be given a de dicto reading.

(5.88) Bob: Alice believes that I am here now.

In chapter 8 it will be shown that it is still possible to express a derived notion of cognitive content based on formal belief attributions in which the target language analogues to the indicator are interpreted non-rigidly. But there is no reading of an English belief ascription according to which the embedded indicators would refer to whoever and whatever Alice believes to be the speaker, time, or place of 5.88. One possible exception to this rule is belief ascriptions in which the embedded indicator denotes the same person as the attitude holder, as in the following one.

(5.89) Alice: I believe that I am hungry.

The corresponding de se readings will be addressed in chapter 8. In the normal case, when the attitude holder is not the speaker, no referentially opaque reading of a non-shifting indicator can be given, and so non-shifters can be considered absolutely rigid except possibly for the first-person case.

Let us now turn to demonstratives. According to Kaplan (1989) they are rigid as well. This can be seen from examples like the following one.

(5.90) It is possible that $\underset{\longrightarrow}{\text{this}}$ weren't where I'm pointing at.

A situation in which the object pointed at wasn't at the place pointed at is indeed conceivable. If 5.90 is true, however, the demonstrative has to be interpreted rigidly, since otherwise the

sentence would have a reading like *there is a counter-factual situation in which the object pointed at by the speaker is not at the place the speaker points at in the same situation*, which would be absurd. Likewise can be argued for other demonstratives. It is also a consequence of egocentricity and token-reflexivity that non-shifting indicators and demonstratives are rigid with respect to temporal modalities.

The situation is less clear when a look is taken at compound indicators. Definite descriptions containing indicators are not rigid with respect to time, but practically always rigid with respect to alethic, spatial, and doxastic modalities. This does, however, not seem to depend on the fact that they contain an indicator. It rather depends on whether the definite description is used attributively or referentially in the sense of Donnellan (1966). Consider for example the following utterances.

(5.91) It is possible that the entrance left of you is locked.

(5.92) It is possible that the main entrance is locked.

(5.93) Alice believes that the entrance left of you is locked.

(5.94) Alice believes that the main entrance is locked.

(5.95) The president of the United States could be a woman.

(5.96) The president of your country could be a woman.

(5.97) Alice believes that the president of the United States is a woman.

(5.98) Alice believes that the president of your country is a woman.

It seems that the definite descriptions in 5.91–5.94 are preferably read as referential uses and are rigid irrespective of whether they contain an indicator or not, whereas 5.95–5.98 are preferably read as non-rigid attributive uses. Consider now 5.99 and 5.100.

(5.99) The entrance left of you was locked.

(5.100) The main entrance was locked.

Both definite descriptions have a rigid and a non-rigid reading. The first one can be read as *the entrance left of the addressee now, at the time of utterance* or as *the entrance left of the body axis relative to where the addressee was located and facing at event time*. Likewise, the description in 5.100 may pick out the entrance that is the main entrance at the time of utterance or the entrance that was the main entrance at event time. The rules that govern the rigidity or non-rigidity of definite descriptions are complicated. One rule of thumb that seems to hold is that the more a situation supports identifying reference and the more identifying reference can be reasonably expected by all discourse participants, the more a referential, rigid reading will be preferred. This is just an hypothesis, though. What can at least be said is that compound indicators are not always rigid. Only the non-compound indicators that these descriptions *contain* seem to be rigid under all embeddings, if they are rigid in isolation in the first place. The indicator «you»

semantically refers to the person addressed by the current speaker at the current time, world, and place of utterance in 5.91, 5.93, 5.96, 5.98, and 5.99.

To summarize: As a good rule of thumb, canonical uses of deictic center indicators are absolutely rigid, with only few exceptions: shifters depend on the context introduced by the verb of indirect speech with regards to their domain, but are rigid otherwise, indicators in the above sort of first-person attitude ascriptions can be interpreted in a special, non-rigid way (see chapter 8) with regards to doxastic modalities, and there may be non-rigid uses of «now» as in 5.85 with regards to alethic modalities. Indicators that are rigid with regards to some modality remain so in compound indicators, but the rigidity of the compound indicator is in many or all cases independent of the rigidity of the deictic center indicator it contains. In contrast to this, demonstratives are absolutely rigid.

5.4.6   Rigidity and Token-Reflexivity

Given that non-shifting indexicals are absolutely rigid proviso the above possible exceptions, one may ask whether there is some particular reason for this or whether this is just linguistic coincidence. Kaplan (1989) propagates the view that direct reference involves some kind of immediacy of speaker reference, and in his opinion indicators are rigid because they are directly referential:

> "The [reference] rules do not provide a complex which together with a circumstance of evaluation yields an object. They provide an object." (Kaplan 1989, p. 495; orig. in italics)

This formulation is problematic, since it suggests the immediacy of reference view that has already been criticized in chapter 3. The mysterious immediacy metaphor is, however, irrelevant to the question of rigidity. In the present view, indicators are rigid because their linguistic meaning is given by at least implicitly token-reflexive rules. This can be seen from proper instantiations of reference rules. Consider once more example 5.84 on page 137. Compare this to the following utterance.

(5.101) Alice: It is possible that the speaker of 5.101 weren't the speaker of this utterance.

This utterance can be considered the result of partially analyzing utterance 5.84 by using reference rule 5.68. This example has two readings: one contradictory reading, according to which ‹this utterance› in 5.101 denotes the token 5.101 as well, and one sloppy reading, according to which ‹this utterance› denotes the type of 5.101. Only under the sloppy reading can 5.101 be true, and by application of Gricean maxims it will be the preferred reading. In both readings, however, «the speaker of 5.101» is rigid, unless «5.101» denotes 5.101 as a type—but it doesn't, since it is the name of a token. There is a sense in which the same token can be uttered actually and under counterfactual situations, but this is not sense in which tokens ought to be understood in instantiations of reference rules. A reference rule determines numerically one token t_1 and, in case of an utterance based reference rule, determines the referent of one communicative use of t_1; if a token t_2 of the same type T is considered that is uttered under other circumstances, then it is another token $t_1 \neq t_2$.

5.4.7 Indexical Speaker Reference

The fact that egocentric indicators and demonstratives are absolutely rigid leads to a tension between the interpretation of attitude ascriptions containing indexicals and the epistemic success condition for speaker reference represented by the notion of identifying reference. For proper names it has been argued that from an epistemic point of view speaker reference cannot be adequately described by formal definite descriptions that are rigidified by an actuality operator, since this would presume identifying reference. From an epistemic point of view successful identification of the semantic referent by a speaker using a term may never just be presumed, since it cannot follow from the mere use of language that there is something that satisfies certain conditions or bears a certain name. There can be no exception to this rule for indexicals. Whenever the relevance of speaker reference for epistemic considerations is an issue, a reference rule has to be non-rigid with respect to the first doxastic modality in question. Suppose that $\square$ is a doxastic KD45 modality, c is an additional parameter for the context of utterance, and S is the property of being the speaker of the utterance in the given context of utterance. How any of this is implemented in detail will be addressed in the subsequent chapters. Now consider the following formula.

$$M, g, c, w \vDash \imath x A x \, \square_x \, \imath y [@ \, Sy] Py \tag{5.102}$$

This is an appropriate specification of the truth-conditional content of 5.104 in context c, given that 5.103 holds under the intended reading of S as the property of being the speaker of the utterance in c.

$$[\![\imath y @ Sy]\!]_g (c)(w) = Bob \tag{5.103}$$

(5.104) Bob: Alice believes that I am hungry.

However, formula 5.102 doesn't indicate any way in which Alice might *interpret* another utterance 5.105 in context c:

(5.105) Bob: I am hungry.

To express Alice's speaker reference by means of ‹I› when she interprets 5.105, i.e. in this case the way she interprets the token as the receiver of the signal, the reference rule must at least be non-rigid, if it is not to be accompanied by additional, subjective identification criteria as described in the last chapter. So a minimal formulation of Alice's interpretation of 5.105 is the following formula.

$$M, g, c, w \vDash \imath x A x \, \square_x \, \imath y [Sy] Py \tag{5.106}$$

Although not a common term in the literature, this can be called a de dicto analysis of Alice's acceptance of 5.105 on the basis of her speaker reference. In intended models, this formula expresses that Alice must believe of whoever she believes to be the speaker of utterance 5.105 that this person is hungry, when she interprets ‹I› in 5.105 as a competent speaker correctly. Let $\square_1$ be a doxastic modality and R be a property expressing the reference rule of the indexical in question. Then a condition for identifying indexical reference for person indexicals like «I» can be expressed quite the same way as in case of speaker reference by means of a proper name.

$$M, g, c, w \vDash \imath x R x \, \square_1 \, \imath y R y (x = y) \tag{5.107}$$

More such examples will be discussed in chapter 8. For now it suffices to say that a formula like 5.106 doesn't reflect the truth-conditions of a corresponding belief ascription involving an indexical, since indexicals are generally rigid.

5.4.8 Indexical vs. Non-Indexical Reference

A comparison can now be drawn between indexical and non-indexical reference. The main feature that sets indexicals apart from proper names and definite descriptions is centricity and in particular egocentricity. Because indexicals are egocentric or at least object-centric, their semantic referent depends on concrete features of the context of utterance or, in the case of shifters, the context of a reported speech act. Therefore identifying reference plays a crucial role in indexical reference, as long as the respective domain supports it. In contrast to this, proper names often act as mere placeholders for the semantic referent in situations in which identifying reference is not mutually expected by discourse participants, for example when the recipient encounters a name for the first time. This does not preclude the case that Alice may expect of Carol that she attempts to identify the semantic referent of the name «Bob» she has used; but however reasonable this expectation may be in the given situation, it isn't triggered by the linguistic conventions governing the use of that name and the linguistic meaning of the name itself doesn't provide many useful identificational criteria (chapter 2). The converse holds for indexicals. Sender and receiver mutually expect identifying reference when an indexical token is used. With this respect, egocentric non-shifting indexicals are shortcut devices that can only be used for successful communication if the discourse participants can easily identify their referent on the basis of the deictic center; they are shortcuts for their reference rule. As Bühler (1934) lays out in detail, from a cognitive point of view an indexical's purpose is to draw the receiver's attention to the referent. In the terms of Stojanovic (2002), they are instructions for the receiver to test whether the given context "[...] meets the descriptive conditions associated with the indexical, before you go on to interpret the rest of the utterance." (Stojanovic 2002, p. 127) Reference rules and pointing gestures provide the identificational criteria needed for identifying reference.

As for rigidity, the rule of thumb says that indexicals are absolutely rigid as long as they are non-shifting and not compound. Proper names, on the other hand, are relatively rigid (chapter 4). They can be interpreted as rigid terms in the scope of any modality, for example in de re attitude ascriptions, or may be interpreted as rigid terms relative to the first doxastic modality, as in de dicto attitude ascriptions. Definite descriptions can also be interpreted rigidly, but are also sometimes interpreted as non-rigid terms. Any referential expression can be context-dependent, but proper names only depend on the conversational context and definite descriptions depend on the conversational context and may depend on the context of utterance. The referent of a non-shifting indexical is determined in relation to the context of utterance, where the interpretation of its reference rule in turn depends on the conversational context. The context of utterance is much narrower than the conversational context; it is the concrete context of the use of individual tokens for communication. It changes at least with each utterance made by a discourse participant. The conversational context, on the other hand, is the context of a larger piece of dis-

course during which the role of discourse participants and linguistic and extralinguistic norms may change. The former is semantic, the latter is pragmatic in nature.

Chapter 6

Indexicals in Modal Logic

6.1   Chapter Overview

Starting from this chapter, the focus will be on concrete ways to deal with indexicals in a formal target language. The topic of this chapter is Kaplan's Logic of Demonstratives, which has become the most prominent formal framework for dealing with the semantics of indexicals. His approach will first be outlined in section 6.2, and afterwards a detailed reformulation of his logic will be presented in section 6.3. Example analyses of indexicals and demonstratives in this language and some of the philosophical issues connected with them will be discussed in section 6.4.

Kaplan's account has become popular in philosophy for one part, because it provides an easy way to rigidify non-rigid and de-rigidify rigid expressions while in a sense remaining compatible with the direct reference view, and for another part, because it makes the conceptual distinction explicit between the context of utterance and the modal indices over which modal operators quantify. Double-index modal logic also allows one to deal to some extent with shifters and to express a sort of subjective content of originally rigid expressions by using a diagonalization operator. Ways to analyze shifters without heavy changes to the framework are outlined in section 6.5. In this section it will be shown how the same trick used in chapter 4 for implementing a relativized actuality operator can be used to analyze shifters, albeit in an inelegant fashion. Finally, in section 6.6 some motivation is given for switching from double-index modal logic to more expressive languages like the one that will be used in the next chapter.

6.2   Background and Motivation

The Logic of Demonstratives (LD) presented by Kaplan (1989) has become a de facto standard for treating indexicals in a formal logical language. His paper was first officially published in 1989, but the ideas in it have been spread by lectures and as drafts during the 70ies and Kaplan presented the formal system already in 1971.[1] Kaplan's LD and its descendants are so-called double-index or two-dimensional intensional modal logics. The main ideas underlying these frameworks are first that contexts are added as parameters and truth in a model is relativized to them, and second, that expressions in the formal language have two intensions in addition to their extension. The first intension, the *character* in Kaplan's terminology, is the formal equivalent to reference rules of indexicals in particular and represents the linguistic meaning of an expression in general. In case of indexical expressions, this linguistic meaning depends on the context of utterance and is thus formalized as a function taking a context of utterance and yielding a second intension. The second intension, the *content* in Kaplan's terminology, represents meaning that can only be grasped by a speaker who has already taken into account the empirical features of the context of utterance that determine the referent of an indexical. Contents are the intensions known from traditional, non-contextual intensional logics; formally, they are represented as functions from worlds or other modal indices into extensions, i.e. into truth-values for sentences, objects for individual terms, sets of objects for unary predicates, and sets of ordered n-tuples for n-ary relations respectively. The evaluation of a formula involves two steps: the first

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[1] See (Kaplan 1989, fn. 1).

step maps the formula in dependence on the context of utterance into the second intension and the second step maps this intension into truth or falsity depending on the modal index. This explains the attribute *two-dimensional* that is sometimes given to Kaplanian frameworks. The term double-index modal logic, on the other hand, comes from the fact that worlds, times, or whatever else modal operators 'run over' are an *index*, a point of reference in logical space in relation to which truth in a model is defined, and adding contexts as other points to which truth is relativized are then a second kind of index. To avoid mixing up the notions, only the second parameter, with respect to which the content is evaluated, will be called index here, namely the *modal index*. Notice that a modal index in this terminology is not directly related to a modality index. The former is an additional parameter, whereas modality indices are used for syntactically enumerating modal operators of a multi-modal system. The following scheme summarizes evaluation in Kaplan's framework:[2]

Character	+	Context	:	Content
Content	+	Index	:	Extension

As can be seen from this scheme, formally all expressions of the target language are context-dependent, since all of them have a character. However, non-indexical expressions will according to Kaplan have *stable character*, i.e. a character that within a given model yields the same content for any given context, whereas indexicals don't have stable character. Correspondingly, rigid terms can be said to have *stable content*, i.e. their content will yield the same extension no matter what index it is evaluated at, whereas non-rigid expressions don't have stable content.[3] Kaplan argues decidedly for the direct reference view and considers indicators as the primordial example of directly referential expressions. In his opinion, indicators are directly referential, because their referent is fixed and determined by the context of utterance and therefore their content has to be stable and they are rigid. Rigidity follows from the way their referent is fixed.[4]

Before the details of a Kaplanian framework are laid out, some remarks about such approaches are in place, not all of which reflect Kaplan's own opinions. An important point in (Kaplan 1989) as opposed to generic double-index theories is his distinction between contexts of utterance and modal indices. There are two important differences between contexts of utterance and modal indices. First, contexts of utterances generally have a more fine-grained structure than modal indices. A context of utterance must specify any reference fixers of indexicals, including speaker, addressee, place, time, and possibly world of utterance, whereas a modal index specifies only the objects that modal operators implicitly quantify over.[5] In the simplest case of a modal logic with one alethic modality, modal indices are just worlds. Only if temporal adverbs or tenses are analyzed as modal operators or if expressions like «everywhere» are analyzed as modal operators running over places will modal indices either come in different sorts or have to be modeled in another way that reflects a more fine grained structure. A formal context, i.e. the formal representation of a context of utterance, is an abstract entity, but it stands for a concrete

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[2]The scheme is almost identical to the one in (Kaplan 1989, p. 506) and has only been paraphrased instead of cited because of the slight differences in terminology.

[3]See (Kaplan 1989, pp. 548-50).

[4]In section 5.4.6 it was argued that this is the result of their token-reflexivity, but this view is not endorsed by Kaplan.

[5]See (Haas-Spohn 1994, pp. 26-7).

situation in which the utterance has been made and features thereof. A modal index, on the other hand, may stand for a whole alternative way in which the universe may have evolved. It may be interpreted in various ways, depending on the respective modality encoded. Second, the criteria for counting contexts of utterance and modal indices differ vastly. Two contexts must be different from each other whenever they occur as parameters in the analysis of two utterances of the same indexical that have different referents. The equality conditions of modal indices, on the other hand, depend on the interpretations of the respective modal operators running over them. Because of these differences, it is not always clear in which way a mapping or conversion from contexts to indices or vice versa ought to be interpreted from a philosophical point of view, even when there is no technical difficulty in implementing such a mapping.

6.3   A Double-Index Modal Logic: DIML

The following logical system called DIML is quite similar to Kaplan's original LD, but also differs from it in some respects. It is intended to capture Kaplan's main ideas.[6]

6.3.1   Syntax

DIML will be two-sorted like Kaplan's LD. Let DVAR be the set of object variables containing x, y, z and their indexed variants, PVAR be the set of place variables containing p and its indexed variants, and VAR be the union of these two sets. Likewise, DCON and PCON containing sequences of one or more letters shall be the set of constants and term operators for objects and places respectively, and let CON be their union. Then for the set of object terms DTERM the condition $(\text{DVAR} \cup \text{DCON}) \subseteq \text{DTERM}$ holds, but this set may contain iota terms as well. The place terms are in $\text{PTERMS} = \text{PVAR} \cup \text{PCON}$, and as another auxiliary definition let TERM be the union of DTERM and PTERM. Predicates are sequences of lower-case letters (except for those already in TERM) and the set of predicates PRED will be sorted into sets PRED_n^m according to the number n of elements in DTERM and subsequently the number m of elements in PTERM they allow in argument position ($n, m \in \mathbb{N}_0$). Quantifiers are $\text{QUANT1} = \{\forall^*, \exists^*\}$ and $\text{QUANT2} = \{\imath*\}$. The set of junctors contains the standard connectives $\text{JUN} = \text{JUN1} \cup \text{JUN2}$, where $\text{JUN1} = \{\neg\}$ and $\text{JUN2} = \{\wedge, \vee, \equiv, \supset\}$. Instead of using simple modality indices, modal operators are defined explicitly. For current purposes, this set MOD will contain the following expressions: $\triangle, \triangledown, \square, \lozenge$, Past, Fut, Always, TwoDaysAgo, Actually, Now, and Yesterday. Given these basic ingredients, the set WFF of well-formed formulas of DIML is defined as follows.

$$
\begin{aligned}
\text{WFF} := \; & \text{JUN1 WFF} \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (6.1) \\
& | \; (\text{WFF JUN2 WFF}) \\
& | \; \text{PRED}_n^m(\text{DTERM}_1, \ldots, \text{DTERM}_n, \text{PTERM}_1, \ldots, \text{PTERM}_m) \\
& | \; \text{QUANT1 VAR WFF} \; | \; \text{QUANT2 VAR (WFF) WFF} \\
& | \; \text{MOD WFF}
\end{aligned}
$$

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[6]See (Kaplan 1989, pp. 541-46) for the original LD formalism.

To ease the discussion of examples, the operators Δ and ∇ will also be allowed to operate on terms:

$$\text{TERM} := \Delta\text{TERM} \mid \nabla\text{TERM} \tag{6.2}$$

Furthermore, any member of PRED_0^0 is stipulated to be in WFF as well, since 0-place predicates act like propositional constants. Be for later reference $\text{EXPR} = \text{PRED} \cup \text{TERM} \cup \text{WFF}$. Redundant parentheses and parentheses around the arguments of unary predicates may be left out for better readability. The following special terms are used.

$$I \in \text{DCON} \tag{6.3}$$
$$here \in \text{PCON} \tag{6.4}$$

And the following special predicates are stipulated:

$$exist \in \text{PRED}_1^0 \tag{6.5}$$
$$located \in \text{PRED}_1^1 \tag{6.6}$$

This is more or less a standard syntax, except for the fact that some sequences of lower-case letters may be predicates, some may be special constants, and some may be operators. However, the sort of such expressions will always be given explicitly by rules like 6.1, and so in case of doubt the definition can be checked.

6.3.2 Semantics

The semantics of DIML spells out in detail what has been said in the introductory section. The basic objects of a DIML model reside in a set of contexts C, a non-empty set of modal indices I, and a domain of objects D. In order to deal with multiple modalities but keep the indices simple it is convenient to assume functions from modal indices to worlds W and times T respectively, as in the following definition.

$$world : (C \cup I) \to W \tag{6.7}$$
$$time : (C \cup I) \to T \tag{6.8}$$

Since contexts are more fine-grained than modal indices, some additional functions are needed that are only defined on contexts. For the examples, we'll need a set of speakers S, which is a subset of the domain $S \subset D$ of a given model, and the following functions:

$$speaker : C \to S \tag{6.9}$$
$$place : C \to P \tag{6.10}$$
$$index : C \to I \tag{6.11}$$

This way of dealing with contexts and modal indices is an alternative to regarding them as n-tuples consisting of a world, a time, a place, and a speaker. To allow mappings between indices and contexts an infix operator $\lhd$ will be used as follows. The expression $c \lhd w$ yields a context

c' that is the same as c except that $world(c') = w$, and likewise for indices on the left hand side and times and places respectively on the right hand side. So for example, $i \lhd time(c)$ is the index i' that is the same as i except that $time(i') = time(c)$. We cannot assign speakers or groups of addressees to indices, though, since this would make no sense unless there were modal operators that would operate on these kinds of entities. So $index$ maps a given context to the corresponding index that has the same world and time as the context, and ignores other aspects of it. Times and places have to be ordered. For example, the time intervals in T have to be partially ordered, i.e. by a temporal before–after relation that is transitive, reflexive, and antisymmetric, in order to be usable as representations of the tense system based on Comrie (1985) outlined in section 5.3.3 of chapter 5. For present purposes, equality $=$ and the strict partial ordering relation $<$ will do for tenses. A more detailed temporal semantics would need to take into account some additional relations dealing with the overlapping and containment of time intervals.[7] In order to deal with calendric expressions, calendric functions like $day(t)$ have to be stipulated, but their implementation details will be left open here. Likewise, places are internally structured and ordered by mereological relations like part-of, but the details will be omitted.[8]

Given these prerequisites, a frame of DIML is a tuple $F = (C, I, D, W, T, P, R)$ containing a set of contexts C, a set of modal indices I, the domain of objects D, the subsidiary sets of times T, worlds W, and places P, and a set of accessibility relations R for each modality defined. For each of the accessibility relations $R_i \in R$ it must either be the case that $R_i \subseteq (W \times W)$ or $R_i \subseteq (T \times T)$ in order to account for alethic or doxastic modalities and temporal operators in the standard way of multi-modal normal modal logic.[9] A model M of DIML based on frame $F = (C, I, D, W, T, P, R)$ is then a tuple consisting of all the elements in F plus an interpretation function $[\![.]\!]$. We use the same function $[\![.]\!]$ to interpret terms, predicates, and formulas alike. We'll write $[\![\mathrm{EXPR}]\!]_g^M (c)(i)$ for the interpretation of EXPR in model M under variable assignment g with respect to a given context c and a modal index i. The interpretation must map expressions into a domain that matches their syntactic sort as follows, where ASG is the set of possible variable assignments:

$$[\![.]\!]^M : \mathrm{DTERM} \times ASG \times C \to D^I \tag{6.12}$$

$$[\![.]\!]^M : \mathrm{PTERM} \times ASG \times C \to P^I \tag{6.13}$$

$$[\![.]\!]^M : \mathrm{PRED}_n^m \times ASG \times C \to (D_1 \times \cdots \times D_n \times P_1 \times \cdots \times P_m)^I \tag{6.14}$$

$$[\![.]\!]^M : \mathrm{WFF} \times ASG \times C \to \{1, 0\}^I \tag{6.15}$$

Notice that these conditions partly characterize two functions. Following the exposition in the last section, the first one, $[\![.]\!]_g^M$ is the character, the second one $[\![.]\!]_g^M (c)$ the content, and the final result $[\![.]\!]_g^M (c)(i)$ is the extension of the given given expression in relation to assignment g, context c, and modal index i. Two special term interpretation rules have to be added to deal

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[7]See (Allen 1983), (Ladkin 1987), and (van Benthem 1991).

[8]See (Simons 1987) and (Smith and Burkhardt 1991) for some general overviews.

[9]Place operators with modalities based on $P \times P$ would be possible, too, but will not be used, because place terms are available in the object language.

with I and *here* respectively.

$$\text{For any } c \in C, i \in I :$$

$$\llbracket I \rrbracket_g^M (c)(i) = speaker(c) \tag{6.16}$$

$$\llbracket here \rrbracket_g^M (c)(i) = place(c) \tag{6.17}$$

So the character of I is a function that takes a context and yields a content that is a function that for an arbitrary modal index yields the speaker of the context, and respectively for the place of the context and *here*. Furthermore, Kaplan uses special semantic rules for the existence predicate and being located at a certain place.

$$\text{For } x \in D, p \in P, c \in C, i \in I :$$

$$\text{there is a } c \text{ and an } i \text{ s.t. } x \in \llbracket exist \rrbracket_g^M (c)(i) \tag{6.18}$$

$$\langle speaker(c), place(c) \rangle \in \llbracket located \rrbracket_g^M (c)(i \lhd time(c) \lhd world(c)) \tag{6.19}$$

$$\langle x, p \rangle \in \llbracket located \rrbracket_g^M (c)(i) \supset x \in \llbracket exist \rrbracket_g^M (c)(i) \tag{6.20}$$

These constraints ensure that any object exists at some context, that the speaker of a context is located at the place of that context, and whenever something is located at some place in some context and given modal index, then it must also exist with respect to that context and modal index. Two further special rules for the so-called diagonalization and dthat operators are needed:

$$\llbracket \Delta \text{TERM} \rrbracket_g^M (c)(i) := \llbracket \text{TERM} \rrbracket_g^M (c \lhd world(i) \lhd time(i)) \tag{6.21}$$

$$\llbracket \nabla \text{TERM} \rrbracket_g^M (c)(i) := \llbracket \text{TERM} \rrbracket_g^M (c)(index(c)) \tag{6.22}$$

Finally, truth in a model has to be defined for formulas, which is accomplished by the following chunk of definitions.

$$(6.23) \quad \llbracket \text{PRED}(\text{TERM}_1, \ldots, \text{TERM}_n) \rrbracket_g^M (c)(i)$$
$$= \begin{cases} 1 \text{ if } \langle \llbracket \text{TERM}_1 \rrbracket_g^M (c)(i), \ldots, \llbracket \text{TERM}_n \rrbracket_g^M (c)(i) \rangle \in \llbracket \text{PRED} \rrbracket_g^M (c)(i); \\ 0 \text{ otherwise} \end{cases}$$

$$(6.24) \quad \llbracket \neg \text{WFF} \rrbracket_g^M (c)(i)$$
$$= \begin{cases} 1 \text{ if } \llbracket \text{WFF} \rrbracket_g^M (c)(i) = 0; \\ 0 \text{ otherwise} \end{cases}$$

$$(6.25) \quad \llbracket \text{WFF}_1 \wedge \text{WFF}_2 \rrbracket_g^M (c)(i)$$
$$= \begin{cases} 1 \text{ if } \llbracket \text{WFF}_1 \rrbracket_g^M (c)(i) = 1 \text{ and } \llbracket \text{WFF}_2 \rrbracket_g^M (c)(i) = 1; \\ 0 \text{ otherwise} \end{cases}$$

$$(6.26) \quad \llbracket \exists^* \text{ VAR WFF} \rrbracket_g^M (c)(i)$$
$$= \begin{cases} 1 \text{ if there's an } h \approx_{\text{VAR}} g \text{ such that } \llbracket \text{WFF} \rrbracket_h^M (c)(i) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.27) $[\![\forall^*\ \text{VAR}\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if for all } h \approx_{\text{VAR}} g \text{ it is the case that } [\![\text{WFF}]\!]_h^M (c)(i) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.28) $[\![\Box\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if in all } w \in W \text{ such that } R_\Box(world(i), w) : \\ \quad [\![\text{WFF}]\!]_g^M (c)(i \lhd w) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.29) $[\![\text{Actually}\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if } [\![\text{WFF}]\!]_g^M (c)(i \lhd world(c)) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.30) $[\![\text{Now}\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if } [\![\text{WFF}]\!]_g^M (c)(i \lhd time(c)) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.31) $[\![\text{Always}\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if for all } t \in T : [\![\text{WFF}]\!]_g^M (c)(i \lhd t) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.32) $[\![\text{Past}\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if for some } t < time(c) : [\![\text{WFF}]\!]_g^M (c)(i \lhd t) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.33) $[\![\text{Fut}\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if for some } t > time(c) : [\![\text{WFF}]\!]_g^M (c)(i \lhd t) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.34) $[\![\text{TwoDaysAgo}\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if } [\![\text{WFF}]\!]_g^M (c)(i \lhd t) = 1, \\ \quad \text{where } t = day(time(i)) - 2\, days \\ \quad \text{(assuming calendric arithmetics)}; \\ 0 \text{ otherwise} \end{cases}$$

(6.35) $[\![\text{Yesterday}\ \text{WFF}]\!]_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if } [\![\text{WFF}]\!]_g^M (c)(i \lhd t) = 1, \\ \quad \text{where } t = day(time(c)) - 1\, day \\ \quad \text{(assuming calendric arithmetics)}; \\ 0 \text{ otherwise} \end{cases}$$

(6.36) $\llbracket \nabla \text{WFF} \rrbracket_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if } \llbracket \text{WFF} \rrbracket_g^M (c)(index(c)) = 1; \\ 0 \text{ otherwise} \end{cases}$$

(6.37) $\llbracket \Delta \text{WFF} \rrbracket_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if } \llbracket \text{WFF} \rrbracket_g^M (c')(i) = 1, \\ \qquad \text{where } c' = (c \lhd world(i) \lhd time(i)); \\ 0 \text{ otherwise} \end{cases}$$

(6.38) $\llbracket \imath * \text{VAR WFF}_1 \text{ WFF}_2 \rrbracket_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if there's exactly one } h \approx_{\text{VAR}} g \text{ such that} \\ \qquad \llbracket \text{WFF}_1 \rrbracket_h^M = 1, \text{ and for this } h \text{ it is the case that} \\ \qquad \llbracket \text{WFF}_2 \rrbracket_h^M = 1; \\ 0 \text{ otherwise} \end{cases}$$

6.3.3 Indirect Speech and Belief Operators

The usual way of implementing indirect speech and attitudes is to make them depend on the content of what has been said. In this view, belief and indirect speech are modal operators as in first-order modal logic. This can either be done by adding a modal operator based on a dyadic accessibility for each speaker or, as in chapter 4, by introducing a third place for the speaker in the accessibility relation. Since there are only finitely many speakers, the difference doesn't really matter. In the following addition to DIML a triadic accessibility relation is used, where S is a finite subset of the domain D and MOD2 is the set of modal operators taking a WFF and an object term.

$$\text{WFF} := \text{MOD2}_{\text{DTERM}} \text{WFF} \tag{6.39}$$

(6.40) $\llbracket \text{Say}_{\text{DTERM}} \text{WFF} \rrbracket_g^M (c)(i)$

$$= \begin{cases} 1 \text{ if } \llbracket \text{DTERM} \rrbracket_g^M (c)(i) \in S \text{ and in all } w \in W \text{ such that} \\ \qquad R_{\text{Say}}(world(i), w, \llbracket \text{DTERM} \rrbracket_g^M (c)(i)) : \\ \qquad \llbracket \text{WFF} \rrbracket_g^M (c)(i \lhd w) = 1; \\ 0 \text{ otherwise} \end{cases}$$

Analogous definitions for Believe and other attitudes can be assumed, which only differ in the respective accessibility relation. As before, KD45 modality will be assumed for rational belief, whereas R_{Say} is a sheer K modality. Kaplan (1989) discusses adding an operator like the above one to the object language, but also suggests a form of believe that is a relation between the attitude holder, the content, and the character of an expression, where the character represents cognitive content.[10] Referential opacity in attitude ascriptions can to some extent be dealt with

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[10]See (Kaplan 1989, pp. 553-7), (Kaplan 1990b, pp. 39-49).

this. However, this account is limited for expressing cognitive content, because it cannot encode behaviorally relevant differences between two tokens of the same type if features of their context of utterance aren't taken into account as an additional individuation criterion in the meantime.

6.3.4   Technical Remarks

Before entering the philosophical discussion of DIML, some mostly technical issues have to be addressed.

[1] Since indices and contexts are mapped to W, T, P by functions, these sets are in a sense auxiliary and the choice to make them part of a DIML frame is not mandatory. In DIML, all of these sets are put into a frame just to be explicit, even if this involves some kind of redundancy. Notice, however, that DIML frames in the end boil down to Kripke structures and the semantics of DIML is traditional Kripke semantics, since accessibility relations in these frames are no more than binary relations over sets of states in W, T, or P, or ternary relations that can be reduced to finitely many binary relations, as there are only finitely many speakers. The fact that these states are sorted into worlds and times doesn't have any significant semantic effect; it merely has to do with the way various modal operators are interpreted informally. From a purely formal perspective the modal operators could also just run over the same set of abstract state indices.

[2] Following Haas-Spohn (1994, pp. 29-32), ∇ is called syntactic dthat operator and Δ is called syntactic diagonal operator.[11] In contrast to definitions 6.3.2 and 6.3.2, Kaplan (1989) uses a version of dthat that operates only on terms. Furthermore, it must be mentioned that the diagonalization operator has originally been devised by Stalnaker (1978) for a different purpose than the one here, namely that of manipulating propositional concepts in modeling the pragmatics of beliefs shared by discourse participants.

[3] Following Kaplan with this respect, DIML is two sorted, but instead it could have been made 1-sorted and *here* could have been defined as sentential operator. The question what arguments a predicate should have is primarily a matter of the syntax–semantics interface, i.e. of the mapping from source to target language, and to another part a matter of philosophical deliberation. If places were part of contexts, this would mean that truth in a model is relativized to places. Hence, no placeless statement could be made. Given that a place can comprise the whole universe plus arbitrary ethereal locations, this doesn't seem to pose any problems, but to some philosophers relativizing truth to places might still not be acceptable.

[4] Kaplan uses an operator *the* on terms that works exactly like a iota operator, and in order to deal with empty (non-denoting) terms he introduces an alien object † that is denoted by a term that doesn't denote. This trick allows one to deal with non-denoting terms while avoiding the cumbersome use of partial functions. Whether it is also legitimate and elegant is controver-

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[11]Other symbols sometimes used are @ for dthat and † for the diagonal operator. Cf. (Van Rooji 2006, p. 32-3).

sial; in DIML this issue is avoided by using the iota quantifier.

[5] In the version of FOML used earlier, ι was defined by means of the existence-relativized existential quantifier. In contrast to this, the $\iota*$ quantifier above is possibilist. In order to also have an existence-relativized quantifier, the following definition is needed.

$$\iota\,\mathrm{VAR}[\mathrm{WFF}_1]\mathrm{WFF}_2 := \iota * \mathrm{VAR}[exist(\mathrm{VAR}) \wedge \mathrm{WFF}_1]\mathrm{WFF}_2 \tag{6.41}$$

There is, however, a problem with this definition and operators like Δ or ∇. The restriction of for example $\iota x[\Delta Fx]Gx$ will expand to $exist(x) \wedge \Delta Fx$. When it is needed within the priority scope of an operator, the existence predicate will have to be put explicitly into the quantifier restriction.

6.4 Examples and Discussion

6.4.1 Indexicals

For the following example, let's assume an additional operator.

$$(6.42) \quad [\![22\mathrm{thFebruary\,WFF}]\!]_g^M\,(c)(i)$$
$$= \begin{cases} 1 \text{ if } [\![\mathrm{WFF}]\!]_g^M\,(c)(i \lhd t) = 1, \\ \quad \text{where } t \text{ is the 22.2. of } year(time(i)) \\ \quad \text{(assuming calendric arithmetics);} \\ 0 \text{ otherwise} \end{cases}$$

In the following examples, 6.43 faithfully reports 6.45 and analyzed as 6.44, whereas 6.45 is mapped to 6.46 in the target language DIML. Since the day of the context c is the 27th February, 6.44 is true in M if and only if Alice said at some time in the past that she was sick on the 26th February, whether she uses indexicals like «yesterday» or calendric expressions to convey this information. Yesterday depends on the context and has stable content. In contrast to this, «two days ago» is analyzed as a non-rigid expression: TwoDaysAgo depends on the index, i.e. it is a temporal operator that picks out the day before the day of the index. So 6.48 is true in M if and only if Alice said at some time in the past of 27th February that she was sick on the 22th February of the year of the index, which in this case must be stipulated to be the same year as the year of the context of utterance.

(6.43) *Bob on 27th February:* Alice said that she was sick yesterday.

(6.44) $M, g, c, i \vDash \iota x Ax\mathrm{Past\,Say}_x\,\mathrm{Past\,Yesterday}\,sick(x)$

(6.45) *Alice on 27th February:* I was sick yesterday.

(6.46) $M, g, c, i \vDash \mathrm{Past\,Yesterday}\,sick(I)$

(6.47) *Bob on 27th February:* Alice said on 22th February that she was sick two days ago.

(6.48) $M, g, c, i \vDash \imath x A x \operatorname{Past} 22\text{thFebruary} \operatorname{Say}_x \operatorname{Past} \operatorname{TwoDaysAgo} sick(x)$

The indicator «yesterday» is rigid and «two days ago» is read as a non-rigid expression with respect to time. It doesn't matter whether «two days ago» can also be understood as rigid expression, since this reading could simply be mapped to a respective *day before yesterday* indicator that would work like «yesterday».[12]

One of Kaplan's motivations for parameterizing the context of utterance is that it allows for distinctions in truth-conditions that are relevant from a philosophical point of view. In LD and DIML formulas like 6.50 will be true in all contexts, whereas 6.51 might still be false.

(6.49) I exist now.

(6.50) $M, g, c, i \vDash \operatorname{Now} exist(I)$

(6.51) Necessarily I exist now.

(6.52) $M, g, c, i \vDash \Box \operatorname{Now} exist(I)$

This is the case because of a deliberate stipulation 6.18. Another matter is whether this stipulation really should hold. According to the purely token-reflexive view on indexicals it ought not hold, because it is trivial to conceive contexts in which a token ‹I› of 6.49 doesn't denote. Deceased people may leave strange messages to posterity on their desk, or a random-number generator based on radioactive decay combined with a simple context-free grammar might eventually produce 6.49. On the other hand, 6.18 is implicit to the utterance-based account, because an utterance is always made by a speaker at some time. In this view 6.49 is understood in the sense of *whoever speaker utters ‹6.49› at the time of utterance exists at the time of utterance by virtue of the fact that an utterance is uttered by someone*. So Kaplan's stipulation does make sense, as long as it is not taken as a metaphysical claim about the existence of Cartesian Egos or something alike. All it says is that if a proper context of utterance is such that it involves an utterer, then the utterer exists in that context. It is based on the silent, but reasonable assumption that non-existent things like Superman cannot *actually* utter something.

6.4.2 Demonstratives

Following section 5.4.2 of the last chapter, the use of a demonstrative can be analyzed by taking its pointing gesture as a definite description. This is Kaplan's opinion with one caveat. He emphasizes that demonstratives are rigid and that therefore the character of a demonstrative cannot be *solely* given by a definite description. This theory, which he calls a Fregean theory of demonstrations, would be inadequate, because definite descriptions don't ensure rigidity and the character of a singular term must be understood as a way to fix the referent, not as a way

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[12]Kaplan uses «one day ago», but some of my informants considered a non-rigid reading of this expression very marked. It seems also that a non-rigid reading is more preferred if the past time interval is given by a calendric expression like «on 22nd February» than if it is given by an indexical like «last week».

to supply a synonym.[13] If the pointing gesture is abstracted into a definite description, this description must at least be rigidified by means of ∇ dthat. To give one example in DIML:

(6.53) $\underset{\longrightarrow}{\text{He}}$ now lives in Princeton, New Jersey. (Kaplan 1989, p. 516)

(6.54) $M, g, c, i \vDash \text{Now } \imath x[\nabla \delta(x)][livein(x, Princeton)]$

If we had the iota operator available, ‹he› in 6.53 could be analyzed as $\iota x \nabla \delta(x)$, where δ would be a description derived from the pointing gesture. The character of this expression represents the meaning of this demonstrative, but *meaning* should in this case only be read as *the formal analogon to the pointing gesture that fixes the semantic referent of the use of the demonstrative*. Kaplan goes on to argue against the wide scope theory and in favor of the direct reference view in a rather tricky way. He names the 'proposition' expressed by 6.54 and considers it under counterfactual circumstances. Assuming Millianism, the demonstrative will remain rigid.[14] However, the wide scope theory cannot be applied, because no modal operator is involved. As laid out in detail in chapter 3, arguments like that aren't very convincing and potentially obfuscate the source–target language distinction. Apart from Kaplan's endorsement of the direct reference view and problematic features thereof, such as the immediacy of reference metaphor, his analysis of demonstratives is fully acceptable. Following (Ind 3) of the last chapter, it could be extended by putting the various selectional criteria of a demonstrative's use into its respective definite description, i.e. into the characterization of its character. This will be done in the next chapter using a slightly different framework based on first-order predicate logic.

6.4.3   The Role of Dthat and Diagonalization

A feature of double-index theories in general is that they technically make it feasible to conveniently map back-and-forth between modal indices and contexts of utterance by using the diagonalization Δ and dthat ∇ operators. Despite watering the conceptual distinction between contexts of utterance and modal indices, these operations have been considered important by many philosophers of language and some epistemologists, who believe that possible world semantics can give us new insights into epistemological questions. ∇ (dthat) can be used to rigidify a definite description and thus to analyze Donnellan's referential uses of definite descriptions (Donnellan 1966), as suggested by Kaplan (1990a), but also, this time definitely not in the spirit of Kaplan, for the heretic purpose of giving a description analysis of proper names within a framework that also deals with indexicals. Regarding the first suggestion, take a look at the reading according to which the description in 6.55 might be true. This can be analyzed as 6.56.

(6.55) It is possible that the president of the United States weren't the president of the United States.

(6.56) $M, g, c, i \vDash \Diamond \imath x[\nabla(exists(x) \land Px)]\neg Px$

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[13]See (Kaplan 1989, pp.516-9).
[14]See (Kaplan 1989, p. 517).

∇ ensures that the restriction $exists(c) \land Px$ is evaluated with respect to $index(c)$ and therefore rigid with respect to the modal operator. New in this view isn't the rigidification operation itself, but its conceptual underpinnings. The semantic referent of certain expressions depends on the actual context of utterance and *for that reason* they are rigid. Regarding the second suggestion, consider how the converse operation diagonalization works. Suppose Bob is unbeknown to Alice also known under the name «Chuck» among some of his friends. Now take a look at the following example and partial DIML evaluation, where the constants Bob and $Chuck$ denote Bob and are the target language analogues of «Bob» and «Chuck».

(6.57) Alice believes that Bob isn't Chuck.

(6.58) $M, g, c, i \vDash \text{Believe}_{Alice} \Delta \neg (Bob = Chuck)$

$\quad\quad\quad\quad\Updownarrow$

$\quad\quad$ for all $w \in W$ s.t. $R_{believe}(world(i), w, \llbracket Alice \rrbracket_g^M (c)(i))$:

$\quad\quad M, g, c, i \lhd w \vDash \Delta \neg (Bob = Chuck)$

$\quad\quad\quad\quad\Updownarrow$

$\quad\quad$ for all $w \in W$ s.t. $R_{believe}(world(i), w, \llbracket Alice \rrbracket_g^M (c)(i))$:

$\quad\quad M, g, c \lhd w \lhd time(i), i \lhd w \vDash \neg (Bob = Chuck)$

If the constants used to represent proper names are stable with respect to indices, i.e. rigid, but not stable with respect to characters, then it can be the case that 6.58 because of 6.59.

$$\llbracket Bob \rrbracket_g^M (c \lhd w \lhd time(i))(i \lhd w) \neq \llbracket Chuck \rrbracket_g^M (c \lhd w \lhd time(i))(i \lhd w) \tag{6.59}$$

$$\forall i : \llbracket Bob \rrbracket_g^M (c)(i) = \llbracket Chuck \rrbracket_g^M (c)(i) \tag{6.60}$$

6.59 may hold even if Bob and Chuck are indeed the same person at every index 6.60 for some c. The diagonalization operator ensures that the expressions it is applied to, i.e. in this case constants and the equality relation where the latter ought to have stable character, are evaluated with respect to only those contexts that are compatible with the indices that the embedding modal operator implicitly quantifies over, i.e. in this case the worlds accessible by Alice's belief relation. So diagonalization can be used to express speaker reference without having to resort to subjective identification criteria that seemingly would make the account non-compositional. As has been laid out in chapter 4, the corresponding effect can be achieved in a single-index theory by using non-rigid constants, adopting the wide scope theory of proper names, or using a relativized actuality operator. Whether the conceptual differences of these accounts to the two-dimensional are huge or small depends on the viewpoint and cannot be judged from the formal properties of the systems alone. On one hand, it may be argued that using diagonalization in a double-index framework maintains the direct reference view, while at the same time being able to deal with cases of subjective meaning and speaker reference. On the other hand, diagonalizing rigid expressions like indicators can on equal footing be taken as support for a description theory of reference, since a diagonalized singular term occurring in the scope of a doxastic modal operator will denote whatever object the respective attitude holder believes, fears, or hopes it denotes according to its character, i.e. according to the formal means of representing its reference rule.

6.5 Shifters in Double-index Modal Logic

6.5.1 Monsters

The following classification of operators or functors in double-index theories is useful.

☆ **Definition 1** (Classification of Operators in Double-index Frameworks). *In a double-index theory an operator or functor α applied to β is...*

1. *extensional iff $[\![\alpha(\beta)]\!] (c)(i) \equiv [\![\alpha(\beta)]\!] (c')(j)$*

2. *intensional iff for some c and some β: $[\![\alpha(\beta)]\!] (c)(i) \neq [\![\alpha(\beta)]\!] (c)(j)$*

3. *localizing iff for some c, c' and some β: $[\![\alpha(\beta)]\!] (c)(i) \neq [\![\alpha(\beta)]\!] (c')(i)$*

4. *a monster iff it is intensional and localizing,*

where c, c' are contexts and i, j are indices.

The term *monster* goes back to Kaplan (1989), who stipulates that these kind of operators don't exist in natural languages, i.e. that there are no expressions in natural languages that have to be analyzed as monster operators. Although Kaplan doesn't further back up this claim, it is prima facie compelling, since the context of an utterance is an extralinguistic entity. When the diagonalization operator is not used, the context of utterance is the actual situation in which an utterance is made and that has concrete features like a speaker, a time, or being at a certain location. It seems plausible to deny that there are linguistic expressions whose interpretation changes or influences the context in which they have been uttered, and this is even more plausible if the distinction between source and target language is taken seriously. Nevertheless, as Perry and Israel (1996) point out, Kaplan's monster prohibition is an ad hoc constraint. Finally, Schlenker (2000) takes the data on shifters as evidence that the monster prohibition doesn't hold. To see why this is the case, let's take a look at one of Schlenker's examples:

(5.32) ǰon   ǰəgna   nə-ññ   yɨl-all
        *John   hero   be.*PF*-1sO   3M.*say*-AUX.3M*
        'John says that he is a hero.'
      (Schlenker 2003, p. 68)

The Amharic equivalent of «I» must be evaluated with respect to the reported speech act introduced by the Amharic verb of indirect speech. Since the verb is analyzed as an intensional operator, and the shifting of the context is localizing, the resulting analysis will be monstrous.[15]

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[15]There are ways to circumvent this result by using an alternative technical apparatus. See for example (von Stechow 2003). Target language restrictions such as the monster prohibition often just hold for some analysis and under certain assumptions concerning the syntax–semantics interface.

6.5.2   Shifters and Diagonalization

As both English and Amharic first-person indicators have to be expressible in the target language, because the target language must be universal, not just one operator that shifts the context of utterance can be used for analyzing the Amharic and English verbs of indirect speech. The English verb of saying doesn't shift the context. Moreover, just supposing that attitude verbs unselectively change the context parameter would make very strong predictions; either all or none indexicals would be shifted when they occur in a verb of indirect speech. According to Anand and Nevins (2003) this is the case in Dimli, but it may not hold for other languages. One way to alleviate this problem is to implement the verb of speech as a context binder and introduce context variables into the object language, and this is for example done in Schlenker (2003) and will also be done here in the next chapter. If we want to stay within the realms of DIML some simpler mechanism is needed. Diagonalization is localizing and can therefore do the job to some extent:

☆ **Abbreviation 1** (Amharic First-Person Indexical in DIML)**.**

$$I^{Amh} := \Delta I \tag{6.61}$$

This only works as intended, as long as it is additionally stipulated that a context of utterance whose world is compatible with what some speaker said is a context whose agent is besaid speaker, as expressed by the following constraint.

☆ **Constraint 1** (DIML Speaker Contexts)**.**

$$\forall c \in C \, \forall w \in W \, \forall x \in D :$$
$$R_{Say}(w, world(c), x) \supset speaker(c) = x \tag{6.62}$$

The following sample computation shows what is going on under the hood:

$$M, g, c, i \vDash \mathrm{Say}_{John} hero(I^{Amh}) \tag{6.63}$$

$$\Updownarrow$$

$$M, g, c, i \vDash \mathrm{Say}_{John} hero(\Delta I) \tag{6.64}$$

$$\Updownarrow$$

$$\text{for all } w \in W \text{ s.t. } R_{Say}(world(i), w, [\![John]\!]_g^M(c)(i)) :$$
$$M, g, c, i \lhd w \vDash hero(\Delta I) \tag{6.65}$$

$$\Updownarrow$$

$$\text{for all } w \in W \text{ s.t. } R_{Say}(world(i), w, [\![John]\!]_g^M(c)(i)) :$$
$$\langle [\![\Delta I]\!]_g^M(c)(i \lhd w) \rangle \in [\![hero]\!]_g^M(c)(i \lhd w) \tag{6.66}$$

$$\Updownarrow$$

$$\text{for all } w \in W \text{ s.t. } R_{Say}(world(i), w, [\![John]\!]_g^M(c)(i)) :$$
$$\langle [\![I]\!]_g^M(c \lhd w \lhd time(i))(i \lhd w) \rangle \in [\![hero]\!]_g^M(c)(i \lhd w) \tag{6.67}$$

$$\Updownarrow$$

$$\text{for all } w \in W \text{ s.t. } R_{Say}(world(i), w, [\![John]\!]_g^M (c)(i)) :$$

$$speaker(c \lhd w \lhd time(i)) \in [\![hero]\!]_g^M (c)(i \lhd w) \tag{6.68}$$

It then follows from 6.62 that $speaker(c \lhd w \lhd time(i))$ is John. The problem with this method is that a stipulation like 6.62 is generally dubious, because it is a technical solution without independent informal justification. Without going one step further and introducing contexts into the object language, a better solution is to use some implicit binding mechanism that works the same way as the one discussed in chapter 4.

6.5.3 Language SDML

Let language SDML be the same as DIML except for the following changes. First, $[\![.]\!]$ is redefined to take a storage parameter ν for contexts into account, and the initial value of ν is *undefined*. Conditional assignment to this operator then works analogous to the way it was done in section 4.6.1 of chapter 4.

$$\nu \leftarrow c = \begin{cases} c \text{ if } \nu = undefined \\ \nu \text{ otherwise} \end{cases} \tag{6.69}$$

The Say operator pushes a designated context value onto this parameter, namely the reported speech act. For this a function must be stipulated that yields the reported speech act in dependence of the speaker reporting it, the reporting context, and the index:

$$rsa : S \times C \times I \rightarrow C \tag{6.70}$$

The revised operator is then:

$$(6.71) \quad [\![\text{Say}_{\text{DTERM}} \text{ WFF}]\!]_{g,\nu}^M (c)(i)$$
$$= \begin{cases} 1 \text{ if for } \nu' = \nu \leftarrow rsa([\![\text{DTERM}]\!]_{g,\nu}^M (c)(i), c, i) : \\ \quad \text{in all } w \in W \text{ such that } : \\ \quad R_{\text{Say}}(world(i), w, [\![\text{DTERM}]\!]_{g,\nu}^M (c)(i)) : \\ \quad [\![\text{WFF}]\!]_{g,\nu'}^M (c)(i \lhd w) = 1; \\ 0 \text{ otherwise} \end{cases}$$

The Amharic first-person indexical then retrieves this value if available, whereas the English one is evaluated with respect to the actual context as before.

$$[\![I^{Amh}]\!]_{g,\nu}^M (c)(i) = \begin{cases} speaker(c) \text{ if } \nu = undefined \\ speaker(\nu) \text{ otherwise} \end{cases} \tag{6.72}$$

This is preferable to the diagonalization approach, as long as shifters depend on the reported speech act introduced by the first verb of indirect speech in a sequence of nested uses of verbs of indirect speech. This would be analogous to the way in which de dicto readings of proper names

have been analyzed with respect to the modal index. If on the other hand this is not the case and in nested verbs of indirect speech the respectively *latest* reported speech act (from left to right, earlier to later) is relevant for the evaluation of a shifter, then the conditional assignment operation has to be changed to an unconditional one. Which analysis is adequate is a language-dependent, empirical question.[16]

6.6 Shortcomings

There are some shortcomings to the way DIML is used above. Three of them will be briefly addressed in the following subsections, but only one of them, Cresswell's argument, indicates an expressive limitation of DIML itself. The others just point out in which respect the above analyses remain too coarse-grained. There are other limitations that will not be addressed, because they don't concern indexicals in particular. For example, it is well known that normal modal logic is only suitable for encoding rational belief closed under deduction, not any notion of belief. Double-index modal logic provides an adequate analysis of indexicals up to a certain degree, just as any kind of formal modeling of linguistic expressions only captures aspects thereof and will invariably be based on certain idealizations.

6.6.1 Cresswell's Argument

Cresswell (1990) argues that full quantification over modal indices is needed for any reasonable and descriptively adequate analysis of natural language.[17] He considers more and more complex linguistic examples whose analysis would require referring back to more and more indices. Here is one such example:

(6.73) If the economic climate had been favorable it would have been desirable that some who are not actually rich but would then have been rich be poor. (Cresswell 1990, p. 40)

   Figure 6.1 illustrates the dependencies in this example. The «then» causes evaluation to jump back to the economically favorable worlds, whereas «actually» jumps back to the actual world.

   Similar examples can be found for the spatial and temporal domain. Cresswell argues that in principle more and more complex examples that require evaluation to jump back to previous worlds can be constructed. A mechanism is needed in order to store n indices for later retrieval and retrieve them later during evaluation of the target language formulas from left to right. If formulas can be of finite, but arbitrary length (without upper bound), then denumerably infinite many storage places for indices are needed, and this amounts, according to Cresswell (1990), to full quantification over indices. One may object to this argument that in fact only finitely long formulas of a certain length can be processed, and that any fixed, finite number of jumps in evaluation can be dealt with by storing and retrieving a fixed number of indices, which is for example possible in hybrid logic with downarrow and at operator. The problem with only

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[16]Unfortunately, in the present case it couldn't be decided due to lack of Amharic informants.

[17]Schlenker (2003, pp. 44-9) presents a shortened version of Cresswell's argument.

w_0 actual world

$w_1, w_1', w_1'', \ldots$ economically favorable worlds

$w_2, w_2', w_2'', \ldots$ desirable worlds

$\exists x \neg \ \underline{\text{actually}} \ rich(x) \wedge \underline{\text{then}} \ rich(x) \wedge \underline{\text{poor}}(x)$
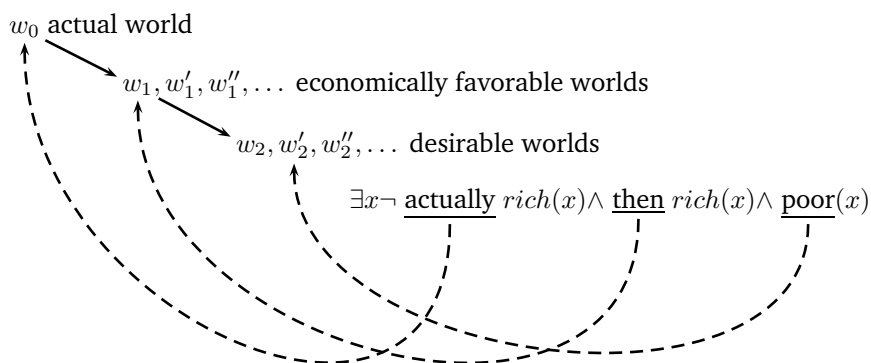
Figure 6.1: Evaluation dependencies of example 6.73, indicated by dotted lines.

allowing a fixed number of finitely many indices to be stored and retrieved is that it assumes an ad hoc limit, an upper bound on the number of indices, which isn't desirable in general. This is comparable to using non-recursive grammars in syntax, that can only be used to parse or produce sentences of finite length. To such grammars it can be objected that we have the competence to parse *arbitrary long* finite sentences, although we lack the performance to do so. By the same token it can be argued in favor of full quantification over indices that we have in principle the competence to understand arbitrary complex sentences of the above kind.

6.6.2 Conversational Contexts Versus Context of Utterance

A pure double-index modal logic without additions only parameterizes contexts of utterance. While there is nothing wrong with ignoring certain semantic or pragmatic aspects of source language expressions, for a more adequate truth-conditional analysis some implementation of the conversational context is desirable. As laid out in the last chapter, especially spatial indexicals are systematically vague and at least some rudimentary mechanism should account for that. For example, whether a use of «here» has broad or narrow reading depends on the conversational context. If the context of utterance is taken as the concrete situation in which a token is used for communication, then it will be unreasonable to meanwhile take the place of utterance encoded by the context parameter to be the whole physical universe or the earth. Taking conversational contexts explicitly into account allows for more fine-grained distinctions. Consider example 5.37 from last chapter and figure 6.2.

(5.37) *Sitting in the office in winter*: It's cold here.

In the simplified view, the place of the context of utterance is blown up such that the place denoted by ‹here› is a part of it. In a bit more detailed analysis the reference space is taken
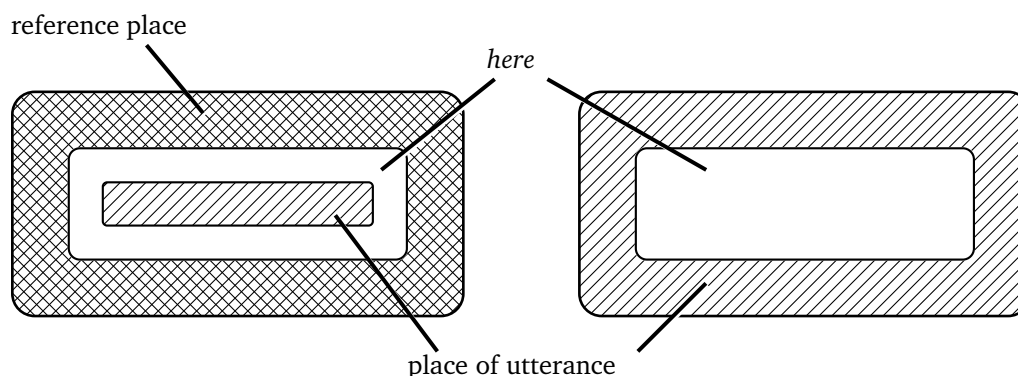
Figure 6.2: Place of ‹here› in terms of mereological part-of relation with and without a reference place that is given by the conversational context.

explicitly into account and the place of utterance is understood as the place of the concrete situation in which the utterance happens. The reference place is then considered the larger place that depends on the conversational context, hence depends on something which remains stable within a given discourse fragment, is at least partly shared between discourse participants, and is not fixed for itself by the mere act of uttering something. It is easy to change DIML to take into account an additional conversational context parameter, and so this isn't a hard limit.

6.6.3   Selectional Features and Other Missing Ingredients

From a descriptivist point of view on reference, not expressing the descriptive conditions that constitute the character of an indexical in the object language is a misfeature of the above definitions of indexicals. This point doesn't regard the expressivity of DIML at all, but the direct reference view that underlies it. In light of the rich descriptive content of indexicals it is desirable to make this more explicit in the object language than it is done by Kaplan's notion of a character as a function from contexts to intensions. This can be done in DIML by using ∇ dthat, and so the issue is a matter of perspective rather than principal limitations.

6.6.4   Further Literature

Reichenbach (1947) gives a token-based account of indexicals in first-order predicate logic. (Oksanen 2000) makes possible mappings between different speaker perspectives explicit, like for

example the mapping of «I» from the first-person perspective to «he» or «she» in the third-person perspective. Another suggestion to formally deal with indexicals with special regards to forms of belief attributions can be found in (Richard 1983). Schlenker (2000, 2002, 2003) and von Stechow (2002, 2003) propose complex, feature-based mechanisms to deal with indexicals and anaphoric binding, and in order to provide a linguistic explanation for the fact that certain indexicals are non-shifters, others sometimes shift, and yet others always shift. Using update logic, Stojanovic (2002, 2005) proposes a radical departure from traditional Kaplanian accounts.

Chapter 7

Indexicals in Predicate Logic

7.1   Chapter Overview

In this chapter, indexicals will be analyzed by means of a variant of first-order predicate logic in order to do justice to Cresswell's argument. In support of Thesis 7 it will be shown by example that a fine-grained analysis of indexicals can be given on the basis of a description theory of indexical reference. The proposed variant of first-order predicate logic, called FOLC here, will allow for analyses that are similar to those in event semantics. As opposed to the latter, FOLC doesn't rely on any special event mereology and the binders for modalities will be defined in close analogy to the analogous operators in normal modal logic. Quantification over contexts of utterance will be available in the object language, but these objects are basically placeholders for worlds, times, and places to keep object language expressions shorter. FOLC also has a few non-standard features: non-traditional predication theory allows one to deal with vagueness to some extent, a conversational context and a context of utterance are introduced as designated reference points of the interpretation function in order to fix the range of vague indexicals and encode contextual dependencies across utterance level, and quantifiers are given unlimited binding scope for a given input. These mostly cosmetic changes will make FOLC more convenient for analyzing indexicals than standard first-order predicate logic (FOL). However, except for the use of non-traditional predication theory any given sequence of formulas of FOLC could also be written down explicitly in normal first-order predicate logic.

The formal language and its interpretation will be defined in section 7.2. The common indicators for the deictic center will be analyzed in section 7.3. Some examples of complex indicators are discussed in section 7.4, some examples of demonstratives will be analyzed in section 7.5, and finally, in section 7.6 some ways to deal with shifters in this framework will be outlined. All of the analyses will be done from the perspective of semantic reference. Speaker reference by means of indexicals and the related problem of essential indexicals will be addressed in chapter 8.

7.2   Language FOLC

FOLC is a two-sorted predicate logic and unlike the previous formal languages will have prefix style syntax with arguments separated by blank spaces instead of commas. This has the advantage of making formulas with a lot of bound variables more readable and easier to type, though more cumbersome to write by hand. FOLC uses non-traditional predication theory (NTPT), according to which an inner negation is considered a sort of predication. This branch of logic goes back to work by Sinowjew (1970) and Wessel (1989, 1998) in the 60ies and 70ies of 20th century. The given implementation of NTPT will differ from theirs in many respects. For example, only a simple denotational semantics will be given for FOLC, but the set-theory used in the meta language will remain classical. This is problematic and not acceptable from a foundational point of view, but acceptable for the purpose of doing natural language semantics.[1] Another change to

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[1] See (Wessel 1989) for an axiom system, a completeness proof, and some philosophical justification of NTPT. As pointed out by Uwe Scheffler in a talk given on 22.3.2005 at Roskilde University, soundness and completeness can also be proved by translating and reinterpreting all NTPT formulas as formulas of classical first-order predicate calculus.

classical predicate logic is that binders may have maximal scope to the right. This has at least two benefits: First, target language expressions become much easier to read, because they contain less parentheses. Second, referential terms that are analyzed as quantifiers can be moved to the left in the target language. In Appendix C a generic syntax–semantics interface is presented that exploits this feature. However, for any given input sequence of formulas to the interpretation function of FOLC it is possible to find a corresponding FOL formula in a corresponding model that is an explicit conjunction of the FOLC sequence and in which the binders have traditional scoping rules, and so the only change that makes FOLC non-classical is the use of NTPT.

In FOLC all predicates are relativized to a first context argument similar to the way this is done in event semantics. However, the use of just one context argument is eye-candy in the following sense. Part of a FOLC model will be contexts of utterance, conversational contexts, times, places, worlds, and ordinary objects, and a number of mapping functions will be used under the hood to retrieve the world, or some times and places associated with a given context of utterance in a given conversational context.

7.2.1 Syntax

Let CVAR be the set of utterance context variables containing C and its numbered variants, DVAR be the set of ordinary variables containing X, Y, Z and their numbered variants. As before, constants can be sequences of letters like predicates and one has to consult the definition in order to determine the syntactic sort. CCON and DCON contain constants for utterance contexts and objects respectively. As auxiliary sets, we define CON = CCON∪DCON, VAR = CVAR∪DVAR, CTERM = CVAR ∪ CCON and likewise for DTERM, and TERM = CTERM ∪ DTERM. This time, the set of predicates PRED is not only sorted into subsets by their arity, but also into their positive and inner negation form. Predicates are sequences of letters, and we say that any n-ary predicate not starting with - is in positive form and an element in PRED_n^+ ($n \geq 1$). We then say that for all positive forms of predicates: If A is in PRED_n^+, then $-A$ is in PRED_n^-, where $-A$ is said to be in inner negation form. No other expressions than the ones defined by this rule are in inner negation form. The rule ensures that every positive form has a corresponding inner negation form. Notice further that every predicate this time has at least arity one, and this argument will be required to be an element in CTERM. In other words, all predicates depend on a context. For typographical reasons quantifiers and operators are written as text. QUANT1 = { **all**,**some**,**iota**$_*$} and more quantifiers may be added when needed, while the basic quantifiers appear to take no argument at all QUANT0 = {**forall**$_*$,**exists**$_*$}. This works because the binding scope of quantifiers will be defined on a maximum sequence of formulas. Junctors are textual variants of the standard junctors. Operators will be defined as needed and are assumed to be in OPn for operators taking n well-formed formulas, where OP is the union of these sets, and in SOP if they take a maximal sequence, i.e. operators consuming the whole given input at a time. Furthermore, operators from terms to terms will be in TOP = DTOP∪CTOP. The prefix syntax of FOLC is then given by the following grammar rules.

$$\mathrm{QHD} := (\mathrm{QUANT0\ VAR}) \tag{7.1}$$
$$| \ (\mathrm{QUANT1\ VAR\ MSQ})$$

$$\text{WFF} := (\text{PRED}_n \, \text{CTERM} \,.\, \text{TERM}_2 \dots \text{TERM}_n) \tag{7.2}$$
$$| \; (\text{JUN MSQ})$$
$$| \; (\text{OP MSQ})$$
$$| \; \text{QHD MSQ} \; | \; (\text{QHD MSQ})$$
$$| \; \text{SOP MSQ} \; | \; (\text{SOP MSQ})$$
$$\text{SEQ} := \text{WFF} \; | \; \text{SEQ SEQ} \tag{7.3}$$
$$\text{MSQ} := \text{SEQ} \; stop \tag{7.4}$$
$$\text{DTERM} := (\text{DTOP DTERM}) \tag{7.5}$$
$$\text{CTERM} := (\text{CTOP CTERM}) \tag{7.6}$$

MSQ stands for maximal sequence and we will usually not write the special $stop$ symbol. The purpose of this somewhat twisted way of defining the syntax is to make sure that a sequence operator or quantifier always takes a sequence of some known, fixed length delimited by $stop$. It is thus possible to define the maximal extension sequence of a formula WFF_i in a maximal sequence $\text{WFF}_1 \dots \text{WFF}_i \dots \text{WFF}_n \, stop$ as the sequence $\text{WFF}_{i+1} \dots \text{WFF}_n \, stop$, and the length of this sequence is $n - i - 1$. From this and the above definition it follows that a sequence

$$\text{QHD WFF}_1 \dots \text{WFF}_n$$

without surrounding parentheses is only well-formed if $\text{WFF}_1 \dots \text{WFF}_n$ is the maximal extension sequence of QHD. So quantifiers may have maximal binding scope to the right, but according to the above rules they may also be put into additional parentheses to give them limited binding scope, and the same choice can be made for fixing the priority scope of sequence operators. The purpose of the separate quantifier head QHD definition might not be apparent at first glance. Just as human brains can hardly survive without body, bodiless quantifier heads should be disallowed, and this is achieved by not making a quantifier head a well-formed formula on its own. From the syntax it follows that all predicates take a context argument. However, it is helpful if these context arguments can sometimes be omitted and therefore we will adopt the following convention.

✩ **Definition 2** (Optional Argument Convention). *In a given input sequence* MSQ *an n-ary predicate may be written without the first k arguments ($k \leq n$) if no ambiguity can arise. Any such missing argument places are completed by a variable of the respective sort in* CVAR *or* DVAR *that must be free with respect to its position in* MSQ.

This convention will mainly be used to omit the first context argument in a predicative clause. It is by convention completed by an unbound context variable, and another, semantic convention will later ensure that this open variable is bound to the currently active context parameter. The first context argument will sometimes be separated from the following arguments by a dot in order to indicate that it hasn't been omitted. Arguments other than the first one will rarely be left out, except in the definition of some tense binders. According to these conventions, the following formulas are equal:

(7.7) (**iota**∗ X (Alice X))
    (**iota**∗ Y (Bob Y))
    (love X Y)

(7.8) (**iota**∗ X (Alice C0 . X))
    (**iota**∗ Y (Bob C0 . Y))
    (love C0 . X Y)

In abbreviations, optional arguments may also be specified using square brackets. For example, the following abbreviation could be used for model ling belief.

(7.9) (**believe** [CVAR$_1$] . CVAR$_2$ DTERM) MSQ)
    := (**forall**∗ CVAR2)
        (**implies** (Rb [CVAR$_1$] . CVAR$_2$ DTERM)
                MSQ)

The square brackets in this definition must be read in the following way: If no utterance context term is given to the binder, then it misses as argument to Rb as well and will thus be completed by a free context variable; otherwise, CVAR$_1$ will occur at first argument position of Rb. In such abbreviations we will also allow arguments in square brackets that occur *after* some other arguments. They are likewise mapped to an open variable if not present on the left hand side, and to the left hand side variable if present.

7.2.2 Semantics

The basic ingredients of a FOLC frame is a set of utterance contexts C, a set of conversational contexts K, a set of possible worlds W, a set of time intervals T, a set of places P, and a set of other objects D. Although we can only overtly quantify over the objects in C and D in the object language, the other sets will be used implicitly in the semantics of certain expressions. A FOLC frame also contains a set Σ of mapping functions, including the following ones:

$$time, utime, rtime : (C \times K) \to T \tag{7.10}$$

$$place, rplace, uplace : (C \times K) \to P \tag{7.11}$$

$$world : (C \times K) \to W \tag{7.12}$$

These functions retrieve the event, utterance, and reference time and place and the world of a (c, k) pair respectively. There is a decent amount of overhead involved in the use of these functions, but they simplify the object language. Binders and operators will work on the respective world, time, or place slices of a pair of utterance and conversational context, and for this purpose the notion of a *variant* is needed. This is only defined with respect to utterance contexts, because these are the ones available in the object language.

☆ **Definition 3** (Context Variants)**.** *A time variant c' of c for given k, written as $c \simeq_t^k c'$, is a context c' such that possibly $time(c', k) \neq time(c, k)$, $utime(c', k) \neq utime(c, k)$, or $rtime(c', k) \neq$*

$rtime(c, k)$ but any of the above place or world functions will yield the same result for c, k and c', k respectively. Likewise, a place variant $c \simeq_p^k c'$ is a context c' whose place functions might yield different results, but which remains stable with respect to world and times, and a world variant $c \simeq_w^k c'$ is the c' for which $world(c', k)$ might differ from $world(c, k)$ but the other functions yield the same result as for c.

A FOLC frame is then a structure $F = (C, K, W, T, P, D, \Sigma)$, where none of the sets in it are empty. A FOLC model based on a frame F consists of the elements of F and the interpretation function $\llbracket . \rrbracket_{g,k}^M (c)$, which takes an expression of FOLC, a context of utterance c, a conversational context k, an assignment g, and yields the extension of that expression with respect to the designated reference points $c \in C$ and $k \in K$. The interpretation must map a syntactic sort into the correct interpretational domain of that sort, i.e. the interpretation must satisfy the following constraints.

$$\llbracket . \rrbracket^M : \mathrm{CTERM} \times C \times K \times \mathrm{ASG} \to C \tag{7.13}$$

$$\llbracket . \rrbracket^M : \mathrm{DTERM} \times C \times K \times \mathrm{ASG} \to D \tag{7.14}$$

$$\llbracket . \rrbracket^M : \mathrm{PRED}_n \times C \times K \times \mathrm{ASG} \to \wp(C \times (C \cup D)_2 \times \cdots \times (C \cup D)_n) \tag{7.15}$$

$$\llbracket . \rrbracket^M : \mathrm{SEQ} \times C \times K \times \mathrm{ASG} \to \{1, 0\} \tag{7.16}$$

As an alternative notation to the above one, $M, g, c, k \vDash \mathrm{MSQ}$ may be written. In addition to the above constraints, the interpretation of a variable must conform to the following rule.

$$\llbracket \mathrm{VAR} \rrbracket_{g,k}^M (c) = g(\mathrm{VAR}) \tag{7.17}$$

Furthermore, we need to put a restriction on the interpretation of positive and inner negation forms of predicates, in order to make the inner negation work in the way it is supposed to work in a system using non-traditional predication theory.

✩ **Constraint 2** (Inner Negation Constraint). *The extensions of the positive form of a predicate and the inner negation form of a predicate must be distinct.*

$$\llbracket \mathrm{PRED}^+ \rrbracket_{g,k}^M (c) \cap \llbracket \mathrm{PRED}^- \rrbracket_{g,k}^M (c) = \emptyset \tag{7.18}$$

for arbitrary given g, c, k

This is one change that makes FOLC non-traditional. Another, less significant change is to 'dynamize' evaluation. In order to make this work, we need another auxiliary function.

$$U : (\mathrm{WFF} \times (\mathrm{ASG} \cup C \cup K)) \to (\mathrm{ASG} \cup C \cup K) \tag{7.19}$$

This can be regarded as comprising three functions that have been combined into one for the sake of brevity. The function will be called *update function*. As the name suggests it will update the assignment, the context of utterance, and the conversational context by the result of evaluating each formula in a sequence of formulas from left to right. To get the desired mode of function composition in the update function, the following non-standard notation will be used:

$$f^{\star 1}(x, y)(z) = f(z, f(x, y)) \tag{7.20}$$

$$f^{\star n}(x, y)(z_1, \ldots, z_{n-1}, z_n) = f(z_n, f^{\star n-1}(x, y)(z_1, \ldots, z_{n-1})) \tag{7.21}$$

Based on this notation, a writing shortcut will be used to indicate the *update step* for each stage k in updating the parameter or assignment p by a sequence of formulas $\mathrm{WFF}_1 \ldots \mathrm{WFF}_n$ ($1 \leq k \leq n$):

$$\mathcal{U}(\mathrm{WFF}_k, p) = \begin{cases} U(\mathrm{WFF}_1, p) \text{ if } k = 1 \\ U^{\star k-1}(\mathrm{WFF}_1, p)(\mathrm{WFF}_2, \ldots, \mathrm{WFF}_k) \text{ if } k > 1 \end{cases} \tag{7.22}$$

Notice that this is not a definition in the strict sense but really just a notational shortcut, since the actual sequence of formulas isn't given as argument to $\mathcal{U}$. In the definitions of truth in a model below, this notation is used to indicate that assignments and both sorts of context respectively are updated by the result of updating the previous formula of the given sequence. The first case in the definition below is special. It says that if none of the other rules apply, including those of later definitions, then a sequence of two formulas is treated as an implicit conjunction. The other rules are just standard first-order logic definitions that work on sequences of formulas instead of single formulas. The update function on complex formulas is defined simultaneously with truth in a model.

☆ **Definition 4** (FOLC Truth-in a Model).

(7.23) Case $A = \mathrm{WFF}_1 \mathrm{WFF}_2$ *and no other rule applies*

$$[\![A]\!]_{g,k}^M(c) = \begin{cases} 1 \text{ if } [\![\mathrm{WFF}_1]\!]_{g,k}^M = 1 \\ \text{and } [\![\mathrm{WFF}_2]\!]_{U(\mathrm{WFF}_1,g),U(\mathrm{WFF}_1,k)}^M (U(\mathrm{WFF}_1, c)) = 1; \\ 0 \text{ otherwise} \end{cases}$$

$$U(A, g) = U(\mathrm{WFF}_2, U(\mathrm{WFF}_1, g))$$
$$U(A, c) = U(\mathrm{WFF}_2, U(\mathrm{WFF}_1, c))$$
$$U(A, k) = U(\mathrm{WFF}_2, U(\mathrm{WFF}_1, k))$$

(7.24) Case $A = (\mathrm{PRED}\ \mathrm{TERM}_1 \ldots \mathrm{TERM}_n)$:

$$[\![A]\!]_{g,k}^M(c) = \begin{cases} 1 \text{ if } \langle [\![\mathrm{TERM}_1]\!]_{g,k}^M(c), \ldots, [\![\mathrm{TERM}_n]\!]_{g,k}^M(c) \rangle \in [\![\mathrm{PRED}]\!]_{g,k}^M(c) \\ 0 \text{ otherwise} \end{cases}$$

$$U(A, g) = g;\ U(A, c) = c;\ U(A, k) = k$$

(7.25) Case $A = (\mathbf{or}\ \mathrm{WFF}_1 \ldots \mathrm{WFF}_n)$:

$$[\![A]\!]_{g,k}^M(c) = \begin{cases} 1 \text{ if one or more of } [\![\mathrm{WFF}_1]\!]_{g,k}^M(c), \\ [\![\mathrm{WFF}_2]\!]_{\mathcal{U}(\mathrm{WFF}_2,g),\mathcal{U}(\mathrm{WFF}_2,k)}^M(\mathcal{U}(\mathrm{WFF}_2, c)), \ldots, \\ [\![\mathrm{WFF}_n]\!]_{\mathcal{U}(\mathrm{WFF}_n,g),\mathcal{U}(\mathrm{WFF}_n,k)}^M(\mathcal{U}(\mathrm{WFF}_n, c)) \text{ is } 1; \\ 0 \text{ otherwise} \end{cases}$$

$$U(A, g) = \mathcal{U}(\mathrm{WFF}_n, g);\ U(A, c) = \mathcal{U}(\mathrm{WFF}_n, c);\ U(A, k) = \mathcal{U}(\mathrm{WFF}_n, k)$$

(7.26)   *Case $A = ($**and** $\mathrm{WFF}_1 \ldots \mathrm{WFF}_n)$:*

$$[\![A]\!]^M_{g,k}(c) = \begin{cases} 1 \text{ if all of } [\![\mathrm{WFF}_1]\!]^M_{g,k}(c), \\ [\![\mathrm{WFF}_2]\!]^M_{\mathcal{U}(\mathrm{WFF}_2,g),\mathcal{U}(\mathrm{WFF}_2,k)}(\mathcal{U}(\mathrm{WFF}_2,c)), \ldots, \\ [\![\mathrm{WFF}_n]\!]^M_{\mathcal{U}(\mathrm{WFF}_n,g),\mathcal{U}(\mathrm{WFF}_n,k)}(\mathcal{U}(\mathrm{WFF}_n,c)) \text{ are } 1; \\ 0 \text{ otherwise} \end{cases}$$

$U(A,g) = \mathcal{U}(\mathrm{WFF}_n,g)$; $U(A,c) = \mathcal{U}(\mathrm{WFF}_n,c)$; $U(A,k) = \mathcal{U}(\mathrm{WFF}_n,k)$

(7.27)   *Case $A = ($**equiv** $\mathrm{WFF}_1 \ldots \mathrm{WFF}_n)$:*

$$[\![A]\!]^M_{g,k}(c) = \begin{cases} 1 \text{ if all of } [\![\mathrm{WFF}_1]\!]^M_{g,k}(c), \\ [\![\mathrm{WFF}_2]\!]^M_{\mathcal{U}(\mathrm{WFF}_2,g),\mathcal{U}(\mathrm{WFF}_2,k)}(\mathcal{U}(\mathrm{WFF}_2,c)), \ldots, \\ [\![\mathrm{WFF}_n]\!]^M_{\mathcal{U}(\mathrm{WFF}_n,g),\mathcal{U}(\mathrm{WFF}_n,k)}(\mathcal{U}(\mathrm{WFF}_n,c)) \text{ yield the same value}; \\ 0 \text{ otherwise} \end{cases}$$

$U(A,g) = \mathcal{U}(\mathrm{WFF}_n,g)$; $U(A,c) = \mathcal{U}(\mathrm{WFF}_n,c)$; $U(A,k) = \mathcal{U}(\mathrm{WFF}_n,k)$

(7.28)   *Case $A = ($**implies** $\mathrm{WFF}_1 \ldots \mathrm{WFF}_n)$:*

$$[\![A]\!]^M_{g,k}(c) = \begin{cases} 0 \text{ if } [\![\mathrm{WFF}_1]\!]^M_{g,k}(c) = 1 \\ \text{and one of } [\![\mathrm{WFF}_2]\!]^M_{\mathcal{U}(\mathrm{WFF}_2,g),\mathcal{U}(\mathrm{WFF}_2,k)}(\mathcal{U}(\mathrm{WFF}_2,c)), \ldots, \\ [\![\mathrm{WFF}_n]\!]^M_{\mathcal{U}(\mathrm{WFF}_n,g),\mathcal{U}(\mathrm{WFF}_n,k)}(\mathcal{U}(\mathrm{WFF}_n,c)) \text{ is } 0; \\ 1 \text{ otherwise} \end{cases}$$

$U(A,g) = \mathcal{U}(\mathrm{WFF}_n,g)$; $U(A,c) = \mathcal{U}(\mathrm{WFF}_n,c)$; $U(A,k) = \mathcal{U}(\mathrm{WFF}_n,k)$

(7.29)   *Case $A = ($**not** $\mathrm{WFF}_1 \ldots \mathrm{WFF}_n)$:*

$$[\![A]\!]^M_{g,k}(c) = \begin{cases} 1 \text{ if one or more of } [\![\mathrm{WFF}_1]\!]^M_{g,k}(c), \\ [\![\mathrm{WFF}_2]\!]^M_{\mathcal{U}(\mathrm{WFF}_2,g),\mathcal{U}(\mathrm{WFF}_2,k)}(\mathcal{U}(\mathrm{WFF}_2,c)), \ldots, \\ [\![\mathrm{WFF}_n]\!]^M_{\mathcal{U}(\mathrm{WFF}_n,g),\mathcal{U}(\mathrm{WFF}_n,k)}(\mathcal{U}(\mathrm{WFF}_n,c)) \text{ is } 0; \\ 0 \text{ otherwise} \end{cases}$$

$U(A,g) = \mathcal{U}(\mathrm{WFF}_n,g)$; $U(A,c) = \mathcal{U}(\mathrm{WFF}_n,c)$; $U(A,k) = \mathcal{U}(\mathrm{WFF}_n,k)$

(7.30)   *Case $A = \mathrm{QHD}\,\mathrm{MSQ}$ or $A = (\mathrm{QHD}\,\mathrm{MSQ})$,*
*where $\mathrm{QHD} = ($**forall** $_* \mathrm{VAR})$*

$$[\![A]\!]^M_{g,k}(c) = \begin{cases} 1 \text{ if for all } h \approx_{\mathrm{VAR}} g : [\![\mathrm{MSQ}]\!]^M_{h,k}(c) = 1 \\ 0 \text{ otherwise} \end{cases}$$

$U(A,g) = U(\mathrm{MSQ},h)$; $U(A,c) = U(\mathrm{MSQ},c)$; $U(A,k) = U(\mathrm{MSQ},k)$

(7.31)   *Case $A = \mathrm{QHD}\,\mathrm{MSQ}$ or $A = (\mathrm{QHD}\,\mathrm{MSQ})$,*
*where $\mathrm{QHD} = ($**exists** $_* \mathrm{VAR})$*

$$[\![A]\!]^M_{g,k}(c) = \begin{cases} 1 \text{ if there is a } h \approx_{\mathrm{VAR}} g : [\![\mathrm{MSQ}]\!]^M_{h,k}(c) = 1 \\ 0 \text{ otherwise} \end{cases}$$

$U(A,g) = U(\mathrm{MSQ},h)$; $U(A,c) = U(\mathrm{MSQ},c)$; $U(A,k) = U(\mathrm{MSQ},k)$

(7.32) *Case $A = \text{QHD MSQ}_2$ or $A = (\text{QHD MSQ}_2)$,*
where $\text{QHD} = (\textbf{\textit{iota}}_* \text{VAR MSQ}_1)$

$$\llbracket A \rrbracket_{g,k}^M (c) = \begin{cases} 1 \text{ if there is exactly one } h \approx_{\text{VAR}} g \text{ such that} \\ \quad \llbracket \text{MSQ}_1 \rrbracket_{h,k}^M (c) = 1, \text{ and for this } h: \\ \quad \llbracket \text{MSQ}_2 \rrbracket_{h,k}^M (c) = 1; \\ 0 \text{ otherwise} \end{cases}$$

$U(A, g) = U(\text{MSQ}_2, h)$; $U(A, c) = U(\text{MSQ}_2, c)$; $U(A, k) = U(\text{MSQ}_2, k)$

The definitions on sequences are admittedly a bit clumsy, but the idea behind them is simple: A parameter or assignment is updated by a sequence of formulas by taking the update of it by the first formula as the input for updating the second formula, and so on until all formulas have been processed from left to right.[2]

7.2.3 Some Technical Remarks

There is some subtle points in the above formalism. Consider a predicate rain that only takes a context variable as argument. In a rather simple model M let $K = \{k\}, C = \{c, c_1, c_2, c_3\}$ and the following be the case.

$$\llbracket \text{rain} \rrbracket_{g,k}^M (c) = \{c_1, c_2, c_3\} \tag{7.33}$$

[1] The time of the rain events is *not* given by any of the contexts of utterance alone. It is given by the *time* mapping function, which is short for *event time*. In the above model, it rains at $time(c_1, k)$, $time(c_2, k)$, and $time(c_3, k)$. The same holds for the respective places. It rains only at $place(c_1, k)$, $place(c_2, k)$, and $place(c_3, k)$. These mapping functions yield the time and place of the described event, where *event* is taken in a very broad sense and doesn't presuppose any special event ontology, but is rather a loose way of talking about truth or falsity of formulas relativized to times, worlds, and places. The other mapping functions retrieve values like the reference time according to Reichenbach's S-R-E scheme. An event's world is retrieved by the *world* function.

[2] In the same context of utterance a FOLC expression can have different truth-values, if it is evaluated with respect to different conversational contexts. For example, $time(c, k)$ and $time(c, k')$ can yield different times. This is the case if k and k' have different underlying calendric systems or origins, or when they use different standards of precision or measurement. The equality conditions between such different representations and the actual implementation of time intervals (with or without margins of error, etc.) and places are left open.

[3] Conceptually, it is the context of utterance, the concrete utterance situation, that introduces the time and place of the deictic center. So *utime* and *uplace* depend mainly on utterance

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[2]As an alternative to the above rules FOLC semantics could be given by a translation function that translates FOLC formulas, C, K, and assignments g into formulas of first-order predicate logic with non-traditional predication theory and functions. This would be simpler than the above definitions, but would also make additions in subsequent sections hard to read, since these would need to be given as extensions to the translation function.

contexts; subsidiary factors like the calendric time system in use or the way of describing places require additional dependency on the conversational context. Likewise, utterances take place in the actual world, and so *world* usually mainly depends on the given c, but since this doesn't hold in some narrative contexts the function also has to depend on conversational contexts. Vice versa, for example *rtime* yields the reference time and so *mainly* depends on the conversational context, but may still change from utterance to utterance.

[4] Most of the available mappings are never needed and only included to avoid using partial functions. For example, if a past time is introduced by one of the tense binders below, this will be done by putting constraints on some new time-variant c_2 of a given context c_1. In the same conversational context, this c_2 will then have some associated utterance time $utime(c_2, k)$, but in reality there might not have been any utterance at the described past event, and so this time will simply not be used and might have no reasonable informal interpretation. To avoid this overhead the mappings could be defined as partial functions on *admissible* pairs c, k only, i.e. the context pairs that can occur as designated parameters. However, this is not done here for simplicity.

[5] The c parameter will only be used on very few occasions, implicitly in a few definitions of special predicates and by the open context variable convention. It is a designated reference point on which egocentric expressions depend. From the fact that it is an argument to the interpretation function it ought not be deduced that the semantic value of many FOLC expressions actually varies in dependence of it. The few predicates depending implicitly on c could be changed to having another context variable argument place, and then only the interpretation of open variables would have to take into account the context of utterance as a reference point. Then 7.14–7.16 could be redefined as taking no arguments in C. The k parameter, on the other hand, is more than a designated reference point, since many predicates depend on the conversational context because of their inherent vagueness, and there are no terms for this kind of context available in the object language. It is also dispensable from a technical point of view: Since it will not be shifted by operators, except for one reading of «actually» below, the parameter could be dropped in favor of considering different models. It visually indicates when two formula sequences are interpreted with respect to the same conversational context, and that is one reason to keep it. From a more philosophical perspective the eliminability issue will be addressed again in section 7.7.1.

[6] Strictly speaking the inner negation form of a predicate would have to be characterized in any intended reading, definition, or abbreviation in addition to the positive form. This will not be done in general here, since the respective reading of the inner negation form should be clear from the specification of the corresponding positive form. In predicates stipulated for technical reasons, as in the definition of binders below, the corresponding inner negation form usually is neglectable, because the binder only has a positive reading. In other cases like the existence predicate the inner negation simply has the intended reading that the property or relation expressed by the predicate is clearly and without doubt denied of the object(s) in question in the

given context of utterance and conversational context.

[7] Expressing all constraints and semantic rules in the object language would be desirable from a logical point of view, but since foundational issues like defineability are not the main concern here, semantic constraints are used in many places. The chosen mix of object-language abbreviations and semantic rules using mapping functions is a tradeoff between 'cleanliness' and readability.

7.2.4 Auxiliary Notions

In order to make practical use of FOLC, a number of auxiliary definitions and model restrictions are needed. Before definitions are introduced, let us adopt the following useful interpretation guideline.

☆ **Constraint 3** (Open Context Variable Convention). *A proper assignment evaluates all context variables, that are free in a sequence of formulas given to the interpretation function, to the currently given context parameter. By convention, only input sequences A, models, and context parameters such that g in $[\![A]\!]_{g,k}^{M}(c)$ is a proper assignment are taken into account.*

Moreover, the following terminological conventions will be adopted. *Actual* are pairs of contexts c, k for which $world(c, k)$ is the actual world. Some relations and predicates can have meaning rules that only hold if their first argument evaluates to some c such that $world(c, k)$ is actual in the given conversational context k. Sometimes the phrase ϕ *according to* c for some non-actual context parameter c (in combination with the given k) will be used in order to indicate that the interpretation of ϕ depends on the interpretation of the modality by whose accessibility relation c has been reached.

Also needed is an existence predicate. This will in FOLC express existence of something at a world, time, and some place. While in an actualist system the inner negation of the existence predicate would have to be false as long as the term in the object argument place denotes, this is not the case in a possibilist system. Thus, the existence predicate in FOLC has no logical properties, i.e. it behaves just like any other predicate.

☆ **Intended Reading 1** (Canonical Existence).

$$exist \in \mathrm{PRED}_2 \tag{7.34}$$

$\langle c_1, a \rangle \in [\![exist]\!]_{g,k}^{M}(c)$ *is interpreted as: (Case 1) if c_1, k are actual: in k, a exists at $world(c_1, k)$, $time(c_1, k)$ in $place(c_1, k)$; (Case 2) c_1, k are non-actual: a exists according to c_1 in k.*

Hereby, *according to* c_1 can for example mean that a has to exist according to what Alice believes in case c_1 has been reached by a belief accessibility relation, or has to exist according to what could conceivably exist if c_1 has been reached by some epistemic modal accessibility relation. There is nothing special about the corresponding relativized quantifiers:

☆ **Abbreviation 2** (Relativized Existential Quantifier).

(exists *[CVAR]* VAR*)* MSQ
   := *(exists* * VAR*)* *(exist* *[CVAR]* VAR*)* MSQ

☆ **Abbreviation 3** (Relativized Universal Quantifier)**.**

(forall *[CVAR]* VAR*)* MSQ
   := *(forall* * VAR*)* *(implies* *(exist* *[CVAR]* VAR*)* MSQ*)*

☆ **Abbreviation 4** (Relativized Iota Quantifier)**.**

(iota *[CVAR]* VAR MSQ_1*)* MSQ_2
   := *(iota* * VAR *(exist* *[CVAR]* VAR*)* MSQ_1*)* MSQ_2

In addition to existence some equality predicate is needed; the following weak equality will be used.

☆ **Intended Reading 2** (Equality)**.**

$$= \in \text{PRED}_3 \tag{7.35}$$

$$\langle c_1, a, b \rangle \in [\![=]\!]_{g,k}^M (c) \tag{7.36}$$

is interpreted as: a is equal to b according to c_1 in k

The symbol $\neq$ is used for the inner negation form of this predicate. In contrast to the above weak equality, strict identity can be defined as follows.

$$[\![\text{id}]\!]_{g,k}^M (c) = C \times \{(a,a) \mid a \in (C \cup D)\} \tag{7.37}$$

Although in many cases = should be read as strict identity, this will not generally be presumed here. Finally, the following abbreviation is convenient for making use of NTPT.

☆ **Abbreviation 5** (? Symbol)**.**

*(?*PRED VAR_1 ... VAR_n*)*
   := *(and* *(not* *(*PRED VAR_1 ... VAR_n*))*
           (not *(*−PRED VAR_1 ... VAR_n*)))*

Informally, a predicative clause with a question mark in front of the predicate indicates that it can neither be denied that some object has a certain property or some objects stand in a certain relation to each other nor can this be asserted without any doubt. So this is the 'third case' that non-traditional predication theory allows without giving up the principle of bivalence. This third case allows us to deal with vagueness to some extent, but it should be mentioned that nothing in the following discussion of indexicals will hinge on non-traditional predication theory in particular. Intuitionists can deal with vagueness in a similar fashion by giving up the principle of bivalence, and classical predicate logic can deal with indexicals as well, though under some higher degree of idealization.

7.2.5 Modalities

Instead of modal operators, binders will be used. Each definition of a binder involves two steps. First, FOLC models have to be restricted to the intended reading of the accessibility relation of the modality in question. Second, the syntactic abbreviation as a binder is given in order to facilitate work with the respective modality. Binders for alethic modalities are defined as follows.

☆ **Constraint 4** (S5 Accessibility for Alethic Modalities). *The accessibility relation of **Pos** and **Nec** is Rn* $\in \text{PRED}_2$*, where the second argument must be in* CVAR *as well. It is interpreted as a reflexive, symmetric, and transitive relation, and any pair* $\langle c, c' \rangle$ *can only be in this relation if* $c \simeq_w c'$*.*

☆ **Abbreviation 6** (Modal Binders). *Alethic modalities are encoded as context binders.*

(*Nec* [CVAR₁] . CVAR₂) MSQ
   := (*forall*∗ CVAR₂) (*implies* (Rn [CVAR₁] . CVAR₂) MSQ)

(*Pos* [CVAR₁] . CVAR₂) MSQ
   := (*exists*∗ CVAR₂) (Rn [CVAR₁] . CVAR₂) MSQ

The following constraints and definitions define belief as a binder based on an accessibility relation between two contexts and a speaker.

☆ **Definition 5** (Speakers). *The set of speakers is a subset of the domain* $S \subset D$.

☆ **Constraint 5** (KD45 Belief Accessibility). *The accessibility relation for **believe** is Rb* $\in \text{PRED}_3$*, where the second argument is in* CVAR*, the third argument is in* DTERM *and for the latter it must be the case that* $[\![\text{DTERM}]\!]^M \in S$*, for any assignment and context. Belief accessibility is serial, transitive, and Euclidean in the first two argument places, and a tuple* $\langle c, c', a \rangle$ *can only be in this relation if* $c \simeq_w c'$*.*

☆ **Abbreviation 7** (Belief Binder). *Belief is encoded as a context binder.*

(*believe* [CVAR₁] . CVAR₂ DTERM) MSQ
    := (*forall*∗ CVAR₂)(*implies* (Rb [CVAR₁] . CVAR₂ DTERM) MSQ)

As an example of the use of these binders, consider 7.38 and its de dicto analysis 7.39.[3]

(7.38) Alice: Alice believes that it is possible that Bob loves Carol.

(7.39) (**iota** SUBJ (Alice SUBJ)) (**believe** C1 SUBJ)
    (**iota** C1 . SUBJ2 (Bob C1 SUBJ2)) (**iota** C1 . DO (Carol C1 DO)) (**Pos** C1 C2)
    (love C2 SUBJ2 DO)

Other rational attitudes can be defined in the same way.

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[3]Proper names in the following and all subsequent examples are analyzed using the existence-relativized iota quantifier and thus express their existence presupposition. In cases like «Aristotle» or «Superman» this isn't adequate, and then **iota**∗ has to be used instead.

7.2.6 Tense Binders

In order to examine the interplay between temporal indexicals and tense, Comrie's tenses from table 5.2 are needed.[4] These have to be defined on some temporal ordering relations. Since the actual implementation of time intervals and calendric dates would lead far apart, we will make only minimal assumptions. Let $x \sqsubseteq y$ have the reading x *is a subinterval of* y, $x < y$ have the reading x *is before* y, and $x > y$ be the converse of the latter. The following correspondences of mapping functions with Reichenbach's S-R-E scheme are assumed.

- The Speech Time *S* is given by $time(c, k)$ of the currently active contexts c, k.

- The Event Time *E* is $time(c, k)$ of a context c introduced by some existential quantifier.

- The Reference Time *R* is given by $rtime(c, k)$ of the currently active contexts c, k.

Additionally, the *utterance time* is given by $utime(c, k)$ of the currently active contexts c, k; this is the time at which the actual utterance takes place. On the basis of these intended interpretations the following egocentricity constraint should hold.

☆ **Constraint 6** (Egocentricity of Time of Speech)**.**

$$\text{\textit{For any }} c, k :$$
$$utime(c, k) \sqsubseteq time(c, k) \tag{7.40}$$

This constraint has been given separately, because it seems to be (a) language dependent and (b) might not hold in narrative or other non-canonical conversational contexts. Under the assumption that it holds, the condition for the absolute present tense below will stipulate that the time of the described event must be within the speech time and the actual utterance must occur within the speech time as well, but the described event may or may not occur while the utterance is made. The definitions of the other absolute tenses are likewise straightforward.

☆ **Constraint 7** (Present)**.**

$$\textit{if } \langle c', c'' \rangle \in [\![pres]\!]_{g,k}^{M}(c) \tag{7.41}$$
$$\textit{then } c' \simeq_t^k c'' \textit{ and } time(c'', k) \sqsubseteq time(c, k)$$

☆ **Constraint 8** (Past)**.**

$$\textit{if } \langle c', c'' \rangle \in [\![past]\!]_{g,k}^{M}(c) \tag{7.42}$$
$$\textit{then } c' \simeq_t^k c'' \textit{ and } time(c'', k) < time(c, k)$$

☆ **Constraint 9** (Future)**.**

$$\textit{if } \langle c', c'' \rangle \in [\![fut]\!]_{g,k}^{M}(c) \tag{7.43}$$
$$\textit{then } c' \simeq_t^k c'' \textit{ and } time(c'', k) > time(c, k)$$

---

[4]See page 122 of section 5.3.3, chapter 5.

☆ **Abbreviation 8** (Basic Absolute Tenses)**.**

*(Pres [*CVAR₁*] . CVAR₂) MSQ*
  *:= (exists * CVAR₂)*
      *(pres [*CVAR₁*] CVAR₂)*
      MSQ

*(Past [*CVAR₁*] . CVAR₂) MSQ*
  *:= (exists * CVAR₂)*
      *(past [*CVAR₁*] CVAR₂)*
      MSQ

*(Fut [*CVAR₁*] . CVAR₂) MSQ*
  *:= (exists * CVAR₂)*
      *(fut [*CVAR₁*] CVAR₂)*
      MSQ

The relative tenses work the same way, but on the basis of the *reference time* of the active conversational context.

☆ **Constraint 10** (Relative Present)**.**

$$if \langle c', c'' \rangle \in [\![relpres]\!]^M_{g,k}(c) \tag{7.44}$$
$$then\ c' \simeq^k_t c''\ and\ time(c'', k) \sqsubseteq rtime(c, k)$$

☆ **Constraint 11** (Relative Future)**.**

$$if \langle c', c'' \rangle \in [\![relfut]\!]^M_{g,k}(c) \tag{7.45}$$
$$then\ c' \simeq^k_t c''\ and\ time(c'', k) > rtime(c, k)$$

☆ **Constraint 12** (Relative Past)**.**

$$if \langle c', c'' \rangle \in [\![relpast]\!]^M_{g,k}(c) \tag{7.46}$$
$$then\ c' \simeq^k_t c''\ and\ time(c'', k) < rtime(c, k)$$

☆ **Abbreviation 9** (Basic Relative Tenses)**.** ***RelPres, RelFut,*** *and* ***RelPast*** *are abbreviated as in 8 but on the basis of Constraints 10–12.*

The abbreviations of the complex tenses can be read off the table on page 122 almost directly and are included here mainly for the sake of systematicity.

☆ **Constraint 13** (PluPerfect)**.**

$$if \langle c', c'' \rangle \in [\![pluperf]\!]^M_{g,k}(c) \tag{7.47}$$
$$then\ c' \simeq^k_t c''\ and\ time(c'', k) < rtime(c, k) < time(c, k)$$

✩ **Constraint 14** (Future Perfect)**.**

$$\textit{if } \langle c', c'' \rangle \in [\![\textit{futperf}]\!]^{M}_{g,k} (c) \tag{7.48}$$

$$\textit{then } c' \simeq^{k}_{t} c'' \textit{ and } \textit{time}(c'', k) < \textit{rtime}(c, k) \textit{ and } \textit{rtime}(c, k) > \textit{time}(c, k)$$

✩ **Constraint 15** (Future in the Future)**.**

$$\textit{if } \langle c', c'' \rangle \in [\![\textit{futfut}]\!]^{M}_{g,k} (c) \tag{7.49}$$

$$\textit{then } c' \simeq^{k}_{t} c'' \textit{ and } \textit{time}(c'', k) > \textit{rtime}(c, k) > \textit{time}(c, k)$$

✩ **Constraint 16** (Future in the Past)**.**

$$\textit{if } \langle c', c'' \rangle \in [\![\textit{futpast}]\!]^{M}_{g,k} (c) \tag{7.50}$$

$$\textit{then } c' \simeq^{k}_{t} c'' \textit{ and } \textit{time}(c'', k) > \textit{rtime}(c, k) \textit{ and } \textit{rtime}(c, k) < \textit{time}(c, k)$$

✩ **Abbreviation 10** (Complex Tense Binders)**.** *The complex tense binders **PluPerf, FutPerf, FutFut, FutPast** are implemented in the same way as 8 but on the basis of Constraints 13–16.*

All of these translations from Comrie's scheme are approximations, since they don't take into account possible more fine-grained structure of intervals in the constraints, such as allowing or disallowing overlapping intervals. To deal with temporal quantifier expressions like «whenever» or «always» a larger interval depending on the conversational context is needed to constrain the quantifier's maximum range, but since no such expressions are analyzed in the following, this is ignored for simplicity. For present purposes, the above schemes should suffice.

7.3   The Deictic Center

Now that the basic framework has been laid out it is time to take a look at how indexical reference can be expressed in that language. Hereby, a descriptive theory of indexical reference will be assumed, as it has been introduced in the previous chapters. Notice that the descriptive content of the binders defined below is sometimes rather given by the intended interpretation of the mapping functions and corresponding semantic rules than just by the intended interpretation of object language predicates.

7.3.1   Now

Although languages like Burmese according to Comrie (1985) have no grammaticalized tenses and in languages like Mandarin tense particles are often left out, temporal indexicals can, for the sake of simplicity, be assumed to *modify* a time introduced by some formal tense binder, no matter whether there is a corresponding source language expression for the tense or not.[5] English «now» in this view modifies the event time introduced by the English present tense. As in earlier definitions, we first introduce a special predicate.

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[5]Burmese (mya) is a Sino-Tibetan language spoken by approximately 32 million speakers in Myanmar and neighboring regions, Mandarin (cmn) is a Sino-Tibetan language of China with a population of approximately 873 million speakers (Gordon 2005).

☆ **Constraint 17** (now Special Predicate).

$$now \in \mathrm{PRED}_2, \text{ where all arguments are in } \mathrm{CVAR} \qquad (7.51)$$

$$\text{if } \langle c', c'' \rangle \in [\![\boldsymbol{now}]\!]^M_{g,k}(c) \qquad (7.52)$$

$$\text{then } c' \simeq^k_t c'' \text{ and } utime(c', k) \sqsubseteq time(c'', k) \sqsubseteq time(c', k)$$

N.B. the use of *if* instead of *if and only if*; the constraint is formulated as a meaning rule, because some speakers might have a specific time interval in mind. Here is the respective binder.

☆ **Abbreviation 11** (Jetzt Binder). *(**Jetzt** [*CVAR_0*] . * CVAR_1*)* MSQ
   := *(**exists** *CVAR_1*)* *(**now** [*CVAR_0*] . * CVAR_1*)* MSQ

This binder isn't rigid by default and can thus be used to give a past reading of German «jetzt», deviate past tense readings of «now», and readings of «then».[6] To express restrictions on the use of «now» in English we need a constraint on the syntax–semantics interface.

☆ **Hypothesis 1** («now» Constraint). *English «now» is analyzed as FOLC sequence (**Jetzt** C1 . C2), where C1 must be bound by a present or past tense binder. Binding to a past context c in some k is only possible when k is a narrative conversational context.*

This vague hypothesis at least excludes non-rigid interpretations of «now» in combination with future tenses and limits the past tense use of «now» to narrative contexts. A similar constraint for «then» could say that it may only be used in combination with the past tense, but may not be used with a present or future tense. Such hypotheses need empirical backup, and in a more detailed account clear criteria for deciding between narrative and non-narrative conversational contexts would have to be given in order to make Hypothesis 1 falsifiable. For the present purpose of outlining how center indexicals work in general, these language-specific details are omitted. What counts is that the above constraint is an empirical hypothesis.

Based on the above definitions the past tense examples 5.49–5.51 from chapter 5 (page 123) yield the following in FOLC.

(7.53) $M, g, c, k \vDash$

    (**iota** X (Alice X))(**Past** C1)(**Now** C1 . C2)(angry C2 . X)

This says that there is someone x called «Alice», there is a time t which is before the time of speech determined by c and k, and x was angry at t (according to k), during which there is a designated utterance time given by $utime$. The use of $utime$ in this context is stipulative and not imposing any logical restrictions. It doesn't indicate that an actual utterance occurred. This is intended, since the past use of «now» is indeed not very restricting. It just indicates a certain designated time in the past occurring within a larger series of events. In contrast to this, in the following canonical use of «now» with the present tense, $utime$ must really provide the time of utterance.

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[6]See 5.50 and 5.51 on page 123.
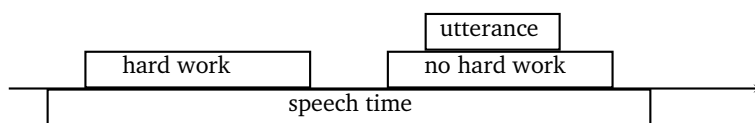
Figure 7.1: Egocentricity of «now» versus bare present tense in example 7.56.

(7.54) Alice now believes that Bob was angry.

(7.55) $M, g, c, k \vDash$

```
(iota X (Alice X))
(Pres C1)
(Jetzt C1 . C2)
(believe C2 . C3 X)
(Past C3 . C4)
(iota Y (Bob Y))
(angry C4 . Y)
```

Notice that present tense alone by Constraint 7.40 only requires the utterance to occur during the time of speech. In contrast to this, the use of «now» requires the utterance to occur during event time. This allows a FOLC analysis of following sentence to become true, as illustrated in Figure 7.1.[7]

(7.56) Alice works hard, but not now.

7.3.2 Here

In the spatial domain, heavier idealizations and more stipulations have to be made, since reified places may stand for rather complicated objects in the real world like rivers, hills, rooms, cities, palms, or universes. The conversational context determines a place given by $time(c, k)$ in which the event, state, or situation talked about takes place, and the space occupied by *here* must be part of that space. A mereological part-of relation is needed, and $p_1 \preccurlyeq p_2$ will be used to denote this relation with the reading p_1 *is a part of* p_2. This relation is reflexive, anti-symmetric, and transitive. Even when «here» is not used, the place of utterance will often be part of the place of the described event, as in the following example.

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[7]Possibly the present tense in this case has a more generic reading as in *Alice usually works hard, but she doesn't work hard now*. If so, this would require an entirely different analysis. If all examples like 7.56 were to be read in this generic way, then ordinary, non-generic present tense and «now» might eventually collapse and both be egocentric, but unless this is shown in detail, the above analysis seems to be an adequate working assumption.

(7.57) *Situation: Alice in Copenhagen is talking on the phone to Bob in Aarhus.*
   Bob: How's the weather?
   Alice: It is raining.

But on the other hand the constraint is clearly not mandatory. Consider for example, the following variation of the above dialog.

(7.58) *Situation: Alice in Copenhagen is talking on the phone to Bob in Aarhus.*
   Bob: I'm so busy with work, I don't even know whether the sun is shining outside or not.
   Alice: It is raining. I've seen the weather report for Aarhus.

Such a non-egocentric reading is not possible if «here» is used, i.e. «here» is strictly egocentric. Again, the following utterance can become true in some models.

(7.59) Alice: It is raining, but not here.

Although the mapping functions for places have been given the same names as those for times, their role differs and depends on the domain. In the spatial domain $rplace(c, k)$ is interpreted as the larger *reference place* in which the actual raining event occurs, whereas $place(c, k)$ is the place of the actual raining event. The mapping functions aren't used in exact analogy to the temporal domain, because in the temporal domain tense always introduces a new time variant, and so there's always an additional time variant available. In contrast to this, at least in English there is no obligatory binder for places.

Given that the place of utterance is $uplace(c, k)$, the condition for «here» is as follows.

☆ **Constraint 18** (here Special Predicate)**.**

$$\textbf{\textit{here}} \in \text{PRED}_2\textit{, where all arguments are in } \text{CVAR} \tag{7.60}$$

$$\textit{if } \langle c', c'' \rangle \in \llbracket \textbf{\textit{here}} \rrbracket^M_{g,k}(c) \tag{7.61}$$

$$\textit{then } c' \simeq^k_p c'' \textit{ and } uplace(c, k) \preccurlyeq place(c'', k) \preccurlyeq rplace(c, k)$$

As before, some syntactic sugar may be added for better readability.

☆ **Abbreviation 12** (Here Binder)**.** *(**Here** [*CVAR$_1$*] CVAR$_2$)* MSQ
   *:= (**exists** CVAR$_2$) (**here** [*CVAR$_1$*] CVAR$_2$)* MSQ

The following example illustrates the possible difference between an utterance involving ‹here› and one without.

(7.62) Alice (*in Copenhagen*): It is raining here.
   $M, g, c, k \vDash$ (**Pres** C1) (**Here** C1 . C2) (rain C2)

(7.63) Alice (*in Copenhagen*): It is raining.
   $M, g, c, k \vDash$ (**Pres** C1) (rain C1)

Example 7.62 expresses the spatial constraint $uplace(c, k) \preccurlyeq place(c_2, k) \preccurlyeq rplace(c, k)$ for $g(\text{C2}) = c_2$, where $uplace(c, k)$ is the place of utterance, i.e. the concrete location of the sender. 7.63 doesn't express this spatial constraint, because when «here» is not used it is possible that $uplace(c, k) \not\preccurlyeq place(c, k)$. One remark on these places is necessary. Although in principle dispensable, the reference place is a reasonable stipulation. It is the place which discourse participants have in mind and which remains stable during a larger discourse fragment. In the above case, this could for example be Denmark. To make sense of the reference place the following constraint has to hold.

☆ **Constraint 19** (Reference Place).

$$\text{For any } c, k : place(c, k) \preccurlyeq rplace(c, k) \tag{7.64}$$

It can then sometimes be the required, within some fragment of discourse, that for several subsequent utterances $c_1, c_2, \ldots, c_n$ it holds that $rplace(c_1, k) = rplace(c_2, k) = \cdots = rplace(c_n, k)$. The places of the individual events described might differ, but they still have to be within the reference place. So for example if Alice and Bob continue their conversation about the weather (in Denmark), and Alice suddenly mentions that there was a cyclone, this utterance can be false even if there was indeed a cyclone somewhere near Papua New-Guinea. However, the stability requirement on $rplace$ is pragmatic and the actual socio-linguistic rules governing such requirements are far beyond the scope of this investigation. Still, it should be clear that if someone says «There is no more pudding left» this rarely means that there is no more pudding left in the known universe.

7.3.3   I

As noted in chapter 5, «I» like many other indexicals in the person domain isn't particularly ambiguous or vague. A mapping function $speaker(c, k) : C \times K \to S$ is added to Σ, but the result of this function will usually only change with its first argument; only in derived uses of «I» will it depend on the conversational context. The corresponding special predicate in the object language is based on this mapping function:

☆ **Constraint 20** (Speaker).

$$Speaker \in \text{PRED}_2 \text{, where the last argument is in DVAR} \tag{7.65}$$

$$\langle c', a \rangle \in [\![Speaker]\!]_{g,k}^{M}(c) \tag{7.66}$$

$$\textit{iff } speaker(c', k) = a$$

☆ **Abbreviation 13** (I Binder). *(I [CVAR] . DVAR)* MSQ
   := (iota DVAR) (Speaker [CVAR] . DVAR) MSQ

A typical use of this binder is as follows.

(7.67) Alice: I'm hungry.

(7.68) $M, g, c, k \vDash$ (**Pres** C1)(**I** X)(hungry C1 . X)

Applying the open variable convention, this is true if $speaker(c, k)$ is hungry in some subinterval of the time of speech. **I** could also depend on an introduced context of utterance, when the variable at its context argument place is bound. This possibility has been admitted to ease illustrating potentially non-rigid interpretations of «I»-tokens in section 8.2.3 of the next chapter.

7.3.4 Actually

If «actually» is read as a modal actuality operator its interpretation can't be analogous to that of the previous center indexicals. The actual world in the sense of the world how it has evolved in fact, as opposed to how it could have conceivably—or in any other sense possibly—evolved, is a matter of reality. But then, a fortiori, it should not depend on the context of utterance either, which may change from token to token. So we face a certain dilemma. A compromise is to implement the actuality operator using $world(c, k)$, but at the meantime stipulate that the world component remains stable under normal conditions in non-narrative conversational contexts. Following the previous definitions, a special predicate actually is used.

☆ **Constraint 21** (actually Special Predicate)**.**

$$actually \in \mathrm{PRED}_2, \text{ where the last argument is in } \mathrm{CVAR} \tag{7.69}$$

$$\langle c', c'' \rangle \in [\![actually]\!]_{g,k}^M (c) \tag{7.70}$$

$$iff\ c' \simeq_w^k c'' \text{ and } world(c'', k) = world(c, k)$$

☆ **Abbreviation 14** (Actually Binder)**.** (***Actually*** *[*CVAR_1*]* CVAR_2*)* MSQ
   $:=$ (***iota*** CVAR_2*)* (***actually*** *[*CVAR_1*]* CVAR_2*)* MSQ

As mentioned in chapter 5, there is other uses of «actually». Consider for example the following short dialog.

(7.71) Alice: Wow, this zeppelin is big!
   Bob: Actually it's quite small. The Hindenburg was 5 times larger.

This can be regarded a shift in conversational contexts. While the first utterance may be true in some conversational context k, Bob considers this context inappropriate. «Actually» indicates to Alice a shift from k to another conversational context k', the one of comparing zeppelins with other well-known zeppelins, making her original utterance false and Bob's utterance true if Bob is right. To express this formally, a function $kontext : S \times C \to K$ is added to Σ, and then the following operator can be used.[8]

☆ **Definition 6** (Actually Operator)**.**

$$Act \in \mathrm{SOP} \tag{7.72}$$

---

[8]The dependency on C might seem redundant at first glance, but is needed, because the same speaker might presume differing conversational contexts at different occasions.

For $A = Act\,\mathrm{MSQ}$:

$$[\![A]\!]^{M}_{g,k}(c) = \begin{cases} 1\ \textit{if}\ \ [\![\mathrm{MSQ}]\!]^{M}_{g,k'}(c) = 1, \\ \qquad \textit{where}\ k' = kontext(speaker(c,k),c); \\ 0\ \textit{otherwise} \end{cases} \tag{7.73}$$

$$U(A,g) = U(\mathrm{MSQ},h); U(A,c) = U(\mathrm{MSQ},c); U(A,k) = U(\mathrm{MSQ},k')$$

7.4   Complex Indicators

The complex tenses introduced above are already examples of complex indicators. Some more examples will be given in this section. They represent a more or less arbitrary selection of common complex indicators in order to exemplify how these can be analyzed in the given framework.

7.4.1   Example: yesterday

English «yesterday» is a paradigmatic example of a complex calendric egocentric indicator. It can be modeled in two ways: (A) Yesterday is the day before the day of the time of speech. (B) Yesterday is the day before the day of the time of utterance. As the following example shows, both readings are possible.

(7.74) *Situation: It's 1st March 2006, 0:06 h.*
     Alice: Yesterday, I was at the cinema.

According to the pedantic reading, this is true if Alice was at some cinema on 28th February, 2006. According to the preferred loose reading, this is true if Alice was at some cinema on 27th February, 2006. (B) only predicts the pedantic reading and is therefore less adequate. (A) predicts both readings if the time of speech is taken large enough to stretch from the end of 28.2.2006 to the very beginning of 1.3.2006 and given that either the start or the end of an interval may be taken for determining the day in question when it stretches over a calendric day boundary.[9] The following definition is therefore based on account A.

☆ **Definition 7** (yesterday Special Predicate)**.**

$$yesterday \in \mathrm{PRED}_2, \textit{ where both arguments are in } \mathrm{CVAR} \tag{7.75}$$

$$\textit{if } \langle c', c'' \rangle \in [\![yesterday]\!]^{M}_{g,k}(c) \tag{7.76}$$

$$\textit{then } c' \simeq^{k}_{t} c'', \, day(time(c',k)) = day(time(c'',k)), \tag{7.77}$$

$$\textit{and } day(time(c,k)) - day(time(c'',k)) = 1\,day$$

Of course, modulo arithmetics based on calendric units is assumed in the above date calculations. The corresponding binder is abbreviated as usual.

---

[9]Cf. 5.3.3. In everyday speech calendric boundaries often collide with personal ad hoc boundaries that are more appropriate in the given conversational context. Sometimes for people that stay up long the evening of the previous day stretches into the morning of the people that have to get up early.

☆ **Abbreviation 15** (Yesterday Binder). *(**Yesterday** CVAR$_1$ CVAR$_2$)* MSQ
  $:=$ *(**exists**$_*$ CVAR$_2$)(**yesterday** CVAR$_1$ CVAR$_2$)* MSQ

The analysans for «tomorrow» is the same as above except that the result of the calculation must be $-1\,day$. The restriction on the day of the event time leaves it open how long the event time is or where in the day that interval is situated, since this is a matter of aspect and the kind of event described, and not of the temporal adverb. Here is the analysis of 7.74, where the phrase «being at the cinema» is read in a generic sense and it is assumed that place= expresses that $place(c_1, k)$ is sufficiently similar to $place(c_2, k)$ in k for two given contexts $g(\text{C1}) = c_1$ and $g(\text{C2}) = c_2$.

(7.78) $M, g, c, k \vDash$

> (**Past** C1)(**Yesterday** C1 C2)(**I** SUBJ)
> (**exists**$_*$ C3)(Cinema C3)(place= C2 C3)(be C3 . SUBJ)

The expression «to be at the cinema» in this reading is a phraseologism according to which «the cinema» has a generic reading and «to be» doesn't mean mere existence but some activity extended in time. The above use of (Cinema C3) might look a bit dubious. This stems from the fact that English isn't sorted in the same sense as FOLC is sorted into context terms and terms for other objects. An English speaker may quantify freely over times and places just as he may quantify over cars or socks. The strong sorting of FOLC into object and context terms is a convenience for the user of the target language, not a feature of the source language.

7.4.2 Example: the former president

The definite description «the former president» can be read as a compound indicator saying *the one and only person that was president but is no longer president now,* where the fact that this person is no longer president is presuppositional, as it is for example preserved under negation. Definite descriptions like this show that past time intervals are often bounded and definite; 7.79 presupposes that there is exactly one definite former president, and therefore it is also a definite past period of presidency the speaker has in mind.

(7.79) The former president is drunk.

This can be mapped to FOLC by assuming, in the syntax–semantics interface in combination with the lexicon, that «former» modifies a noun by using the **Past** and **Jetzt** binders NP-internally.

(7.80) $M, g, c, k \vDash$

> (**Pres** C1)
> (**iota** SUBJ (**Past** C2)(president C2 . SUBJ)
>   (**Jetzt** C3)($-$president C3 . SUBJ))
> (drunk C1 . SUBJ)

There is, however, a problem with this analysis. When used with the past tense as in 7.81, there is a reading according to which the person in question is a former president in the past, not just a former president now.

(7.81) The former president was drunk.

This is a similar kind of reading as can be observed for «now» plus past tense. It seems to be the indirect result of the fact that the narrative time itself is in the past, i.e. that a story is told about some chain of events that have happened in the past, rather than «former» having a pluperfect reading on its own. Otherwise 7.79 should have a reading according to which the person in question *had been* president before some time in the past that is not mentioned and is drunk now, but no such reading seems to be available. One solution is to make the temporal ordering relation available in the object language.

☆ **Definition 8** (earlier)**.**

$$earlier \in \text{PRED}_2, \text{ where the second argument is in } \text{CVAR} \qquad (7.82)$$

$$\textit{if } \langle c', c'' \rangle \in [\![\textit{earlier}]\!]^M_{g,k}(c) \qquad (7.83)$$

$$\textit{then } time(c'', k) < time(c', k)$$

Notice that the order of arguments is the reverse of the ordinary reading, because the first argument is optional. 7.81 is then mapped to:

(7.84) $M, g, c, k \vDash$

```
(Past C1)
(iota SUBJ (exists* C2)(earlier C1 . C2)
  (president C2 . SUBJ)
  (−president C1 . SUBJ))
(drunk C1 . SUBJ)
```

This analysis suggests that there is also a reading of 7.85 according to which the person in question may now still be president. This reading is apparently possible in addition to the first reading according to which the person in question is now no longer president, as in 7.80, and will be drunk later.

(7.85) The former president will be drunk.

Only in the first reading is «the former president» egocentric.

7.4.3 Example: we

The indicator «we» is a typical example of a semantically complex indicator in the person domain. As laid out in chapter 5, it can have inclusive or exclusive reading. To get the respective readings in the object language, some new mapping functions in Σ have to be introduced. The following $addr$ function is also needed for the second person indicators.

☆ **Definition 9** (Addressee Function)**.**

$$addr : C \times K \rightarrow \wp(S) \tag{7.86}$$

☆ **Definition 10** (Speaker Group Function)**.**

$$sgroup : C \times K \rightarrow \wp(S) \tag{7.87}$$

☆ **Constraint 22** (Mutually Distinct Addressee and Speaker Groups)**.**

$$\forall c \in C \; \forall k \in K :$$
$$speaker(c) \notin addr(c, k) \tag{7.88}$$
$$addr(c, k) \cap sgroup(c, k) = \emptyset \tag{7.89}$$

7.88 is not strictly necessary, because there is no English pronoun that would solely refer to the speaker group, but added to make the abbreviations in the object language more explicit. Once again binders will be introduced on the basis of special predicates. To decide inclusive from exclusive reading, the Telugu pronouns «manamu» (inclusive we) and «memu» (exclusive we) are used as symbols.[10]

☆ **Definition 11** (Addressee Predicate)**.**

$$Addressee \in \mathrm{PRED}_2, \textit{ where the second argument is in } \mathrm{DVAR} \tag{7.90}$$
$$\langle c', a \rangle \in [\![Addressee]\!]_{g,k}^M (c) \tag{7.91}$$
$$\textit{iff. } a \in addr(c', k)$$

☆ **Definition 12** (SpeakerGroup Predicate)**.**

$$SpeakerGroup \in \mathrm{PRED}_2, \textit{ where the second argument is in } \mathrm{DVAR} \tag{7.92}$$
$$\langle c', a \rangle \in [\![SpeakerGroup]\!]_{g,k}^M (c) \tag{7.93}$$
$$\textit{iff. } a \in sgroup(c', k)$$

Here are the respective binders:

☆ **Abbreviation 16** (Inclusive We Binder)**.**

```
(Manamu [CVAR] DVAR) MSQ
  := (forall [CVAR] DVAR)
     (implies (or (Speaker [CVAR] DVAR)
                  (SpeakerGroup [CVAR] DVAR)
                  (Addressee [CVAR] DVAR))
              MSQ)
```

---

[10]Telugu (tel) is a Dravidian language spoken by roughly 69.7 million speakers in Andhra Pradesh, India (Gordon 2005).

☆ **Abbreviation 17** (Exclusive We Binder)**.**

*(Memu [*CVAR*] DVAR)* MSQ
  *:= (forall [*CVAR*] DVAR)*
    *(implies (and (or (Speaker [*CVAR*] DVAR)*
                  *(SpeakerGroup [*CVAR*] DVAR))*
             *(−Addressee [*CVAR*] DVAR))*
        MSQ*)*

Here is an example analysis of an utterance in which the exclusive reading of ‹we› is triggered by ‹your› and world knowledge on the basis of Gricean maxims. The possessive pronoun «your» is analyzed, but no abbreviation is given for it.

(7.94) Alice: We will buy your company. (exclusive we)

(7.95) $M, g, c, k \vDash$

    (**Fut** C1)
    (**Memu** SUBJ)
    (**iota** OBJ
      (company OBJ)
      (**forall** MOD)
      (**implies** (Addressee MOD) (ownedBy OBJ MOD)))
    (buy C1 . SUBJ OBJ)

7.4.4   Example: the left entrance

The phrase «the left entrance» is an example of a compound and complex spatial indicator:

(7.96) Alice (*to Bob, both facing a building*): The left entrance was locked.

This definite description is egocentric in the above example at least in its preferred reading: It specifies a spatial relation between the speaker Alice, who isn't mentioned in the utterance, and the entrance. So it can be expressed as follows in an intended FOLC model M.

(7.97) $M, g, c, k \vDash$

    (**Past** C1)
    (**iota** C1 . SUBJ
      (**iota** X (Speaker X))
      (**and** (entrance C1 . SUBJ)(leftOf SUBJ X)))
    (locked C1 . SUBJ)

At least in the above reading the definite description is non-rigid with respect to time except for the speaker predicate. The entrance is picked out that existed *then*, at the event time specified by the past tense, at the location that is *now* to the left side of the body axis in relation to where the speaker is facing now, no matter whether this entrance still exists or not.[11] If the entrance no longer exists, the definite determiner requires that the former entrance must have been introduced into discourse before, but that is another matter.

7.5 Demonstratives

As laid out in (Ind 3) on page 131, a demonstrative's lexical meaning in combination with a pointing gesture determines the semantic referent. There is no principal difference between the FOLC treatment of demonstratives to the one in double-index theories. The pointing gesture must be encoded in some way in the target language and in addition to the lexical meaning of the respective demonstrative determines a semantic referent uniquely.

7.5.1 Example: this and that

The following utterance is a good example of the opposition between «this» and «that» and the minimal adequacy requirement that two demonstrative tokens of the same type must be able to have two different semantic referents. For sake of simplicity, the ellipsis and the contrastivity of «but» will be ignored.

(5.7) $\underrightarrow{This}_1$ is different from $\underrightarrow{that}$, but $\underrightarrow{this}_2$ isn't.

There are several ways to deal with multiple tokens of the same type within one utterance:

1. Each token is given an index and treated like an expression of its own. This solution is already rejected by Kaplan (1989), because it doesn't do justice to the use of pointing gestures.

2. The target language itself allows reference to tokens and the formulation of token-reflexive reference rules. This is technically feasible only if definitions that lead to contradictions, like the Liar Paradox, are excluded.

3. Each pointing gesture is stipulated in the target language. This is perhaps the most satisfying account from a philosophical point of view, since it makes the extralinguistic requirement explicit; properly understanding two tokens of the same demonstrative in one utterance requires the hearer to interpret two different pointing gestures.

4. A new context of utterance is introduced with each use of the demonstrative, and the pointing gesture is considered part of the context. This makes sense in light of the fact that contexts of utterance are concrete situations and under canonical circumstances occur one after the other.

---

[11]Cf. 5.4.5 of chapter 5. Notice that the above example *also* has a passive reading, according to which there was someone who locked the entrance.
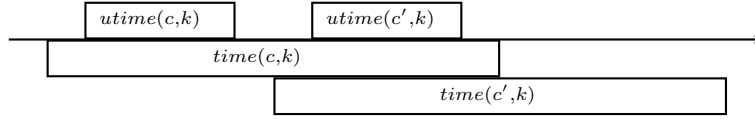
Figure 7.2: Example of two consecutive utterances and associated speech times.

Both the third and the fourth method can readily be used in FOLC. We will use the fourth one, as the third has already been exemplified in DIML. To get the desired analysis, first a generic shift operator is needed that steps the time a little bit ahead. Here is a definition that should suffice:

☆ **Definition 13** (NewToken Shifter)**.**

$$NewToken \in \mathrm{SOP} \tag{7.98}$$

For $A = NewToken\, \mathrm{MSQ}$:

$$\llbracket A \rrbracket_{g,k}^{M}(c) = \begin{cases} 1 \text{ } if \text{ } \llbracket \mathrm{MSQ} \rrbracket_{g,k}^{M}(c') = 1, \\ \quad for \text{ } some \text{ } c', \text{ } where \text{ } c \simeq_{t}^{k} c', \\ \quad utime(c,k) < utime(c',k), \\ \quad and \text{ } utime(c',k) \sqsubseteq time(c,k); \\ 0 \text{ } otherwise \end{cases} \tag{7.99}$$

$$U(A,g) = U(\mathrm{MSQ}, h); U(A,c) = U(\mathrm{MSQ}, c'); U(A,k) = U(\mathrm{MSQ}, k) \tag{7.100}$$

One example structure fulfilling this constraint in combination with Constraint 7.40 is depicted in Figure 7.2. Using this operator, the FOLC version of 5.7 looks complicated, but in fact only does so because no abbreviations for the demonstratives have been given yet:

```
(7.101) (Pres C1)
    (iota SUBJ (iota X (Speaker X))
            (proximal SUBJ X)
            (pointingTo X SUBJ))
    (iota DO (iota X (Speaker X))
          (−proximal DO X)
          (pointingTo X DO))
    (≠ C1 . SUBJ DO)
    NewToken
    (iota C1 . SUBJ2 (iota X (Speaker X))
                  (proximal SUBJ2 X))
                  (pointingTo X SUBJ2))
    (not (≠ C1 . SUBJ2 DO))
```

Hereby, (proximal X Y) must have the reading *X is located in the vicinity of Y* and (pointingTo X Y) must have the reading *X is pointing in the direction of Y*. Notice further that in the above example the new token operator has only been applied when it was necessary. Since its definition does ensure that the new time interval is within the speech time, it could equally well have been applied before each target language expression that is the analysis of a particular source language token. As a third alternative, **NewToken** could also be made part of the abbreviation of the respective demonstratives. Which route is chosen depends on the syntax–semantics interface and the nature of the source language input to it. One more thing to note about 7.101 is that the internal structure of the demonstratives in an abbreviation requires the use of new variables. So for example the definition of «this» looks as follows.

✩ **Abbreviation 18** (this Binder). *For new, unique variable* DVAR_2:

$$
\begin{array}{l}
(\textit{this}\ [\text{CVAR}]\ \text{DVAR}_1)\ \text{MSQ} \\
\quad := (\textit{iota}\ [\text{CVAR}]\ \text{DVAR}_1 \\
\qquad\qquad (\textit{iota}\ \text{DVAR}_2\ (\textit{Speaker}\ \text{DVAR}_2)) \\
\qquad\qquad (\textit{proximal}\ \text{DVAR}_1\ \text{DVAR}_2) \\
\qquad\qquad (\textit{pointingTo}\ \text{DVAR}_2\ \text{DVAR}_1))\ \text{MSQ}
\end{array}
$$

If there were non-rigid demonstratives, then the above use of **NewToken** would be inadequate. Instead, the definition of the respective demonstrative binder would have to take optional variables into account and a new token binder would have to be implemented that delivers a suitable time variant based on the previous context. But demonstratives are absolutely rigid, and so this more general mechanism isn't needed.

7.5.2 Example: kore, sore, are

Expressing the Japanese demonstrative system can readily be done in FOLC using the means introduced so far. «kore» can be expressed by the **this** binder. Consider then the following uses of «sore» and «are»:

(7.102) $\underset{\overrightarrow{\text{That}}}{\textit{Sore}}$ wa   konpyuuta   desu.

          TOPIC   computer   COPULA+PRES+POLITE

    'That's a computer.'

(7.103) $\underset{\overrightarrow{\text{That}}}{\textit{Are}}$ wa   daigaku   desu.

          TOPIC   university   COPULA+PRES+POLITE

    'That [building] overthere is a university.'

These demonstratives can be translated directly into FOLC provided that the respective predicates are given their intended meaning.

✩ **Abbreviation 19** (sore Binder). *For new, unique variables* $\text{DVAR}_2, \text{DVAR}_3$:

$$
\begin{array}{l}
(\textit{sore}\ [\text{CVAR}]\ \text{DVAR}_1)\ \text{MSQ} \\
\quad := (\textit{iota}\ [\text{CVAR}]\ \text{DVAR}_1
\end{array}
$$

>   *(iota* DVAR$_2$ *(Speaker* DVAR$_2$*))*
>   *(pointingTo* DVAR$_2$ DVAR$_1$*)*
>   *(forall* DVAR$_3$*)*
>   *(implies (Addressee* DVAR$_3$*)*
>   *(proximal* DVAR$_1$ DVAR$_3$*)))*
>   MSQ

✰ **Abbreviation 20** (are Binder). *For new, unique variables* DVAR$_2$, DVAR$_3$:

*(are [*CVAR*]* DVAR$_1$*)* MSQ
  *:= (iota [*CVAR*]* DVAR$_1$
          (iota DVAR$_2$ *(Speaker* DVAR$_2$*))*
          (pointingTo DVAR$_2$ DVAR$_1$*)*
          (−proximal DVAR$_1$ DVAR$_2$*)*
          (forall DVAR$_3$*)*
          (implies (Addressee DVAR$_3$*)*
                      (−proximal DVAR$_1$ DVAR$_3$*)))*
       MSQ

What matters is the mutual restrictions between proximity to speaker, proximity to addressee, and lack of proximity to both of them that are expressed by **this**, **sore**, and **are** in intended models. The conditions could be made stronger by putting the additional constraints into the definitions or by imposing model constraints instead of just relying on intended readings. It is, however, doubtful whether these constraints hold in each and every model. For the sake of demonstrating how demonstratives work this issue can be left open. Here is the fully expanded analysis of example 7.103:

(7.104) $M, g, c, k \vDash$

       (**Pres** C1)
       (**iota** C1 . SUBJ
               (**iota** X (Speaker X))
               (pointingTo X SUBJ)
               (−proximal SUBJ X)
               (**forall** Y)
               (**implies** (Addressee Y)
                       (−proximal SUBJ Y)))
       (university C1 . SUBJ)

Under the intended interpretation in M this means, roughly speaking, that there is a time interval at which the utterance takes place and in the contexts c_1, k at that time there is exactly one object x that the speaker of the current context is currently pointing at and which is neither in the vicinity of the speaker nor in the vicinity of any of the addressees in the current context of utterance, and x is a university at the time of c_1, k (present) at the place of c_1, k (determined on the basis of the utterance context in the conversational context) and in the world of c_1, k (the actual world unless k is fictional).

7.6 Shifters

Many aspects of the systems in (von Stechow 2003) and (Schlenker 2003) concern the syntax–semantics interface. These factors will be ignored in the following paragraphs, whose purpose is only to give examples of how to deal with shifters in FOLC. Alternative ways of dealing with the Amharic first-person indicator will be outlined first, whereas just one analysis is given for the subsequent examples in the temporal domain. In principle the other alternatives could be applied to these examples, too.

7.6.1 Example: Amharic First-Person Indicator

To start with one of Schlenker's examples, a FOLC analysis of the shifting Amharic first-person indicator in 5.32 will be given.[12] Since Amharic first-person in the above example is indexical when it doesn't occur in a clause embedded by a verb of saying, it cannot just be analyzed as a plain bound variable. There are several ways to analyze such a person shifter that make different predictions and differ in generality. First, essentially the same trick as in section 6.5.2 can be used by stipulating that the contexts compatible with what a speaker x has said are exactly those in which x is the speaker. This solution predicts that all first-person indexicals are shifted. Second, the respective indirect speech binder may be modified to introduce some designated contexts with the same speaker as the referent of the subject-NP of the matrix clause, and the first-person pronoun is made dependent on these designated contexts. This solution predicts that in nested verbs of indirect speech a first-person shifter will be co-referential with the referent of the last subject-NP of the matrix clause. Third, designated contexts may be introduced with full binding. This solution is most flexible and makes the least predictions. Finally, the designated context parameter may be shifted and conditional assignment may be used. This modal operator approach predicts that either none or all embedded indexicals are shifted. Since the shifting just works like a normal modal operator it will not be illustrated. The first approach will not be illustrated either, as it just involves a non-rigid use of **I** accompanied by a requirement no less dubious than Constraint 1 of the last chapter and not working with attitude verbs.

The second solution is implemented as follows.

(7.105) (**I** DVAR)
             := (**iota** CS . DVAR (Speaker CS . DVAR)

Hereby, CS is a designated context variable. The abbreviation for the verb of indirect speech then implicitly binds this variable by means of an additional accessibility relation Rs∗.

(7.106) (**say** [CVAR₁] . CVAR₂ DTERM) MSQ
      := (**forall**∗ CVAR₂)(**forall**∗ CS)
         (**implies** (**and** (Rs [CVAR₁] . CVAR₂ DTERM)
                             (Rs∗ [CVAR₁] . CS DTERM)
                             (Speaker CS . DTERM))
                  MSQ)

---

[12]See page 115, section 5.3.1 of chapter 5.

Apart from being dissatisfying from a technical point of view, the built-in dependency on the respective last indirect speech binder is likely empirically inadequate.[13] In any case this is a matter of the syntax–semantics interface. The one outlined in Appendix C can move a first-person shifter before the second indirect speech binder and thereby fix the problem at the level of mapping from source to target language.

The full binding solution is straightforward. Definition 13 is used without modification. The verb of saying is analyzed as above, but binds an additional variable.

(7.107) (**say** [CVAR$_1$] . CVAR$_2$ CVAR$_3$ DTERM) MSQ
   := (**forall**$_*$ CVAR$_2$)
    (**forall**$_*$ CVAR$_3$)
    (**implies** (**and** (Rs [CVAR$_1$] . CVAR$_2$ DTERM)
           (Rs$_*$ [CVAR$_1$] . CVAR$_3$ DTERM)
           (Speaker CVAR$_3$. DTERM))
       MSQ)

The result is then the following formula.

(7.108) $M, g, c, k \vDash$

  (**iota** SUBJ (John SUBJ))(**Pres** C1)
  (**forall**$_*$ C2)
  (**forall**$_*$ C3)
  (**implies** (**and** (Rs C1 . C2 SUBJ)
       (Rs$_*$ C1 . C3 SUBJ)
       (Speaker C3 . SUBJ))
     (**I** C3 . SUBJ2)
     (hero C2 . SUBJ2))

7.6.2 Example: Russian Present Tense

Turning to the temporal domain, the following example taken from (von Stechow 2003) involves shifting of the Russian present tense.

(7.109) *Petja skazal, čto Miša plakal (von Stechow 2003)*
   Petja said that Misha is-crying
  'Petja said, "Misha is crying."'

Although there could be a particular time introduced by the verb of indirect speech, it seems that in the temporal domain shifters can simply be analyzed as non-rigid expressions. This corresponds to the first of the above mentioned solutions and boils down to using a non-rigid binder.

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[13]Unfortunately, at the time of this writing no informants of shifter languages were available to get more data in order to disconfirm or confirm this for some given language. The data in (Schlenker 2000, 2003), (von Stechow 2003), and (Anand and Nevins 2003, 2004) doesn't involve nested verbs of indirect speech.

☆ **Definition 14** (pres* Special Predicate)**.**

$$if \langle c', c'' \rangle \in [\![pres_*]\!]_{g,k}^{M}(c) \tag{7.110}$$

$$then \; c' \simeq_t^k c'' \; and \; time(c'', k) \sqsubseteq time(c', k)$$

(7.111) (**iota** SUBJ (Petja SUBJ))
(**Past** C1)
(**say** C1 . C2 SUBJ)
(**iota** SUBJ2 (Misha SUBJ2))
(**Pres**$_*$ C2 . C3)
(cry C3 . SUBJ2)

7.6.3   Example: Dimli vɨzeri

According to Anand and Nevins (2003), Dimli indicators shift systematically under verbs of saying. In the following example, «vɨzeri» (yesterday; the day before) is considered a shifter.

(7.112) *Hefte   nayeraraver,   Hɛseni   mɨ-ra   va   kɛ   o   vɨzeri   Rojda paci kɛrd.*
    week   ago,   Hesen.obl   me-at   said   that   he   yesterday   Rojda   kiss   did
(Anand and Nevins   2003)

    'A week ago, Hesen told me that he kissed Rojda [eight days ago].'

Here is the respective non-rigid binder:

☆ **Definition 15** (yesterday* Special Predicate)**.**

$$yesterday_* \in \mathrm{PRED}_2, \; where \; both \; arguments \; are \; in \; \mathrm{CVAR} \tag{7.113}$$

$$if \; \langle c', c'' \rangle \in [\![yesterday_*]\!]_{g,k}^{M}(c) \tag{7.114}$$

$$then \; c' \simeq_t^k c'' \; and \; day(time(c', k)) - day(time(c'', k)) = 1 \, day$$

☆ **Abbreviation 21** (Yesterday* Binder)**.** *(**Yesterday**$_*$ [CVAR$_1$] CVAR$_2$) MSQ*
*:= (**exists**$_*$ CVAR$_2$)(**yesterday**$_*$ [CVAR$_1$] CVAR$_2$) MSQ*

Of course, as always proper date arithmetics is assumed. The only change is that the new predicate depends on the previous time-variant instead of the current context parameter. This is a generalization of the previous definition, and as such desirable. Assuming suitable definitions for «hefte nayeraraver» and «mɨ-ra va kɛ», example 7.112 may be written down in FOLC as follows.

(7.115) $M, g, c, k \vDash$

```
(Past C1)
(1weekAgo C1)
(iota SUBJ (Hesen SUBJ))
(I DO)
(tell C1 . C2 SUBJ DO)
(Yesterday* C2 . C3)
(iota DO2 (Rojda DO2))
(kiss C3 . SUBJ DO2)
```

For comparison, a verbose version of 7.112 would look as follows:

(7.116) $M, g, c, k \models$

```
(exists* C1)(past C0 . C1)(1weekAgo C0 . C1)
(iota* SUBJ (exist C0. SUBJ) (Hesen C0 . SUBJ))
(iota* DO (exist C0 . D0)(Speaker C0 . DO))
(forall* C2)
(implies (Rt C1 . C2 SUBJ DO)
         (exists* C3)(yesterday C2 . C3)
         (iota* DO2 (exist C0 . DO2)(Rojda C0 . DO2))
         (kiss C3 . SUBJ DO2))
```

Hereby, ‹hefte nayeraraver› as been mapped non-compositionally to 1weekAgo, which is true iff the time of its second argument is one week before the time of its first argument; a compositional treatment of such expressions would be far too complicated in the present setting. To make it fully clear what 7.116 expresses in intended models M, here is one more verbose, informal paraphrase: There is a time variant c_1 of c in k such that $time(c_1, k) < time(c, k)$ and $time(c_1, k)$ is one week before $time(c, k)$ and there is exactly one object in c, k called «Hɛsen»[14] and there is exactly one object in c, k that is the speaker of c, k and in all world-variants c_2 of c_1 that are compatible with what Hesen told the speaker of c, k it is the case that there is a time variant of c_3 of c_2 such that the day of c_3, k is one day before c_2, k and there is exactly one object called «Rojda» in c, k such that Hesen kissed her (according to what he has said a week ago) at the time of c_3, k (8 days ago), place of c_3, k (event place), and world of c_3, k (the worlds compatible with what Hesen told the speaker).

7.7   Simplifications and Extensions

The above examples show how the truth-conditional aspect of indexical reference can be expressed using descriptive conditions in dependency of the deictic center. Apart from Cresswell's argument, they could also have been given in double-index modal logic and are just a bit more fine-grained than analyses based on direct reference theory. We will now briefly address the questions which kind of context-dependency can be eliminated and how the framework might be extended.

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[14]It depends on the purpose of the analysis whether the predicate Hesen is universal or regarded to encode features of being called «Hɛsen» that are specific to Dimli.

7.7.1   On the Eliminability of Context-Dependency

From a philosophical point of view, the conversational context is irreducible. Spatial and temporal indexicals are inherently vague. Particular cases of vagueness can be expressed in NTPT by asserting that a given property can neither be ascribed to nor can it be denied of some particular, and this can in principle happen even when all discourse participants agree on the conversational context. If for example all participants agree that the reference place associated with a given «here»-token is Copenhagen, it can still be the case that the exact boundaries of Copenhagen are unclear and cannot be asserted or denied without doubt. In practice, it is often possible to agree on some reasonable level of precision by convention. But the interpretation of speech is an active process, and a particular speaker may at any time have reasons to interpret the spatial or temporal range of an indexical more or less precise, and sender and receiver will always just agree on the range of an indexical to some degree. In a particular situation it may make sense to break or disregard conventions, or the discourse participants may be unaware that they presume different conventions. In this sense, the conversational context cannot be eliminated. It can be made more explicit by taking a closer look at the different notions of context it comprises, but there is no Archimedean point which would allow one to dispense with it altogether. The deeper reasons for this is that there are no fully competent speakers, as the competent speaker model is an idealization based on the competence–performance distinction, that actual communication is always a process of *partial* understanding each other on grounds of each other's being in the world (Lebenswirklichkeit), part of which is the discourse participants' idiolects, and that literal meaning is an idealization thereof.[15] So the current position is contextualist, but in a moderate sense, because it is not claimed that dependency on the conversational context implies that there is not much well-established public language meaning. Many utterances have a prevalent literal, public language meaning. For example, even though it depends on the context of utterance, there is nothing to debate about the meaning of the following utterance.

(7.117) *In a US shop, the shop owner holds up a T-shirt and utters:*
    This is $ 9.95.

This means that the T-shirt costs exactly 9.95 US dollar, not five cent less or more and not Canadian dollars. Many aspects of the conversational context are a matter of public, social conventions compatible with social externalism, and not a matter of the particular belief states of discourse participants. In the present view, there is no doubt that your utterance can be literally false when the police stops you while you're driving the car, and you say:

(7.118) I'm just a bit tipsy. We didn't drink much.

This utterance can be false, no matter how much you and your drunken friends might believe, agree, and insist on it being true, because you presume a standard for drunkenness that differs from the policeman's.

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[15]Philosophers' tendency to resort to *the cat is on the mat* examples may be the reason why these hermeneutic truisms are sometimes neglected. Just ask yourself what the meaning of «freedom» is—as opposed to, say, «cat»—and the idealized nature of public language will become more apparent.

In contrast to the conversational context, the context of utterance, as it is understood here, can be eliminated to some extent. In a given concrete situation an egocentric indexical can be substituted salva veritate by a co-referential non-egocentric substitute expression. For example, ‹now› uttered at 12:11h on 4th April 2005 can be substituted by «at 12:11 on 4th April, 2005», ‹here› can be substituted by «in Copenhagen», or ‹I› uttered by Alice can be substituted by «Alice». Recall from chapter 5 that instantiated reference rules are not egocentric. There are limits to eliminating egocentricity, though. First, essential indexicals according to the common view cannot be eliminated without loosing some of their explanatory power. This issue will be addressed in the next chapter. Second, the origin of a calendric or geographic coordinate system in turn has to be fixed by convention up to a sufficient level of precision, though this doesn't have to involve the use of egocentric expressions. Even if egocentricity is eliminated, dependency on some conventionally fixed origin of coordinate systems cannot be fully eliminated from an ideal language.

As mentioned in 7.2.3, from a technical perspective both contexts are dispensable *as parameters*. The context of utterance can be reduced to an open variable interpretation guideline. Dependency on the conversational context can be dropped when Definition 6 is dropped. The reason for this is that many aspects of context-dependency this parameter comprises have been left unanalyzed.

7.7.2 Possible Extensions

The context of utterance only determines the deictic center, whereas the conversational context comprises many factors like the common ground, norms of exactness, standards of measurement, or fixing semantic ambiguity in the mapping from source to target language. Some of them can be dealt with by making conversational contexts available in the object language and putting constraints on them that aren't directly derived from linguistic expressions, while others, like the common ground, require more elaborate mechanisms. In any case the two sorts of context are orthogonal to each other. Often the context of utterance changes from utterance to utterance, as the name implicates, but within the same conversational context. Vice versa, the conversational context can change within the same utterance situation, for example when expressions like «actually» or phrases like «according to the Mayan calender» or «strictly speaking» are used. Perhaps more importantly, the conversational context can also change within the speaker dimension in a pragmatic model of communication. If means to express constraints on the conversational context are made available, then it will become possible to describe cases of failure or success of *communication* within the same model. Suppose k is Alice's sender kontext and k' is Bob's receiver kontext. Alice utters 7.119.

(7.119) Alice to Bob: It is raining.

Suppose now we can add constraints on the conversational contexts based on extralinguistic information, which boil down to the following constraints:

$$rplace(c, k) = a \tag{7.120}$$

$$rplace(c, k') = b \tag{7.121}$$

$$a \not\sqsubseteq b \wedge b \not\sqsubseteq a \tag{7.122}$$

Then it can be inferred that communication between Alice and Bob has failed. This kind of success or failure of communication is independent from Alice's and Bob's non-linguistic beliefs, as it can also occur when Alice is lying or Bob doesn't believe that it is raining anywhere in b. There are certainly limits to the usefulness of reified conversational contexts. Consider for example 7.95 for 7.94 on page 192. The formula sequence represents the reading *we will buy the business enterprise owned by you, the addressee(s)*. But there is another reading of 7.94: *We will buy your accompaniment [your accompanying us]*. English «company» is mapped to FOLC company by the syntax–semantics interface and the conversational context could at the level of the target language decide whether a business enterprise or some accompaniment by prostitutes or an escort service is bought. However, in the second reading «you» doesn't mean *owned by*, it rather indicates the agentive role of the addressee(s) in the event of accompanying the buyers Alice and her group, and it is hardly feasible to account for this difference on the basis of the conversational context at target language level. If the possessive pronoun is given as an abbreviation, this would require quasi-abbreviations whose expansion depends on a conversational context parameter. Even if such quasi-abbreviations can be made to work, it seems more advisable to follow the traditional approach and put such ambiguities into the source language lexicon as two different target language schemes or deal with them at the level of the syntax–semantics interface.

Chapter 8

Indexicals in Thinking

8.1   Chapter Overview

This chapter deals entirely with the cognitive content of indexicals in the broad sense. This is necessary, because the phenomenon of essential indexicality can be taken to counter and ultimately refute any attempt to explain the reference of indexicals by resorting to any notion of identification by means of an object's properties. But, of course, description theory and other forms of indirect reference theory are devised to explain speaker reference by a speaker's attempts to identify the referent by means of certain properties, which in case of an indexical are represented by its reference rule. Before this obvious challenge can be tackled, some more things have to be said about the cognitive content of indexicals. In section 8.2 examples and their FOLC analyses are considered, in which a speaker refers to a doxastic object that differs from the semantic referent. As laid out in section 5.4.5, indexicals are strictly rigid with only few possible exceptions, and so there are no attitude ascriptions that would directly correspond to these analyses. Still, they correspond to the view on cognitive content of proper names in chapter 4 and from a descriptivist point of view represent the subjective meaning of indexicals. Essential indexicality, the challenge to this view, is outlined in section 8.3. The arguments in favor of essential indexicals show that indexicals are irreducible in thinking, but in section 8.4 it is argued that indexicality plays no role in episodal thinking and that the irreducibility of *I*-thoughts is a trivial consequence of their definition. Given that even the one who utters a token of «I» or «now» might be wrong about its referent, which can happen easily in case of persistent tokens, it is suggested that essential indexicality and corresponding de se belief attributions ought to be dispensed with in the context of doing truth-conditional semantics of public language expressions (Thesis 8). This leaves the epistemic status of essential indexicals in thinking open as a problem of the philosophy of mind that is closely related to the epistemic status of qualia.

8.2   De Dicto Cognitive Content of Indexicals in FOLC

In chapter 5 it has been argued that the cognitive content of an indexical will have to be modeled as being non-rigid if it is bound to play a role in explanations of actions and behavior, even if it is rigid from a linguistic perspective. In the following subsections it will be shown by example how this can be done in FOLC. There is an important difference of the following non-rigid indexicals to the way de dicto attitudes involving referentially opaque proper names have been analyzed in chapter 4. While readings of referentially opaque proper names exist at least for purporters of the semantic view on de dicto attitude ascriptions, corresponding de dicto readings of indexicals are hard to come up with.

8.2.1   Example: now

Let us start with «now» and take a look at an example that motivates why one would be interested in some sort of cognitive content of this indexical. Suppose Alice and Bob have a short conversation about the current time. Alice knows that Bob has a date with Carol at 13h, but she

doesn't want him to go there. She believes that it is already 13h, and so she decides to lie to Bob and utters 8.1.

(8.1) *Situation: It is 12h and Alice believes that it is 13h.*
　　　Alice: It is now 12 o'clock.

This is a typical situation in which the cognitive content of an indexical diverges from its rigid interpretation with respect to the truth-conditional content of a corresponding belief ascription. What Alice literally says is true and what Alice believes is false. To account for this fact it would be feasible to analyze Alice's belief state in a way that would imply that Alice was mistaken about the referent of «13h» or the meaning of «is». However, Alice should be considered competent with regard to these expressions in the given example; she is rather mistaken about the referent of ‹now› in 8.1 used in combination with the present tense. As 8.2 illustrates, speaker referent and semantic referent of ‹now› do not match.

	subjective	13h	=	12h
(8.2)	uttered	‹now›	‹is›	‹12 o'clock›
	objective	12h	=	12h

This situation and subsequent examples are set up as an attempt to lie in order to make it clear that the intentional referent, i.e. the object the speaker intends to refer to, doesn't have to be the same as the speaker referent and plays only an indirect role in determining the cognitive significance of ‹now›, although it plays a role in categorizing Alice's speech act as a lie or attempt to lie. To account for Alice's speaker reference gone astray one may attempt to specify the *cognitive content* of ‹now› in 8.1 for Alice by the following belief attribution, where time= checks whether $time(c_2, k)$ is sufficiently similar to $time(c_3, k)$ in c_1, k and it is assumed that $g(\text{C1}) = c_1$, $g(\text{C2}) = c_2$, and so on.

(8.3) $M, g, c, k \models$

```
(iota X (Alice X))
(Pres C1)
(believe C1 . C2 X)
(Jetzt C2 . C3)
(time= C2 . C3 13h)
```

To see why this isn't adequate, let's take a look at the variants expressed:

$$c \simeq_t^k c_1 \simeq_w^k c_2 \simeq_t^k c_3 \tag{8.4}$$

For these the following constraints hold in the example model under consideration:

$$time(c_1, k) \sqsubseteq time(c, k) \qquad\qquad \text{present tense} \tag{8.5}$$
$$time(c_2, k) = time(c_1, k) \qquad\qquad \text{world variant} \tag{8.6}$$
$$utime(c_3, k) \sqsubseteq time(c_3, k) \qquad\qquad \text{df. \textbf{Jetzt}} \tag{8.7}$$
$$time(c_3, k) \sqsubseteq time(c_2, k) \qquad\qquad \text{df. \textbf{Jetzt}} \tag{8.8}$$

$$utime(c, k) = 12h \qquad\qquad \text{assumption} \qquad (8.9)$$
$$utime(c_3, k) = 13h \qquad\qquad \text{assumption} \qquad (8.10)$$

From these, the transitivity of the subinterval relation, and the egocentricity of speech time (Constraint 7.40 on page 180) it follows that both $12h \sqsubseteq time(c, k)$ and $13h \sqsubseteq time(c, k)$. This would be acceptable in many conversational contexts. For example the conversation could be about salaries now in comparison to salaries 30 years ago. In such a context, Alice could believe that ‹now› denotes 13h, whereas Bob could believe that ‹now› denotes 12h without problems in understanding each other, since the time of speech mutually assumed by both of them would be sufficiently large. But in the present example about the time of the day, the time of speech must be much smaller, only allowing for minor variations around 12 o'clock. Then 13 o'clock cannot be part of that interval.

One crude way to adjust the analysis is to stipulate another predicate **now**$_*$ which is relativized to actual contexts but otherwise works the same as **now**:

☆ **Constraint 23** (now* Special Predicate).

$$\textbf{now}_* \in \mathrm{PRED}_2, \textit{where all arguments are in } \mathrm{CVAR} \qquad (8.11)$$
$$\textit{if } \langle c', c'' \rangle \in [\![\textbf{now}]\!]^M_{g,k}(c) \qquad\qquad\qquad\qquad (8.12)$$
$$\textit{then } c' \simeq^k_t c'' \textit{ and } utime(c', k) \sqsubseteq time(c'', k) \sqsubseteq time(c', k)$$
$$\textit{for actual } c', k; \textit{ otherwise } c'' \textit{ depends on the interpretation of } c' \textit{ in } k$$

The *otherwise* clause turns **now**$_*$ from a special predicate, which certain *now* subintervals of the given event time satisfy, into an arbitrary predicate with the same intended interpretation, but not expressing any logical constraint whenever its first argument leads to a non-actual c, k pair. The analysis of the above situation then looks the same as 8.3, except that a binder **Jetzt**$_*$ based on **now**$_*$ instead of **now** is used. It must be stressed, though, that there is no reading of a belief ascription that would correspond to the use of **now**$_*$ for specifying the cognitive content of ‹now› in 8.1 for Alice.[1]

The above change also has an effect on other than doxastic modalities. Since non-actual contexts are those whose $world(c, k)$ is not the actual world, the revised analysis allows to account for non-rigid readings with regards to alethic modalities. Such readings are depicted in Figure 8.1. For example the following utterance could come out true under such an analysis:

(8.13) *At 12h:* It is possible that it were now 13h.

According to some understanding of «now» and «possible» this might indeed be the case. Although highly unlikely, it is conceivable that the people who implement the official calendric time have made a grave error that would require advancing the clock by one hour. Suppose for example that the parliament of a small island republic has decided to switch to daylight savings time, but the local administration has forgotten to implement the change. However, this reading

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[1]According to Castañeda (1967) there are readings of embedded indicators and personal pronouns he calls quasi-indicators. For reasons to be given below, the above analysis is not adequate for them.
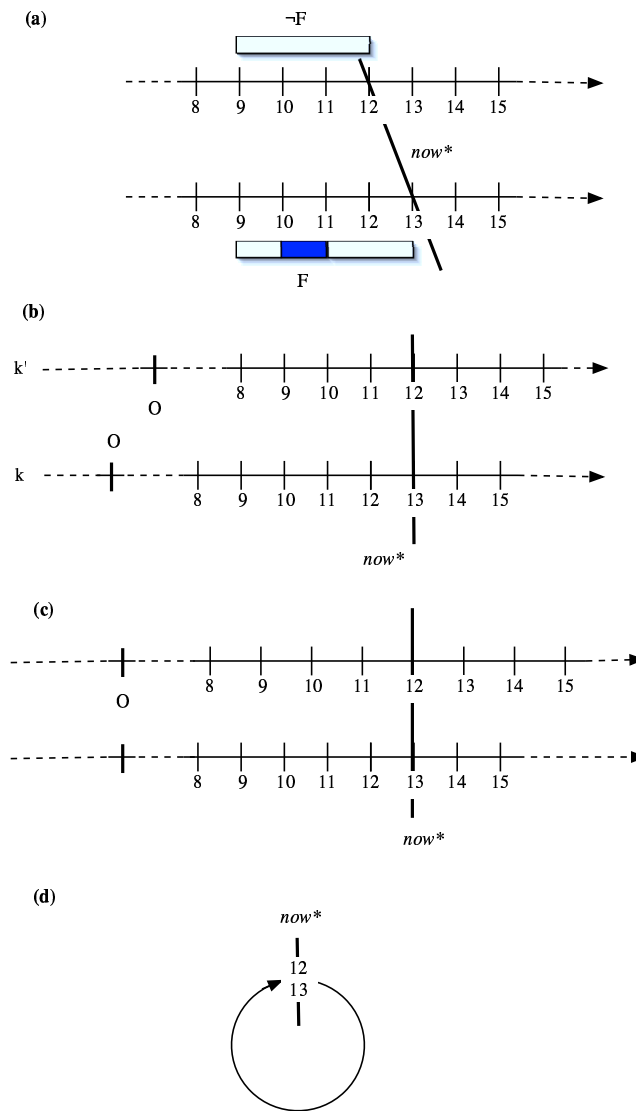
Figure 8.1: Deviate, non-rigid interpretations of ‹now› (a) in a counterfactual conditional, (b) when the conversational context changes, and (c) & (d) as metaphysical statements about the Now.

is deviate, since it plays with the fact that under rare circumstances «possible» can be used to indicate the arbitrariness of conventions governing the conversational context; the switching between the two time systems ought to be modeled as a change of conversational contexts. This is depicted as case (b) in the figure and can already be dealt with by the original **Jetzt** binder. If on the other hand «possible» is understood as expressing an alethic modality, then a reading like 8.13 can hardly become true. Cases (c) and (d) in the figure are metaphysical claims about the philosophical Now and the nature of time that are barely understandable, if just 8.13 is used without further explanation. A perhaps more acceptable non-rigid reading of «now» already mentioned in section 5.4.5 of chapter 5 is in counterfactuals like «If the tire hadn't been flat, it would now* be 12 o'clock» (uttered at 13h). This is case (a) in the figure and might be acceptable; if so, it is another reason for using **now**$_*$ instead of the original definition.

8.2.2   Example: here

The same tweaking as for «now» can be done for «here». Take for example the following situation analogous to 8.1.

(8.14) *Situation: Alice believes that she is in room 388, but in fact she is in room 386.*
       Alice (*to Bob*): Room 386 is here.

Given how difficult it can be to find the right room at certain universities this is a perfectly conceivable situation. Suppose for example that Alice tries to lure Bob into a lecture on modal logic in room 388 instead of attending the student session in room 386 which would involve good music, free beer, and cookies for everyone. By using a predicate **here**$_*$ to obtain an analysis of Alice's reference to the place of room 386 using ‹here› if its first argument is reached by Alice's belief accessibility, the place of ‹here› becomes any part of an arbitrary place Alice has in mind. Like in the previous case, the multiple use of the world component for various modal binders that are interpreted in different ways would cause **here**$_*$ to become non-rigid with respect to alethic modalities. This can be used for analyses that allow an utterance like 8.15 to have a reading according to which not just «Cambridge» would be used for Oxford, but according to which in fact the entire place of Cambridge would be at Oxford, whereas the entire *place of Oxford* might have been sucked into a black hole and dispersed over several parallel universes.

(8.15) *At Oxford*: It is possible that here were Cambridge.

It is fruitless to speculate whether such a reading exists or not. A reading exists whenever someone argues halfway convincingly for it, but this doesn't mean that it makes sense or can be used to convey any interesting information. It can be said, however, that this purported reading of 8.15 is deviate. It is more natural to interpret the modality in 8.15 as an epistemic one, giving the utterance a paraphrase like *According to what I believe the current place of utterance is likely called «Cambridge»*. In that reading ‹here› is still rigid.

8.2.3 Example: I

Turning to the first-person indexical, matters are both more and less complicated. They are more complicated, since so-called *I*-thoughts have occasionally been considered the speaker referent of a use of «I». This view will be addressed below in section 8.3. Matters are less complicated in the first-person case if the descriptivist position is assumed and we are merely interested in a de dicto interpretation (disquotation, utterance acceptance) of ‹I›. Suppose Alice wants to go to a fancy lecture on modal logic with Bob, but she would have to work instead. In a hurry she writes the following note and inadvertently puts it on Carol's office door instead of her own.

(8.16) *Alice's message on Carol's office door:* I'm ill. [I'll be back tomorrow.]

This is one of the rare examples involving persistent tokens according to which a speaker is mistaken about the referent of his use of «I». Carol could in fact be ill and back tomorrow, and then 8.16 would be true because Carol is the referent of ‹I› in 8.16. However, Alice believes that ‹I› refers to herself. This situation is not exactly analogous to 8.1 and 8.14, though. English «I» is a personal pronoun and not a sentential adverb like «here» or «now». It picks out exactly one person and there is no such mechanism as a 'person variant' available out of the box. So the following tentative analysis is inappropriate:

(8.17) $M, g, c, k \vDash$

```
(iota X (Alice X))(Pres C1)
(believe C1 . C2 X)(I C2 . Y)(ill C2 . Y)
```

This expresses that the current speaker x believes that there is some speaker y—whoever that may be—that is ill in whatever present situation x has in mind.[2] This doesn't describe or explain why or how Alice's speaker reference is gone astray in 8.16. What in fact is needed is that Alice believes *of the current context of utterance* that she is the speaker of it. Thus the following analysis is better:

(8.18) $M, g, c, k \vDash$

```
(iota X (Alice X))(Pres C1)(believe C1 . C2 X)
(iota Y (SpeakerOf C2 . C1 Y))(ill C2 . Y)
```

Hereby, SpeakerOf is a predicate with the intended reading that the person given as third argument is the speaker of the context of utterance given as second argument according to the modality that binds the first context argument, if it is bound. The relationship between this predicate and the special speaker predicate is that if $world(c'', k)$ is the actual world, then $\langle c', a \rangle \in \llbracket \text{Speaker} \rrbracket_{g,k}^{M}(c)$ iff. $\langle c'', c', a \rangle \in \llbracket \text{SpeakerOf} \rrbracket_{g,k}^{M}(c)$ for any model M, assignment g, and c, k. In situation 8.16 the actual speaker of the present context is different from the referent believed by Alice to be determined by the SpeakerOf predicate; the former is Carol, the latter is Alice.

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[2]See constraint 20 and abbreviation 13 on page 186 of the last chapter.

8.3   Essential Indexicality

Essential indexicality seemingly challenges a description-based account of indexical reference, and why this is so will be laid out in the following sections.

8.3.1   The Irreducibility Thesis

Since the seminal works of Castañeda (1967) and Perry (1977, 1979) certain indexicals like «I» or «now» have been considered essential. Roughly speaking, essential indexicals are irreducible in the sense that it is not always possible to find a substitute expression that would have the same explanatory power in the explanation of behavior as the respective indexical. This claim will from now on be called *irreducibility thesis* (IR). It goes back to (Wittgenstein 1958), (Castañeda 1967), and (Shoemaker 1968). One of the best known arguments in favor of IR is Perry's supermarket example in (Perry 1979):

(8.19) John Perry is in a supermarket and leaves behind a trail of sugar that is pouring out a package in his cart.

(8.20) He recognizes the trail of sugar, but doesn't recognize that it's himself who causes it inadvertently.

(8.21) Perry has various thoughts:

1. *Someone is making a mess.*
2. *He[pointing to himself in the mirror] is making a mess.*
3. *John Perry is making a mess.*
4. *The only bearded philosopher in a Safeway store west of Mississippi is making a mess.*

(8.22) Perry goes around in circles in order to find the person who produces the sugar trail while he entertains these thoughts.

(8.23) Suddenly he realizes that it is he himself who is inadvertently pouring the sugar. He thinks: *I am making a mess.*

(8.24) He cleans up the sugar.

When Perry thinks what is described in 8.21, he is temporarily being amnesiac. He just forgot that he didn't shave himself in the morning, forgot his name, sees himself in the mirror without recognizing himself, and has no reasons to assume that the person he sees in the mirror is called «John Perry» or that he is a philosopher fitting the above description. How plausible these scenarios are doesn't matter much to the argument, as long as they are conceivable at all. Kaplan has a similar example. His pants are burning, while he watches himself in a mirror. He thinks various thoughts, like *His pants are burning*, *David Kaplan's pants are burning* (while temporarily having forgotten his name), and so on, until he realizes: *My pants are burning*—and either starts to jump around in horror or calmly extinguishes the fire. Another example of Perry

(1979) involves «now». A professor sits in his office at 12 o'clock. The fact that the professor has some calendric substitute expression in mind for ‹now›, as he may utter it now at 12 o'clock, doesn't seem to explain the fact that he suddenly jumps up and goes to a meeting he believes to be scheduled for 12 o'clock.

Let's call arguments based on examples like these *IR-type arguments*. They have the following structure. Consider a concrete example in which a speaker entertains various thoughts about himself, the current time, or the current place of utterance, without realizing that they are about himself, now, or the place of utterance. Take a look at the behavior or explanations of the speaker's behavior; they indicate that the speaker hasn't realized that the person he's thinking about is himself, the time he's thinking about is now, or the place he has in mind is here. There is a sudden change in behavior, which is (a) explained by pointing out that the speaker just had an appropriate *I*-, *here*-, *now*-thought about the given situation and/or (b) by considering an explanation of the behavior before and after the behavioral change as it is given by the speaker himself. Before the change, the speaker uses 3rd-person expressions to refer to himself, or the time and place of utterance in the explanation of the given situation, afterwards he uses an indexical like «I» or «now». Generalize the example to any situation. Regarding «I», the generalization is for example: In any situation it is conceivable that a speaker uses any 3rd-person expression that semantically refers to himself without realizing that it refers to herself, i.e. without showing an I-response. Here are some conclusions one may tentatively draw from IR-type arguments:

(8.25) *I*-thoughts are irreducible in the sense that they cannot be replaced by other kinds of thoughts without possibly changing the behavioral relevance of the whole thought.

(8.26) *I*-thoughts are irreducible in the sense that they cannot be replaced by other kinds of thoughts without actually changing the behavioral relevance of the whole thought.

(8.27) The cognitive content of each use of an «I»-token (a) must, or (b) may be different from the cognitive content of any other token.

(8.28) Each use of an «I»-token is semantically irreducible in the sense that its truth-conditional content (a) must, or (b) may be different from the token of any other expression.

To a truth-conditional single-aspect theory only 8.28 is relevant. 8.27–8.28 are relevant to a dual aspect theory in which one aspect is the truth-conditional role and the other is the behaviorally relevant cognitive role of expressions. 8.25 and 8.26 become only relevant, if such a DAT identifies the truth-conditional, the cognitive content, or both with thoughts, or at least has the explanatory goal of directly or indirectly specifying behaviorally relevant thought contents. 8.28 will be rejected below, 8.27 will be considered in section 8.5, and it will be shown in section 8.4 that 8.25 and 8.26 hold trivially. The discussion in the following will mainly focus on «I» and *I*-thoughts respectively, since IR-type arguments and underlying 'intuitions' in this case seem to be stronger than in other cases.

8.3.2 Self-Locating Belief

On the background of possible world semantics and on the basis of (Perry 1977, 1979) there is another influential example introduced by Lewis (1979):

> "Consider the case of two gods. They inhabit a certain possible world, and they know exactly which world it is. Therefore they know every proposition that is true at their world. Insofar as knowledge is a propositional attitude, they are omniscient. Still I can imagine them to suffer ignorance: neither one knows which of the two he is. They are not exactly alike. One lives on top of the tallest mountain and throws down manna; the other lives on top of the coldest mountain and throws down thunderbolts. Neither one knows whether he lives on the tallest mountain or on the coldest mountain; nor whether he throws manna or thunderbolts." (Lewis 1983, p. 139)

By *proposition* in this case a set of possible worlds is meant. The problem in the above example is according to Lewis, that the two gods may have the same veridical beliefs about all objects in the world, yet lack the proper knowledge to locate themselves within this world. Another example of this kind can be found in Perry (1977). Rudolf Lingens suffers from amnesia and is lost in the Stanford library; no matter how many books he reads about himself, as long as he doesn't realize that it is he himself they are about, he doesn't know where he is. There could be another person somewhere in the same world in another library that would have the same beliefs in terms of a relation between himself and the set of possible worlds compatible with his belief. It seems that Lingens can *gain* knowledge by finding out that it is he himself that is now here at Stanford library, no matter how much descriptive knowledge he has already about himself. Likewise, the two gods are by stipulation omniscient, and since they are omniscient the sets of possible worlds that is compatible with their belief respectively should only contain the world they inhabit, yet each one of them may fail to realize that it is he himself that respectively is Zeus or Jawhe, as Lewis names them. They lack knowledge required to locate themselves in the world they inhabit. It seems that even de dicto belief is too coarse-grained to account for the kind of self-knowledge the two gods are lacking. Lewis speaks of *de se belief* for the fine-grained belief that is needed for explaining the Zeus-Jawhe example. For Lewis, all belief is self-locating. What is traditionally called de dicto belief involves locating oneself in logical space by deciding the set of possible worlds into the ones that are compatible with what one believes and the ones that aren't, whereas Lewis' de se belief involves locating oneself in time and space *within* a world.

8.3.3 Quasi-Indicators

The above puzzles concerning belief attributions are connected with belief ascriptions. Here is some utterances that could be made in case of Perry's supermarket scenario:

(8.29) Perry: I'm pouring sugar on the floor.

(8.30) Alice: Perry believes that he is pouring sugar on the floor.

(8.31) Perry: I believe that I'm pouring sugar on the floor.

8.30 and 8.31 have two readings. The analogue to ‹he› of 8.30 *in thinking* can on one hand be demonstrative, but on the other hand may also be an *I*-thought. Likewise, the analogue to ‹I› of 8.31 *in thinking* can on one hand be descriptive in the sense used here, i.e. in the sense that Perry (in thinking) would try to identify the speaker of 8.31 by virtue of the property of being the speaker and all the factors this comprises in the given epistemic situation, but may on the other hand be an *I*-thought. Based on Castañeda (1967) the latter readings, whose analogue in the above case is an *I*-thought, are called *quasi-indicators* and marked by a star. A quasi-indicator corresponds, under normal circumstances and assuming fully competent speakers, to a disposition to utter an indexical, even in cases when there's no disposition to use a co-extensional expression like a proper name or definite description. The pronoun «he*» in the third-person ascription 8.30 and «I» in the first-person ascription 8.31 convey an irreducible first-person reference in thinking. In a belief ascription, a quasi-indicative reading is only possible if the embedded pronoun agrees with the subject of the matrix sentence. ‹I› in 8.31 can only be read as quasi-indicator, because the ascription is in the first-person, and ‹he› can only be read as quasi-indicator, since the ascription is in the third person. There is no linguistic evidence, apart from reading pronouns and embedded indicators this way, that quasi-indicators are a distinct class of expressions lexicalized in English, but Schlenker (2003) points out that "...PRO, the unpronounced subject of an infinitive in a 'control structure', can only be used to report a De Se thought." (Schlenker 2003, p. 60-1)[3] So according to this thesis the following example can only be read as a de se belief attribution.

(8.32) Alice believes to be hungry.

Schlenker (2003) further notes that in some languages such as Éwé and Gokana there is pronouns that can only be given a quasi-indicative reading.[4]

8.3.4 The Connection to Notions of Belief

One problem in dealing with essential indexicals is that there is not *the* notion of belief; whether a certain view on belief attributions is fruitful depends on the theoretical purpose of the notion. For example, a way to store and query customer opinions about products in a relational database characterizes a form of belief and possibly other attitudes.[5] For the purpose of doing truth-conditional semantics belief must be suitable to encode the truth-conditional content of belief ascriptions, which in turn can have various readings, and for the purpose of doing epistemology a notion of belief must be capable of adequately representing doxastic alternatives. The two latter purposes don't have to match. To give an example, a quotational theory of belief that deliberately

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[3]He is referring back to Morgan (1970), Chierchia (1989), and Partee (1989), who have also defended this view. Cf. Corazza (2004). Notably, Richard (1983) only uses PRO forms as paraphrases of de se belief.

[4]See (Schlenker 2000, pp. 21-2; 100-1; 140-1), (Schlenker 2003, p. 60). Gokana (gkn) is a Niger-Congo language spoken by approximately 100000 speakers (as of 1989) in Nigeria, Éwé (ewe) is a Niger-Congo language spoken primarily in Ghana by a total population of more than 3 million speakers (Gordon 2005).

[5]Computer scientists sometimes call it knowledge even if the T-principle $\Box p \supset p$ doesn't hold.

violates the Church-Langford translation test is adequate for dealing with de dicto and de se belief ascriptions from a purely linguistic perspective. If the sole criterion for someone's having a belief is the person's disposition to utter a certain source language expression, then belief can simply be regarded a predicate that takes a context c, a speaker x, and term y denoting a source language expression, and has a reading along the lines *in context c, x has the disposition to assent to y*. This kind of belief is irrational in the sense that the quoted source language expression can express a contradiction. It isn't particularly useful for doing epistemology. On the other hand, rational belief such as KD45 belief used throughout here encodes *doxastic alternatives*. Many suggestions have been made to adjust normal modal logic in a way that retains the view that rational belief is a relation of the believer to a set of doxastic alternatives and meanwhile solve the above puzzles. The most obvious way to do this is to make the objects of belief more fine-grained. Lewis (1979) property-ascription notion of de se belief does this by making properties more fine-grained than sets of possible worlds. On the basis of Lewis, von Stechow (1982, 1984) proposes a structured proposition account, according to which objects of belief retain part of the structure of the original source language entities.[6] Another way, suggested by Stalnaker (1981), is using centered worlds: relata of belief are sets of pairs containing an object and a world. Attitudes modeled in situation theory (Barwise and Perry 1983) can also more fine-grained than sets of possible worlds.

Instead of propagating a particular notion of belief, which would go far beyond the scope of this chapter, the purpose of the following sections is to elaborate what consequences essential indexicality has on a description theory of indexical reference on the basis of the rational KD45 belief assumed here.

8.4   Irreducibility in Thinking

In order to establish Thesis 8 it will be argued as follows: (IR 1) IR-type arguments at first glance pose a challenge to description theories of reference, (IR 2) *now* and *I* are immune to error through misidentification *in thinking* (IFRT), (IR 3) episodal thinking doesn't involve reference in the same way as natural languages do, because it is misleading to regard actual cognition as manipulation of representational symbols of a language of thinking, (IR 4) there is no analogue to natural language indexicals in episodal thinking, (IR 5) if no independent means of measuring episodal thoughts are given, IR-type arguments in the realm of episodal thinking are vacuous. The type of the arguments is as follows. Pro (IR 1) and pro (IR 2) are by plausibility, pro (IR 3) is a reductio ad absurdum, pro (IR 4) is introduced by plausibility and later regarded a consequence of (IR 3), pro (IR 5) is analytic, based on the structure of IR-type arguments.[7]

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[6]Other structured proposition accounts can for example be found in (Cresswell 1985), and (Richard 1990, 1997).

[7]The notion of an argument is here understood in a loose sense, comprising both correct deduction steps and the establishing of sound premises, since a purely deductive notion of this term is almost useless in practice. The attribute *by plausibility* above means that there is some plausible evidence supporting a claim, whereas purely deductive arguments might occasionally lead to rather implausible, yet correct conclusions. In a broader sense of *plausible* not meant here, of course any sound and correct argument must be plausible.

8.4.1 The Problem of IR-Type Arguments for Descriptivism

Why do IR-type arguments pose a problem for a description theory of indexical reference? The answer is fairly obvious. Consider the supermarket example. Given the IR-type arguments it is clear that the subjective readings of center indexicals given in section 8.2 don't encode quasi-indicators or ‹I› in the sense of expressing an *I*-thought. Take for example the following attempt to express Perry's sudden insight, as usual in an intended model with the readings of the predicates indicated by their mnemonic symbols.

(8.33) $M, g, c, k \vDash$

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(iota SUBJ (Perry SUBJ))(Pres C1)(believe C1 . C2 SUBJ)
(iota SUBJ2 (SpeakerOf C2 . C1 SUBJ2))
(exists C2 . DO)
(sugar C2 . DO)
(spill C2 . SUBJ2 DO)
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There's no reason why Perry's *I*-thought ought to be in any connection with what Perry believes to be the speaker of the context of utterance. Suppose, as a remedy one would use a predicate with the reading *x is the thinker of c at the time and place of c*. Even then, IR-type arguments can be applied, since Perry might not be aware that it is he* himself who is currently thinking. The claim is that *in thinking* the thinker doesn't have to identify himself by means of any properties, no matter to which 'source of evidence' they belong. A person thinking an *I*-thought may be mistaken about who is currently thinking (whatever that means), his name, any of his physical properties, and also about any evidence about himself given by proprioception. The thesis that self-reference in thinking doesn't need to involve self-identification in thinking is called *identification-free first-person reference in thinking* (IFRT).[8] At least prima facie, IFRT is incompatible with a description theory of indexical reference (IR 1).

8.4.2 Pro IFRT in Episodal Thinking

One problem of pinning down what exactly IR and IFRT say is that there are many different ways in which thinking, thoughts, and the related notion of cognitive content can be understood. In this section, the arguments for essential indexicals will be evaluated with respect to *episodal thinking*. This is understood as a person's actual cognition insofar as it is relevant for her behavior. Although taken from armchair psychology, this notion ought not be too controversial. That people can have an *I*-thought is a reasonable assumption. Such a thought may for example occur in the planning of an action that is under normal circumstances announced or explained by means of using «I». Likewise, a person may have a *now*-thought, a *Bob*-thought, or a *this*-thought. The focus in the following will be on *I*-thoughts.

There are some philosophical concepts of first-person self-reference in thinking that aren't meant in the current context. What for example is not meant is the feeling that it is *me* who is thinking which might accompany other thoughts, or the synthetic unity of all my thoughts

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[8]This notion is taken from (Evans 1982); cf. (Künne 1997, pp. 113-5), (Christofidou 1995).

(synthetic I) in the Kantian tradition. What is rather meant is *I*-thoughts that are fully conscious and stand on their own, like the thought: *I will now press this button*, just before I press the button. Still, the main problem of evaluating IFRT with this notion of cognition is the notion itself. Neither arguments pro nor arguments contra IFRT can be very strong as long as there is no reliable and working theory of episodal thinking (cognition) and as long the respective purported cognitive phenomena cannot be measured precisely. Neuroscience makes constant advances and it is likely that in the near future it will for example be possible to predict even complex future actions, including linguistic actions, solely by measuring brain processes. Until these advances have been made, deliberating IFRT must remain speculative. That being said, it nevertheless seems that the strongest positive evidence for IFRT is simply given by introspection. There is no evidence that someone thinking about oneself, for example when planning an action, is actually identifying or trying to identify oneself in thinking. Care has to be taken about the notion of identification here. To identify someone or something can mean to tell it apart from all other objects in a given context. Let's call this *weak identification*. In the context of me thinking now, this is certainly the case if I think an *I*-thought. If for example I think silently to myself *I ought to fill out the tax form*, then I personally have no doubt that I can tell myself apart from any other object I may be thinking of or might be perceiving at the meantime, such as the tax form or my table. Even in cases of apparent thought insertion experienced by schizophrenic patients, it can be argued that only the sense of agency is deranged, i.e. the person doesn't experience himself as the originator of the thoughts, whereas the sense of ownership remains intact, i.e. the person still doesn't doubt that it is she herself having the alien thoughts.[9] A purporter of IFRT has to argue more specifically that this identification is not done, achieved, the product, the causal effect, etc. of *checking* whether the thinker uniquely satisfies certain properties—identification criteria—in the given context of thinking. The corresponding identification of something as something by means of certain criteria may be called *strong identification*. This is what IFRT is directed against. Ex positivo the argument pro IFRT says that a thinker doesn't have to strongly identify himself in thinking by means of specific properties of himself, simply because there is neither introspective nor external evidence for it. Ex negativo the argument pro IFRT is that of IR, that for whatever properties one may suggest for uniquely identifying the thinker, the thinking person may fail to recognize that it is only himself satisfying them in the given context of thinking, but she may still have an *I*-thought. In other words, first-person reference in thinking is immune to error through misidentification.[10] As Christofidou (1995) points out, immunity to error through misidentification doesn't just mean that the respective thinker is very certain that he is thinking, but rather means that there is no room for doubt about this.[11] If on the other hand a person would identify herself by means of checking whether she satisfies certain identification criteria in thinking, then there would always remain room for some doubt. Despite the notorious unclarity of the notions involved, both the positive and the negative arguments pro IFRT are plausible, if it is assumed that identification by means of certain identification criteria may fail

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[9]See (Künne 1997, pp. 114-5), (Gallagher 2000b); the matter is controversial, cf. (Cole et al. 2000) for a counter-example and Gallagher's reply (Gallagher 2000a).
[10]See (Shoemaker 1968, p. 556), (Frank 2005, 2006).
[11]See (Christofidou 1995, p. 226).

at any time (IR 2). This assumption is reasonable, because a possibility of being in error seems to be part of what it means to strongly identify something, in the same sense as it is an essential part of being a rule that you may or may not follow it.

8.4.3 Are There Indexical Thoughts?

Under the presumption that IFRT holds it is tempting to consider *I*-thoughts themselves indexical. According to Millikan (1990) this is not the case. Millikan points out that in order to refer to myself in thinking it is neither necessary nor possible to check that it is me who is currently thinking and not someone else (IR 4a). As laid out in the previous chapters, indicators are context-dependent and egocentric or at least object-centric. There is no good reason why any of these features should also hold for *I*-thoughts. What would it mean for an *I*-thought to be context-dependent? In analogy to the first-person indicator it could only mean that the 'referent' of the thought was determined by features of the context of thinking. Which features would that be? They cannot be the person qua physical object, say Alice, because according to IFRT Alice may successfully refer to herself in thinking while not recognizing that she is Alice, the person she's pointing to in the mirror. According to IFRT, Alice may be in error about any property of herself, except perhaps the Cartesian property of currently thinking an *I*-thought, when she successfully refers to herself in thinking. So it appears as if the only 'referent' of an *I*-thought could be an *I*-thought. This apparent circularity of thinking results from the silent presumption that an *I*-thought works analogously to «I». However, episodal thinking cannot work the same as natural languages for principal reasons.[12] The circularity problem isn't a matter of *I*-thoughts, but applies to analogues of any other referential expressions as well. Suppose Alice thinks: *Bob is thirsty*, and then brings him a glass of water. If her *Bob*-thought would work like «Bob», she would have to refer in thinking to Bob in order to understand her own *Bob*-thought. This is circular and implausible. Alice's *Bob*-thought is not a symbol that only *represents* Bob in Alice's language of thought, such that Alice would have to interpret this symbol according to the semantic reference relation of her language of thought, it is rather a symbol that *presents* Bob as a doxastic object to Alice in a way that is relevant for her subsequent action of bringing Bob a glass of water. The presentation of Bob is neither Bob himself nor is it *just* a representation in the sense of being a symbol that is conventionally associated with a value. Some crucial semiotic distinctions are needed to resolve the circularity problem. A presentational symbol exemplifies what it means, whereas a representational symbol merely stands for what it means. Any presentational symbol can be regarded a representational symbol, but not vice versa. A symbol is discursive if it is representational and not presentational. Take for example numbers. Arabic numbers are discursive symbols. «5» doesn't exemplify the number 5, but stands for it. In contrast to this, «.....» is a presentational symbol, as it stands for the number 5 and the five dots exemplify this number. A distinction between discursive and presentational symbols that is more rigid than just giving it by example is one of the open problems in semiotics, but for current purposes this distinction should

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[12]The following semiotic argument is not taken from (Millikan 1990). The argument has also been formulated in (Rast 2002), but it is likely not new; at least implicitly it can be found in Castañeda's work, e.g. (Castañeda 1982, 1983, 1989).

be clear enough.[13] The crucial point is that if thoughts in episodal thinking are considered discursive symbols, then they fall prey to the above circularity objection—a modern version of the Homunculus Problem. As long as Alice's *Bob*-thought merely stands for Bob without presenting him to her, the symbol would have to be interpreted first. But Bob himself cannot be *in* Alice's cognition, although he may causally interact with Alice, and so he must be given to her in some way. If on the other hand, the referent of Alice's *Bob*-thought was yet another discursive symbol, then Alice would have to interpret this symbol in turn, in order to understand her own thought, and so on. What this very general consideration shows is that, unlike language, episodal thinking is not a discursive, but a presentational symbolic system, as long as the notion *episodal thinking* is meant to comprise cognitive processes insofar as they are relevant for a person's behavior (IR 3). Bob is presented to Alice in a certain way. Natural languages, on the other hand, are almost entirely discursive symbolic systems. Phenomena like onomatopoeia or iconism play a marginal role in natural languages and if at all are only to a small extent presentational. Expressions in natural languages usually don't exemplify what they mean. This is the reason why speaking of a language of thought is an inappropriate metaphor. It is easy to slip into using this metaphor, since all presentational symbols also represent what they mean, but the metaphor misleads from the fact that in actual cognition aspects of reality have to be encoded, have to be present to thought processes instead of being mere symbols that stand for something else. The thesis that thoughts themselves are indexical results from the inappropriate metaphor of regarding cognitive processes as the use of some language of thought in a sort of inner monologue. If you will say so, Alice's *I*-thought doesn't *have* a referent, it *is* the referent; it is a cognitive process that presents Alice to her thinking in her thinking (IR 4b). Saying that a speaker who interprets an «I»-token from his own first-person perspective is having a behaviorally relevant *I*-thought is an obfuscated way of saying that certain processes in her episodal thinking present herself to her own thinking in a way that other processes don't do.[14] Millikan suggests that *I* in thinking works analogous to a special proper name. By drawing this analogy she suggests: An *I*-thought invariably stands for the person whose thought it is in analogy to the way a proper name is supposed to invariably stand for its *semantic* referent in the direct reference view. Although better suited than the claim that *I* is indexical in thinking, this analogy doesn't go very far either. The direct reference view of proper names is appropriate whenever semantic reference is regarded a notion that presumes a high degree of idealization from speaker reference, ignoring epistemic and cognitive aspects of speaker reference. Still, proper names are discursive symbols. Conversely, *I*-thoughts stand for nothing else than actual self-references in episodal thinking as far as they are relevant for action and behavior. Hereby, the term «self-reference» is a tribute to common usage, but the underlying cognitive process isn't related to semantic reference or speaker reference.

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[13]The distinction between presentational and discursive symbols goes back to Langer (1951, Ch. 4). She uses it in a much broader context of cultural semiotics, and the above use of the distinction is only loosely borrowed from her.

[14]Even this explicans remains unsatisfying, because it suggests that something is given to something else in a mental act of self-reference. This might suffice as a metaphor for analytical *I*-thoughts, but is not adequate for any broader account of self-consciousness. As Frank (2006) points out, "…we'd need a theory that doesn't explain self-consciousness as a relation of something to something numerically different from it, i.e. that isn't relational." (Frank 2006, p. 7) (transl. by myself).

This is an argument internal to IFRT. A discursive *I* in thinking would invariably give room to the possibility of error through misidentification. What kind of magic connection could ever guarantee that an arbitrary and conventional discursive symbol denotes its semantic referent? The answer is: none. But a presentational symbol can guarantee this connection, because it exemplifies what it stands for. However, a folk theory of cognition as a manipulation of presentational symbols is not to be endorsed here. The point is rather that the purporters of IR implicitly characterize *I*-thoughts in a way such that it seems only reasonable to regard them as presentational symbols for the thinker to himself. Consider again Perry's supermarket example. There is continuous stimuli, namely the trail of sugar. The example then classifies two sorts of responses that may be abbreviated as the various non-I-responses and I-responses. The latter is the kind of responses that occur when John Perry realizes that it is himself who pours the sugar on the floor. Further it is suggested that whenever an I-response occurs, there must have occurred an *I*-thought in thinking as well. In other words, the occurrence of an *I*-thought is considered a necessary condition for the I-response that can be externally observed. This seems reasonable. Perhaps already today, at least in a similar experimental setting, it would be possible to measure John Perry's brain processes precisely enough to reliably predict any I-response and any non-I-response just before the response itself occurs. But from this point of view an *I*-thought is trivial—though not its measurement or the underlying cognitive mechanisms—in the sense that it is defined as the necessary condition for an I-response. As long as John Perry's *I*-thoughts and other thoughts like *John Perry*-thoughts or *the only bearded philosopher in a supermarket*-thoughts cannot be measured independently of the responses, any I-response will be explained by the previous occurrence of an *I*-thought and any non-I-response will be explained by the previous occurrence of a non-*I*-thought. Then, of course, IR and IFRT must hold trivially for these kind of thoughts (IR 5).

8.5 From Thinking to Language

After this brief excursus into the Philosophy of Mind it is time to evaluate the connection between episodal thinking and cognitive content as part of linguistic theory. In this section it will be argued for the theses that (IR 6) 'de se' cognitive content of essential indexicals can be given on the basis of rational belief, but (IR 7) this kind of content should play no role in linguistic theory. Pro (IR 6) and pro (IR 7) will be arguments by reductio and by plausibility.

8.5.1 IR-type Arguments and Cognitive Content

What is the connection between a trivial irreducibility of *I*-thoughts in episodal thinking and the meaning of an ‹I›-token? Wittgenstein (1958) suggests that there are two uses of «I», an object use and a subject use. While the former is prone to error through misidentification, the latter isn't. Taking this distinction from Wittgenstein, it might be tempting to say that a subject use of «I» refers to an irreducible *I*-thought. However, speaking of a subject use in this way conflicts with the notion of semantic reference, since semantic reference is an idealization from individual speaker references that must at least allow for communication. But (1) a recipient

might at any time be mistaken about the referent of an «I»-token, and (2) a singular term cannot have two semantic referents depending on the recipient or sender, if it actually has exactly one, by virtue of the notion of semantic reference. Claiming that a token ‹I› has a different semantic referent for the speaker than it has for the recipient would be mixing up semantic reference with speaker reference, whereas claiming that the semantic referent of ‹I› was an *I*-thought would make «I» hardly comprehensible to anyone but the respective sender and is simply not plausible. IFRT for a subject use of «I» if at all can only hold for the sender, as there is no doubt that a recipient might misidentify the referent of a use of «I» at any time. So a subject use of «I» is a matter of speaker reference, if it is a matter of reference at all. The speaker referent of ‹I›$_1$, as understood by the sender, may be considered the sender's *I*-thought in case of a subject use of «I», whereas the speaker referent of the same token as understood by a recipient is the doxastic object that the recipient believes to be the speaker of the context of uttering ‹I›$_1$. Insofar as a notion of cognitive content is bound to play a role in a dual aspect theory of meaning that is supposed to encode the behavioral relevance of expressions, a sort of irreducible cognitive content of ‹I› or uses of other essential indexicals will thus always be the cognitive content of the respective token *for the respective speaker (sender)*. If this kind of content is to be done justice for, then an indirect theory of speaker reference isn't applicable, because it would violate IFRT. The above considerations cast some doubt on the usefulness of this kind of content for linguistic theory, though. For the connection between uses of «I» and corresponding *I*-thoughts of the sender is loose anyway. If a speaker had no troubles understanding «I» uttered by other persons, yet only used his proper name for referring to himself, he would violate linguistic conventions but still be a competent speaker. Essential indexicality ought rather be considered a matter of extralinguistic reference than of speaker reference (IR 7). However, semantic reference, speaker reference, and extralinguistic reference are technical notions, whose definition depends on what the whole theory is bound to describe and explain. So one may simply insist on having a notion of speaker-dependent cognitive content suitable for explaining the puzzles of essential indexicality. Let the meaning-constituting entities of the target language that encode this cognitive content be abbreviated *CCs*. In light of what has been said so far, these entities at least have to satisfy the following criteria:

Granularity. CCs must be as fine-grained as episodal thoughts, insofar as these are deemed relevant for behavior.

Immunity. CCs must not generally rely on or stipulate that the respective thinker has to identify the referent in thinking by means of properties the referent is supposed to satisfy uniquely.

To get a better grasp of these requirements, let us stipulate some CC for an *I*-thought in FOLC by imposing a condition on the referent of a subject use of «I». This is admissible only, because the referent stipulated by the corresponding FOLC belief attribution is considered an aspect of speaker reference by means of «I», it is a doxastic object satisfying a certain constraint, and not claimed to be the semantic referent of an «I»-token. As a concession to the anti-descriptivist, the subject use of «I» will be analyzed in the Millian fashion. Let $\mathbf{I}_*$ be a special non-rigid singular term that serves this purpose. Since terms in FOLC by default don't depend on an additional

context-variable like predicates, special terms have to be introduced. The syntax is augmented by the following rule, and the members of NTERM are treated like terms.

$$\text{NTERM} := (\text{DTERM CTERM}) \tag{8.34}$$

The semantics of these expressions is as follows.

$$[\![(\text{DTERM CTERM})]\!]^M_{g,k}(c) = [\![\text{DTERM}]\!]^M_{g,k}([\![\text{CTERM}]\!]^M_{g,k}(c)) \tag{8.35}$$

Now $\mathrm{I}_* \in \text{DTERM}$ can be added as a special non-rigid term for objects. The term makes no existence stipulations and therefore has to be used in combination with the existence predicate if desired. Suppose now the following utterance 8.36 involves Alice's subject use of ‹I›, revealing the episodal thought in 8.37.

(8.36) *Alice*: I am hungry.

(8.37) *Alice in thinking*: *I am hungry.*

Special 'thought-disquotation' of 8.36 with respect to Alice yields the following FOLC representation, where tense is ignored.[15]

(8.38) $M, g, c, k \vDash$

```
(iota SUBJ (Alice SUBJ))
(believe C1 SUBJ)
(exist C1 . (I* C1))
(hungry C1 . (I* C1))
```

Suppose $[\![(\mathrm{I}_* \text{ C1})]\!]^M_{g,k}(c) = a$ in the evaluation in dependence of the believe binder. The referent a of $(\mathrm{I}_* \text{ C1})$ is a doxastic object: Alice's presentation of herself to herself in her episodal thinking in the given situation, her *I*-thought. The binder for rational belief is used as a rough approximation for encoding episodal thinking in this case. How, then, can the above constraints be imposed on this content in FOLC? Granularity is merely a matter of interpretation and can therefore be stipulated as the intended reading of I_*. Regarding immunity, matters are more complicated. One way to interpret IR-type arguments is the following scheme, where ϕ must be interpreted as a property that is non-trivial:[16]

(8.39) $M, g, c, k \vDash$

```
(forall* C0)
(forall* X)
(implies
  (SpeakerOf C0 X)
  (Pos C0 . C1)
  (believe C1 . C2 X)
  (iota C2 . Y (φ C2 . Y))
  (≠ C2 . Y (I* C2)))
```

---

[15]The use of scare quotes is certainly justified here. The notion is only used as an analogy.

[16]Trivial properties would for example be *being identical to itself* or *being numerically one*.

in any intended M and any g, c, k

Whatever formal definite description ϕ we choose, according to this condition Alice in 8.38 might not believe that she herself is identical to the doxastic object determined by ϕ according to her belief. So whatever property ϕ expresses isn't a sufficient identification criterion *for Alice* to identify herself. Assuming that Alice is fully competent and using source language expressions in a canonical way, she might thus show a non-I-response regarding the *source language* expression corresponding to ϕ, whereas under normal circumstances Alice would express her belief 8.38 as 8.36 (IR 6). The question is, however, whether some ϕ still may *actually* identify a or not, i.e. whether the following holds or not.

(8.40) $M, g, c, k \vDash$

```
(forall* C0)
(forall* X)
(implies
  (SpeakerOf C0 X)
  (Pos C0 . C1)
  (believe C1 . C2 X)
  (iota C0 . Y (φ C0 . Y))
  (≠ C0 . Y (I* C2)))
```

in any intended M and any g, c, k

This condition is very strong, as it says that in any context there might in fact be no property at all that would uniquely identify any speaker's doxastic referent of a subject use of «I». This doesn't preclude the possibility that the doxastic referent actually has *some* properties, but none of them suffices to uniquely determine this doxastic referent independently of the respective speaker's or thinking person's beliefs. From an epistemic point of view, this kind of essentialism is on a par with phenomenal experience or qualia.[17]

Comparing the two cases, it seems that principle 8.40 is too strong and only 8.39 is established by IR-type arguments. The typical IR-type argument says that in any given situation a speaker might show an I-response, but not have any ϕ-disposition, where a ϕ-disposition would be either a corresponding utterance disposition to use the non-first-person-indexical and non-quasi-indicative source language expression α to which ϕ corresponds in the target language or a corresponding disposition to elicit an extralinguistic response that could reasonably be described from a 3rd-person perspective by using α. But this means that no α would uniquely determine the referent to which the speaker would under normal circumstances refer to by using «I» or «now» respectively according to what the speaker believes, not according to the actual referent of α. This is what 8.39 expresses. It only seems as if IR-type arguments would justify 8.40 as well, since by virtue of linguistic competence a speaker like Alice may be assumed to fully understand a 3rd-party source language expression α. But even then the speaker might be in error about the actual semantic referent of that expression.

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[17]This connection is investigated in detail by Stalnaker (2004).

8.5.2 Which Kind of Cognitive Content Is Needed?

It is now time to compare the role of essential indexicals to the role of speaker reference by means of proper names in chapter 4. To do so, we take a look at two very similar utterances. The first involves a use of «I» and the second involves the use of a proper name. Utterance acceptance and disquotation have been interpreted de dicto in chapter 4, but it is also possible to interpret them less fine-grained de re (Kripke 1979) or more fine-grained de se. *Interpretation* in this case only means attributing beliefs to discourse participants in a given context of utterance on the basis of reasonable assumptions about their understanding the given utterances at a chosen level of idealization. The respective belief attributions in the target language, the corresponding source language utterances, and paraphrases of their readings are given in the examples below. Of course, target language formulas have to be interpreted in intended models. For simplicity tense is ignored. Any additional identification criteria Alice or Bob might presume in using a proper name are also ignored, i.e. simplified NDT is presumed.

(8.41) *Situation: Alice is talking to Bob.*
    Alice: I'm hungry.

(8.42) Truth-conditional Content of 8.41 (literal meaning, 'what is said')
    (**iota** X (Speaker X))(hungry X)

(8.43) Broad Cognitive Content of 8.41

 I. De Re Cognitive Content
  a. Disquotation de re with respect to Alice:

```
(iota X (Alice X))
(believe C1 X)
(hungry C1 . X)
```

  Alice believes of Alice that she is hungry.
  b. De re acceptance of the utterance by Bob:

```
(iota X (Bob X))
(iota Y (Alice Y))
(believe C1 X)
(hungry C1 . Y)
```

  Bob believes of Alice that she is hungry.

 II. De Dicto Cognitive Content
  a. Disquotation with respect to Alice:

```
(iota X (Alice X))
(believe C1 X)
(iota C1 . Y (SpeakerOf C1 . C0 Y))
(hungry C1 . Y)
```

  Alice believes (de dicto) that the speaker of the current context of utterance is hungry.
  b. De dicto acceptance of the utterance by Bob:

```
(iota X (Bob X))
(believe C1 X)
(iota C1 . Y (SpeakerOf C1 . C0 Y))
(hungry C1 . Y)
```

Bob believes (de dicto) that the speaker of the current context of utterance is hungry.

(8.44) Narrow Cognitive Content of 8.41

    I. De Se Cognitive Content
    a. 'Thought-Disquotation' with respect to Alice:

```
(iota X (Alice X))
(believe C1 X)
(hungry C1 . (I* C1))
```

Alice believes that she* is hungry.
    b. 'De Se acceptance' with respect to Bob: *not applicable*[18]

Compare this with the following literal and disquotational readings of «Alice» in an otherwise similar situation.

(8.45) *Situation: Bob is talking to Alice and others.*
    Bob: Alice is hungry.

(8.46) Truth-conditional Content of 8.45 (literal meaning, 'what is said')
    (**iota** X (Alice X))(hungry X)

(8.47) Broad Cognitive Content of 8.45

    I. De Re Cognitive Content
    a. De re acceptance of the utterance by Alice:

```
(iota X (Alice X))
(believe C1 X)
(hungry C1 . X)
```

Alice believes of Alice that she is hungry.
    b. De re disquotation with respect to Bob:

```
(iota X (Bob X))
(iota Y (Alice Y))
(believe C1 X)
(hungry C1 . Y)
```

Bob believes of Alice that she is hungry.

---

[18]There are no principal reasons why Bob couldn't have *Alice*-thoughts that are irreducible with respect to his Alice-responses in the same trivial sense as outlined in section 8.4.3 for *I*-thoughts. Yet nobody ever seems to have to argued for such entities in the context of a realist theory of meaning, and so this possibility can be ignored here.

II. De Dicto Cognitive Content

a. De dicto acceptance of the utterance by Alice:

```
(iota X (Alice X))
(believe C1 X)
(iota C1 . Y (Alice C1 . Y))
(hungry C1 . Y)
```

Alice believes (de dicto) that Alice is hungry.
Alice believes of the person$_i$ she believes to be called «Alice» in the given conversational context that she$_i$ is hungry.

b. De dicto disquotation with respect to Bob:

```
(iota X (Bob X))
(believe C1 X)
(iota C1 . Y (Alice C1 . Y))
(hungry C1 . Y)
```

Bob believes (de dicto) that Alice is hungry.
Bob believes of the person$_i$ he believes to be called «Alice» in the given conversational context that she$_i$ is hungry.

(8.48) Narrow Cognitive Content of 8.45

I. De Se Cognitive Content

a. De se acceptance of the utterance by Alice:

```
(iota X (Alice X))
(believe C1 X)
(hungry C1 . (I* C1))
```

b. 'Thought-Disquotation' with respect to Bob: *not applicable*

Notice that de dicto disquotation of the indexical is straightforward and in direct analogy to the respective de dicto interpretation of proper names. The discussion of IFRT has shown that that a speaker might *use* «I» in a way that doesn't involve any attempt identification of himself, because *I*-thoughts in episodal thinking aren't indexical. Nevertheless, the speaker will have to attempt to identify himself from a third person perspective if he wants to *understand* his or another person's use of «I». This follows from examples involving persistent tokens and is further backed up by the fact that it is, as opposed to proper names, precisely the purpose of the reference rule of an indexical and the pointing gesture of a demonstrative to be used as identification criteria in a given context of utterance. The question is where and how de se readings fit into the picture. As outlined above, they link the use of linguistic expressions to phenomena in cognition that are thought to be relevant for certain behavior. But unlike the link between speaker reference by means of proper names and de dicto readings of belief ascriptions, the alleged *linguistic evidence* for this link is sparse and problematic. Examples like 8.32 don't *have to* be considered false when used for reporting a third person reference to oneself

in thinking; they can be considered inappropriate instead, because they would usually convey a first-person reference in thinking and don't indicate any attempt of the subject to identify herself by means of certain properties. The actual irreducibility occurs in actual episodal thinking and isn't a feature of the meaning of linguistic expressions. A receiver has to interpret PRO as an anaphoric expression that is co-extensional with the embedding matrix subject-NP, and his attempt to identify the semantic referent of either referential expression is fallible as any attempt to identify something as something. If source language is under consideration a de se interpretation is always barely indicated or suggested. The same holds for de dicto readings of belief ascriptions, but there is a significant difference. De dicto readings of proper names reflect the way speakers use and understand names in cases when identifying reference is expected, they represent the fact that a speaker takes into account whatever she believes to know about the referent of a name and the information conveyed by the sparse linguistic meaning of that name. This also holds for de dicto readings of indexicals, and even more so, because of their rich descriptive content. Conversely to this, a de se reading of an indexical token only reflects one way how the respective user, i.e. the sender, may and often will understand it prior to using it, not how he may understand it later or how the recipient may understand it. These readings seem to have a better place in a cognitive and anti-realist semantic framework, which represents speaker idiolects and presentations of objects to speakers in thinking right from the start.

8.5.3   Belief and Behavioral Dispositions

De dicto and de se belief attributions are attempts to formally express beliefs that the given believer would express in certain ways, but not in others. They draw a connection between a speaker's belief and his behavioral dispositions. These in particular include the speaker's linguistic dispositions: utterance dispositions and more generally dispositions to accept or reject utterances on the basis of his beliefs. Such dispositions become relevant in case an actual or possible speaker reference by means of some expression doesn't match the expression's semantic referent, i.e. in case identifying reference fails or might fail. However, not all respective formal belief attributions encode any of this directly, some of them only *indicate* the corresponding behavioral dispositions. A de se belief attribution in the above sense can't be said to directly express in terms of its truth-conditions the attitude holder's disposition to elicit an I-response. This is only expressed indirectly, either by stipulating a special referent, such as an *I-* or *now*-thought, or by changing the relatum of the belief relation in general (from sets of possible worlds to structured propositions, sets of centered worlds, properties, Russellian propositions containing additional modes of presentation, etc.) and by *additionally* presuming that these changes guarantee a disposition to elicit the corresponding response. As long as this additional presumption isn't required to be expressed in the formal language of analysis itself, in principle any kind of formal belief attribution according to which the believer believes something about herself, her location, or the current time, and with a semantics more 'fine-grained' than de re and de dicto belief can be *interpreted* as a de se belief. For example, instead of regarding the speaker referent of a subject use of «I» by Alice for Alice her *I*-thought, the referent could be taken as Alice plus an instance of the mysterious substance *thought-phlogiston* representing the way of Alice's being

given to herself in the given situation. Both analyses are 'fine-grained' enough to do justice to de se belief in the sense of being sufficiently distinct from other notions of belief; they are descriptively adequate. From an explanatory point of view they remain incomplete, because they don't draw a direct connection between the presumed mental phenomenon of identification-free self-reference in thinking to the external phenomenon I-response that may occur as the result of the former according to IR-type arguments. Strictly speaking, a formal belief attribution can only encode—as opposed to merely indicating—an utterance disposition if at some place in its formal semantics or the specification of its intended reading linguistic material is quoted or otherwise referred to. Likewise, a formal notion of belief only encodes an extralinguistic behavioral disposition, say the disposition to clean up this trail of sugar, if in its semantics or specification of its intended reading in the target language it is semantically referred to this behavior. Here is for example a belief attribution that directly expresses an utterance disposition in intended models.

(8.49) $M, g, c, k \vDash$

> (**iota** SUBJ (Alice SUBJ))
> (**believe** C1 SUBJ)
> (hungry C1 . SUBJ)
> (DispU SUBJ a)

Hereby, (DispU C . X Y) is a ternary predicate with intended reading *in context C, X is disposed to utter Y* and the constant $[\![a]\!]_{g,k}^{M}(c)$ =«I am hungry».[19] Dealing with extralinguistic behavioral dispositions is more complicated, since it requires quantification over possible I-responses, which are hard to categorize in general. But IR-type arguments do precisely that; so in principle a notion of de se belief based on extralinguistic dispositions doesn't have to be less precise than the IR-type arguments themselves that establish this very notion. For comparison, as far as de dicto belief is concerned the analysis given in chapter 4 encodes utterance dispositions, although it isn't directly based on them. Nominal description theory is quotational, because it is based on the property of being called such and such in the source language. Any additional identificational criteria only indicate a disposition to use certain source language expressions, though. Likewise, the non-rigid interpretations of indexicals in section 8.2 are only indirectly quotational, by virtue of the fact that a competent speaker under normal conditions might use a corresponding source language indexical to express his belief that the current speaker, the current time of utterance, or the current place of utterance is such and such.

On one hand, subject uses of «I» and similar analyses of other indexicals are also quotational, because they indicate utterance and acceptance dispositions of a speaker. On the other hand, they point to the problem of extralinguistic self-reference in thinking, and this problem is not at all a matter of natural language interpretation. IFRT tells us that certain behaviorally-relevant self-references in thinking aren't in any way achieved or performed by strong identification on the basis of identification criteria, yet leaves the nature of the referent open. This referent can

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[19]For the sake of simplicity, a constant is used here. In a more elaborate account source language expressions must be available to the target language as objects constructed on the basis of a reasonable source language grammar. In many linguistic applications this is possible; it is for example done on the basis of HPSG grammars in token-dependency semantics (Dahllöf 2001, 2002), which is motivated by the paratactic view on indirect speech in (Davidson 1968).

be taken as an *I*-thought, and then it must satisfy 8.39, or it can be taken as a complex entity
involving a Millian specification of the referent and an irreducible mode of being given. From
the point of view of description theory, there is yet another possibility. The referent can also be
taken as the thinking person de re, as a physical object, that is speaker-referred to in a special,
infallible way in that person's thinking. This stipulation can be made for a de re attribution
like 8.43.Ia, when at the meantime the description theory of reference is used for analyzing
indexicals and proper names. 8.43.Ia doesn't indicate any identification of the referent by means
of properties—the bound variable indicates infallible reference simply by virtue of being bound.

All of these attempts to specify a special way of attributing belief de se have in common
that they lead away from the real problem: What gives such a self-reference its special epistemic
status for the thinking person, as it is established by IFRT? Making a semiotic distinction between
discursive and presentational symbols is one way to tackle this problem. If episodal thinking,
insofar as it is relevant for the irreducibility thesis, indeed has to be a presentational symbolic
system, then speaking of an extralinguistic 'self-reference in thinking' is an unfitting metaphor,
since transferring the notion of speaker or semantic reference from discursive to presentational
symbolic systems means taking a presentational as a representational system. There might still
be other, good reasons for speaking about 'self-reference in thinking', and the distinction between
discursive and representational symbolic systems might itself be too general to be fruitful in a
more elaborate theory of cognition. But in any case such a theory is a matter of the philosophy
of mind, empirical psychology, and neurophysiology.

8.5.4   Concluding Remarks

Reference is not a homogeneous phenomenon. Figure 8.2 displays various aspects of reference
discussed so far. The more cognitive aspects of speaker reference are taken into account, the
more the notion of reference will be subject to empirical psychology and the investigation of
actual thought processes. Speaker reference in general is an idealization from individual pre-
sentations of objects in actual cognition of persons or animals. When these aspects of episodal
thinking start to involve linguistic, representational symbols, they may become relevant to lin-
guistic theory. De se attitudes live in a gray zone between aspects of actual cognition and aspects
of natural language meaning. Description theory is already more on the side of natural language
meaning and idealizes to a high degree from actual thought processes. On one hand, cogni-
tive aspects of a speaker's reference to a particular can be caught by a description that includes
speaker-dependent identification criteria at each occasion of use of the linguistic expression in
question. These criteria can for example be taken to indicate and explain the speaker's disposi-
tions to accept certain co-extensional terms, for example a definite description, as substitutes for
a term while other are rejected. On the other hand, target language descriptions are also part
of the condition for identifying reference. From an epistemic perspective, a speaker refers to the
semantic referent of a term if she successfully identifies that referent by means of the associated
identification criteria. At the rightmost edge of the scale is Millianism, which is adequate if fail-
ure of identifying reference is not an issue, neglectable, or simply ignored. This is appropriate
for semantic reference, as long as the pragmatic view on referential opacity is adopted.
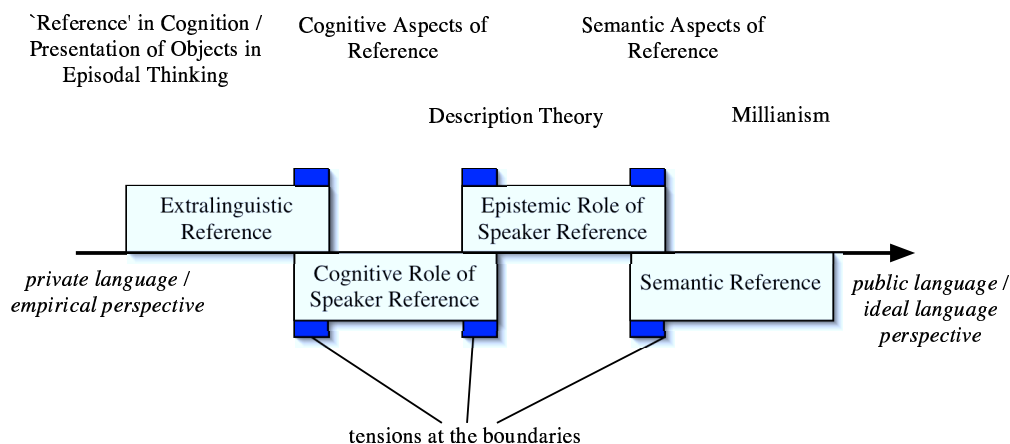
Figure 8.2: Aspects of Reference

As Perry (1997b, a) points out, various notions of semantic content resulting from any of the above aspects of reference can live together and represent aspects of the truth-conditions of an utterance. Whenever strong identification can be ignored, for example because the referents of singular terms are known, a Millian specification of semantic content is adequate. Perry calls this content$_C$ or referential content and points out that it encodes the fact that two speakers may 'say the same' by different utterances,[20] for example when the Russellian proposition $\langle a, P \rangle$ is used to specify the truth-conditional content of Alice's utterance of ‹I'm hungry› and Bob's reporting that ‹Alice is hungry›. To this it must be added that these utterances of course only say the same as long as the speaker in the context of the former utterance is Alice. A purporter of the indirect reference view might insist on making this condition explicit,[21] but this choice is not mandatory. There is no need to make such a condition explicit if epistemic and cognitive aspects of reference are not the focal point, but the main interest is in a notion of truth-conditional content that all utterances have in common that in a sense 'say the same.' Mapping ‹I› and ‹Alice› to the same rigid target language constant can be desirable in this case. The description-theoretic point of view will on the other hand be desirable, once epistemic and cognitive aspects of speaker reference are focused on.[22] Does this mean that the difference between direct and indirect reference is merely a matter of choosing a level of idealization for semantic content? No. The two views differ considerably in overall perspective and also for principal reasons. First, it has

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[20] See (Perry 1997a, p. 603), (Perry 2005, pp. 322-3).

[21] For example, in FOLC the constraint would be expressed as follows, where tense is ignored: $M, g, c, k \vDash$ (**iota** X (Alice X)) (**iota** Y (Speaker Y)) (= X Y)

[22] What Perry calls content$_M$ of indexicals is similar to the FOLC analyses provided here, but doesn't involve a uniqueness condition and is explicitly instead of implicitly utterance-based, i.e. content$_M$ represents reflexive truth-conditions. See (Perry 1997a, p. 601-2), (Perry 2005, p. 323). His view on proper names in (Perry 1997b) is closer to the direct reference view than the one propagated here.

been recognized, starting from chapter 4, that in nested attitude ascriptions de dicto readings of proper names are relativized to the first attitude only. If this is so, just using non-rigid constants is not adequate for expressing de dicto readings of proper names in attitude ascriptions. Either a semantic mechanism for expressing relativized rigidity has to be implemented, as outlined in chapter 4, or the syntax–semantics interface has to manage the scope appropriately, as presumed in later chapters and exemplified in Appendix C. Still, with an appropriate binding mechanism— such as quantification plus equality, or lambda abstraction—non-rigid constants can do the job. There is, however, a second, crucial difference between Millianism and indirect reference theory. Expressing semantic reference by means of Millian specifications is not the same as expressing it by means of wide scope definite descriptions, because the former doesn't assume any non-trivial property the referent must satisfy uniquely. Nominal description theory says that the meaning of a proper name is a set of linguistic conventions of being called by that name, and that semantic reference is the fact that in a given conversational context there is exactly one object that is actually being called by the name, or otherwise the name is empty by violation of the presupposition of number. External description theory is the stronger claim that proper names have an ideal, public language meaning that is fixed by groups of speakers on the basis of actual social processes in addition to being called such and such in the weaker sense. A purporter of EDT might for example claim, against Kripke, that we wouldn't call Aristotle «Aristotle» if many or all of the properties that experts believe him to have would turn out to be wrong. Say, in the unlikely event that someone would show convincingly that Plato never had any scholars, that all of Aristotle's writings have in fact been written by a monk in the Early Middle Age, and that at the time of Aristotle's living only dogs were called «Aristotle» in Ancient Greek, i.e. according to the Ancient Greek naming conventions that correspond to «Aristotle» nowadays, then we would not say, according to EDT, that Aristotle must have been one of these dogs, but would rather say that Aristotle didn't exist. In both views, the relative rigidity of proper names is merely a linguistic fact of how they are interpreted relative to specifications of counterfactual circumstances; it has no metaphysical or otherwise philosophical relevance. These claims set both versions of description theory far apart from the direct reference view, according to which ordinary proper names have no meaning that is relevant for determining semantic reference. Third, going from the Kaplanian character of an indexical to its (Millian) content and then taking belief as a relation of the believer to this content is asking for trouble. Speaker reference by means of an indexical is a speaker's determining the purported referent by means of the indexical's reference rule. This subjective meaning can be expressed by diagonalization, but diagonalized content is not Millian. It is descriptive in the same sense as the non-rigid descriptions used in the beginning of this chapter. Fourth, essential readings of indexicals convey an infallible mode of 'reference' in thinking that is indeed direct and cannot be adequately encoded by means of descriptions because of IFRT. However, as has been argued, speaking of *reference in thinking* and a *language of thinking* are misleading metaphors for the cognitive phenomenas in question.

Appendix A

First-order Modal Logic

I. FOML Specification

FOML Syntax.   Let VAR be the set of variables containing x, y, z and all of their indexed variants, CON the set of individuals constants containing a, b, c and all of their indexed variants, MID be a finite set of modality indices $0, 1, 2, \ldots, m$, $\text{PRED} := \text{PRED}^0 \cup \cdots \cup \text{PRED}^k$ the set of n-ary predicates $0 \leq n \leq k$ $(n, k \in \mathbb{N}_0)$, and $\text{TERM} = \text{CON} \cup \text{VAR}$. Then the set of well-formed formulas WFF of FOML is given by the following recursive rule, where the names of the sets just defined serve as metavariables for any of the respective set's members.

$$\text{WFF} := \forall^* \text{VAR WFF} \mid \exists^* \text{VAR WFF} \mid (\text{WFF} \wedge \text{WFF}) \mid \neg \text{WFF}$$
$$\mid \Box_{\text{MID}} \text{WFF} \mid \text{PRED}^n(\text{TERM}_1, \ldots, \text{TERM}_n) \tag{A.1}$$

Redundant parentheses and parentheses around the arguments of unary predicates may be left out or added for better readability.

FOML Model.   Let D be a non-empty set (the total domain of all objects), W be a non-empty set of possible states of affairs ('worlds') $w_1, w_2, \ldots$, R be a set containing for each member of MID a binary relation on W (written as R_π for $\pi \in \text{MID}$), and $\llbracket . \rrbracket_g^M (w)$ be an interpretation function of model M from well-formed formulas into $\{1, 0\}$ and from terms $t \in \text{TERM}$ into D with respect to a variable assignment function g from VAR to D, with respect to a world w. A frame of FOML is then a tuple $F = (W, R, D)$. A model of FOML based on frame F is the n-tupel consisting of F and the interpretation $\llbracket . \rrbracket_g^M (w)$. A VAR-variant h of an assignment function g, written as $h \approx_{\text{VAR}} g$, is the same as g in all places except possibly for VAR.

FOML Term and Predicate Interpretation.

$$\llbracket \text{VAR} \rrbracket_g^M (w) := g(\text{VAR}) \tag{A.2}$$

$$\llbracket \text{CON} \rrbracket_g^M (w) \in D \tag{A.3}$$

$$\llbracket \text{PRED}^n \rrbracket_g^M (w) \subseteq D^n \tag{A.4}$$

FOML Truth in a Model.

(A.5) $\llbracket \text{PRED}(\text{TERM}_1, \ldots, \text{TERM}_n) \rrbracket_g^M (w)$
$$= \begin{cases} 1 \text{ if } \langle \llbracket \text{TERM}_1 \rrbracket_g^M (w), \ldots, \llbracket \text{TERM}_n \rrbracket_g^M (w) \rangle \in \llbracket \text{PRED} \rrbracket_g^M (w) \\ 0 \text{ otherwise} \end{cases}$$

(A.6) $\llbracket \neg \text{WFF} \rrbracket_g^M (w)$
$$= \begin{cases} 1 \text{ if } \llbracket \text{WFF} \rrbracket_g^M (w) = 0 \\ 0 \text{ otherwise} \end{cases}$$

(A.7) $[\![\mathrm{WFF}_1 \wedge \mathrm{WFF}_2]\!]_g^M (w)$

$= \begin{cases} 1 \text{ if } [\![\mathrm{WFF}_1]\!]_g^M (w) = 1 \text{ and } [\![\mathrm{WFF}_2]\!]_g^M (w) = 1 \\ 0 \text{ otherwise} \end{cases}$

(A.8) $[\![\exists^* \mathrm{VAR}\, \mathrm{WFF}]\!]_g^M (w)$

$= \begin{cases} 1 \text{ if there's an } h \approx_{\mathrm{VAR}} g \text{ such that } [\![\mathrm{WFF}]\!]_h^M (w) = 1 \\ 0 \text{ otherwise} \end{cases}$

(A.9) $[\![\forall^* \mathrm{VAR}\, \mathrm{WFF}]\!]_g^M (w)$

$= \begin{cases} 1 \text{ if for all } h \approx_{\mathrm{VAR}} g \text{ it is the case that } [\![\mathrm{WFF}]\!]_h^M (w) = 1 \\ 0 \text{ otherwise} \end{cases}$

(A.10) $[\![\Box_{\mathrm{MID}}\, \mathrm{WFF}]\!]_g^M (w)$

$= \begin{cases} 1 \text{ if in all } u \in W \text{ such that } R_{\mathrm{MID}}(w,u) : [\![\mathrm{WFF}]\!]_g^M (u) = 1 \\ 0 \text{ otherwise} \end{cases}$

In addition to the above rules, we assume standard definitions of the other truth-functions and of the dual modal operator $\Diamond_{\mathrm{MID}}$ as $\neg \Box_{\mathrm{MID}} \neg$. A modality index MID may be left out if modal operators are discussed in general, different modalities aren't compared, or it is clear what kind of modality is meant. As an alternative notation $M, g, w \vDash \mathrm{WFF}$ will sometimes be used for $[\![\mathrm{WFF}]\!]_g^M (w)$. Notice that the world parameter is sometimes also written as sub- or superscript of the interpretation function, but it is written as a separate argument here in order to accommodate the notation to the one used for double-index theories in chapter 6.

Existence Predicate.   We assume a special unary predicate E whose intended interpretation is *x exists*. Unless otherwise noted only models of FOML are considered in which E is given this extralogical interpretation. Relativized quantifiers are introduced by the following abbreviations.

$$\exists \mathrm{VAR}\, \mathrm{WFF} := \exists^* \mathrm{VAR}\, (E(\mathrm{VAR}) \wedge \mathrm{WFF}) \tag{A.11}$$

$$\forall \mathrm{VAR}\, \mathrm{WFF} := \forall^* \mathrm{VAR}\, (E(\mathrm{VAR}) \supset \mathrm{WFF}) \tag{A.12}$$

Iota Quantifier.   The possibilist iota quantifier is defined as follows:

(A.13) $\imath^* \mathrm{VAR}_1\, \mathrm{WFF}_1\, \mathrm{WFF}_2$

$:= \exists^* \mathrm{VAR}_1 (\mathrm{WFF}_1 \wedge \forall^* \mathrm{VAR}_2\, (\mathrm{WFF}_1[\mathrm{VAR}_1/\mathrm{VAR}_2]$

$\supset \mathrm{VAR}_1 = \mathrm{VAR}_2) \wedge \mathrm{WFF}_2)$

for new variable VAR_2

Canonical Identity.   We assume a special binary predicate $=$ which is interpreted as the same equivalence relation in any state of affairs and has the intended reading *x is identical with y*. Unless otherwise noted, only FOML models are considered, in which $=$ has this reading.

Extension $FOML_\iota$. $FOML_\iota$ is the logical system obtained from the above FOML by making the following changes. (i) The syntax is augmented to include formulas of the form ιVARWFF into the set of terms TERM. (ii) Term interpretation is changed such that $[\![\text{TERM}]\!]_g^M(w) \in D$ or it is undefined, and a term of the form ιVAR WFF is interpreted as follows.

(A.14) $[\![\iota\text{VAR WFF}]\!]_g^M(w)$
$$:= \begin{cases} h(\text{VAR}) \text{ if there is exactly one } h \approx_{\text{VAR}} g \text{ such that } [\![\text{WFF}]\!]_h^M(w) \\ \text{undefined otherwise} \end{cases}$$

(iii) The interpretation of simple predicative clauses is adjusted as follows.

(A.15) $[\![\text{PRED}(\text{TERM}_1, \dots, \text{TERM}_n)]\!]_g^M(w)$
$$:= \begin{cases} 1 \text{ if } [\![\text{TERM}_1]\!]_g^M(w), \dots, [\![\text{TERM}_n]\!]_g^M(w) \text{ are defined and} \\ \quad \langle [\![\text{TERM}_1]\!]_g^M(w), \dots, [\![\text{TERM}_n]\!]_g^M(w) \rangle \in [\![\text{PRED}]\!]_g^M(w), \\ 0 \text{ otherwise} \end{cases}$$

II. Notes

1.   FOML allows statements about objects to come out true at some state of affairs if they don't exist at that state, since the existence predicate can have arbitrary extension at a state.

2.   Constants are non-rigid, but can be made rigid at anytime by a suitable constraint.

3.   The quantifiers relativized to the existence predicate correspond to actualist quantifiers in a normal varying-domain first-order modal logic.

4. $FOML_\iota$ allows non-denoting constants and implements iota terms semantically. Notice that the following holds.

$$FOML_\iota : \text{PRED}(\iota\text{VAR WFF}) \tag{A.16}$$
$$\Updownarrow$$
$$FOML : \iota\text{VAR WFF PRED(VAR)}$$

Appendix B

Miscellaneous Proofs

I. Soames' First Argument

☆ **Proposition 1** (FOML Equivalence of Soames' C and C'). *For any model $M = \{W, R, D, [\![.]\!]\}$ of constant-domain FOML (Appendix A), any chosen $w_0 \in W$, and any rigid constant n: If (B.1) holds, then (B.2) holds if and only if (B.3) holds.*

$$M, w_0 \vDash \imath^* x(Gx)(x = n) \tag{B.1}$$

$$M, w_0 \vDash \Box[Fn \supset \exists^* x(Fx \land Gx)] \tag{B.2}$$

$$M, g, w_0 \vDash \imath^* xGx\Box[Fx \supset \exists^* y(Fy \land Gy)] \tag{B.3}$$

Proof. According to the rigidity condition on term n, (B.4) must hold.

$$\forall w \text{ s.t. } w_0 R_\Box w : [\![n]\!]_g^M(w_0) = [\![n]\!]_g^M(w) \tag{B.4}$$

We further assume that (B.1) is the case. So there is an $a \in D$ such that $[\![G]\!]_g^M(w_0) = \{a\}$ and $[\![n]\!]_g^M(w_0) = a$. We show that given these assumptions, (B.2) $\Leftrightarrow$ (B.3) holds by evaluating (B.2) and (B.3) to the same condition. Part 1. From (B.2) we get:

$$\forall w \text{ s.t. } w_0 R_\Box w : \text{ if } [\![n]\!]_g^M(w) \in [\![F]\!]_g^M(w),$$
$$\text{then } \exists h : h \approx_x g \text{ s.t. } M, h, w \vDash Fx \land Gx \tag{B.5}$$

Since by assumption $\forall w$ s.t. $w_0 R_\Box w : [\![n]\!]_g^M(w) = a$ we get:

$$\forall w \text{ s.t. } w_0 R_\Box w : \text{ if } a \in [\![F]\!]_g^M(w),$$
$$\text{then } \exists h : h \approx_x g \text{ s.t. } M, h, w \vDash Fx \land Gx \tag{B.6}$$

Part 2. We continue by evaluating (B.3) and get from the definition of $\imath^*$:

$$M, g, w_0 \vDash \exists^* x[Gx \land \forall z(Gz \supset x = z) \land \Box[Fx \supset \exists^* y(Fy \land Gy)]] \tag{B.7}$$

Because of assumption (B.1) we can set $h(x) = a$ and know that the uniqueness condition is fulfilled. Thus:

$$M, h, w_0 \vDash \Box[Fx \supset \exists^* y(Fy \land Gy)], \text{ where } h(x) = a \tag{B.8}$$

By further evaluating, we get:

$$\forall w \text{ s.t. } w_0 R_\Box w : M, h, w \vDash Fx \supset \exists^* y(Fy \supset Gy), \text{ where } h(x) = a \tag{B.9}$$

and thus

$$\forall w \text{ s.t.} w_0 R_\Box w : \text{ if } a \in [\![F]\!]_h^M(w),$$
$$\text{then } \exists h' \text{ s.t. } h' \approx_y h \text{ and } M, h', w \vDash Fy \land Gy, \text{ where } h(x) = a \tag{B.10}$$

Since x doesn't occur in $Fy \wedge Gy$, this expresses the same condition as (B.6). $\qquad\square$

II. FOML Equivalence of Rigidified Descriptions with Rigid Terms

☆ **Proposition 2** ($FOML_\iota$ Rigidified Descriptions and Terms). *For any constant-domain $FOML_\iota$ model $M = \langle W, R, D, [\![.]\!], w_0 \rangle$ with designated evaluation point $w_0 \in W$ (see Appendix A and definition (ML 1) on page 53), arbitrary unary property P, any formula A, and any rigid term n: if (B.11) holds, then (B.12) holds as well under arbitrary assignment and for arbitrary $w \in W$.*

$$M, w_0 \vDash n = \iota x \, @ \, Px \tag{B.11}$$

$$M, w \vDash A \equiv A[n / \iota x \, @ \, Px] \tag{B.12}$$

Proof. Proof is by induction on the complexity of formulas in $FOML_\iota$. Note that because of B.11 and the canonical interpretation of identity we can assume that there is an $a \in D$ such that $[\![n]\!]^M (w_0) = a$ and $[\![P]\!]^M (w_0) = \{a\}$. By rigidity condition (Kri 5) on page 45 we further know that $[\![n]\!]^M (w) = [\![n]\!]^M (w') = a$ for any world w' that is accessible from w. We use g for an arbitrary assignment, omit g when it is irrelevant, and abbreviate $t := \iota x \, @ \, Px$ for convenience.

[Case 1] A is a simple predication of the form $R(u_1, \ldots, u_i, n, u_{i+1}, \ldots, u_j)$. We only consider the unary case of the form $R(n)$, since the n-ary cases are analogous.

$$M, g, w \vDash R(n) \equiv R[n/t] \tag{B.13}$$

$$\Updownarrow$$

$$[\![n]\!]_g^M (w) \in [\![R]\!]_g^M (w) \Leftrightarrow [\![\iota x \, @ \, Px]\!]_g^M (w) \in [\![R]\!]_g^M (w) \tag{B.14}$$

$$\Updownarrow$$

$$a \in [\![R]\!]_g^M (w) \Leftrightarrow \exists! h : h \approx_x g \text{ s.t. } [\![@ \, Px]\!]_h^M (w) = 1 \tag{B.15}$$
$$\text{and } h(x) \in [\![R]\!]_g^M (w)$$

$$\Updownarrow$$

$$a \in [\![R]\!]_g^M (w) \Leftrightarrow \exists! h : h \approx_x g \text{ s.t. } [\![Px]\!]_h^M (w_0) = 1 \tag{B.16}$$
$$\text{and } h(x) \in [\![R]\!]_g^M (w)$$

Since by assumption $[\![P]\!]^M (w_0) = \{a\}$, it must be the case that $h(x) = a$, and therefore the above holds by induction assumption.

[Case 2] A is of the form $\neg B$. We have to proof B.17. Since this is classically equivalent to B.18, B.17 must hold by induction assumption.

$$M, w \vDash \neg B \equiv \neg B[n/t] \tag{B.17}$$

$$\Updownarrow$$

$$M, w \vDash B \equiv B[n/t] \tag{B.18}$$

[Case 3] A is of the form $(B \wedge C)$. We have to show B.19.

$$M, w \vDash (B \wedge C) \equiv (B \wedge C)[n/t] \tag{B.19}$$

$$\Updownarrow$$

$$M, w \vDash (B \wedge C) \equiv (B[n/t] \wedge C[n/t]) \tag{B.20}$$

By induction assumption, the following equivalences hold:

$$M, w \vDash B \equiv B[n/t] \tag{B.21}$$

$$M, w \vDash C \equiv C[n/t] \tag{B.22}$$

Therefore B.20 must hold as well.

[Case 4] A is of the form $\forall^* xB$. We have to show B.23.

$$M, g, w \vDash (\forall^* xB) \equiv (\forall^* xB)[n/t] \tag{B.23}$$

$$\Updownarrow$$

$$M, g, w \vDash (\forall^* xB) \equiv (\forall^* xB[n/t]) \tag{B.24}$$

$$\Updownarrow$$

$$\forall h \text{ s.t. } h \approx_x g : M, h, w \vDash B \Leftrightarrow \forall h \text{ s.t. } h \approx_x g : M, h, w \vDash B[n/t] \tag{B.25}$$

Since the induction assumption holds for arbitrary assignment, the above equivalence must also hold under assignment h.

[Case 5] A is of the form $\exists^* xB$. This case is analogous to the previous one.

[Case 6] A is of the form $\square_\pi B$. We have to show B.26.

$$M, w \vDash (\square_\pi B) \equiv (\square_\pi B)[n/t] \tag{B.26}$$

$$\Updownarrow$$

$$M, w \vDash (\square_\pi B) \equiv (\square_\pi B[n/t]) \tag{B.27}$$

$$\Updownarrow$$

$$M, w \vDash \square_\pi B \Leftrightarrow M, w \vDash \square_\pi B[n/t] \tag{B.28}$$

$$\Updownarrow$$

$$\forall w' \text{ s.t. } wR_\pi w' : M, w' \vDash B \Leftrightarrow \forall w' \text{ s.t. } wR_\pi w' : M, w' \vDash B[n/t] \tag{B.29}$$

Since evaluation on both sides start from w, and we universally quantify over all worlds that are π-accessible from w, and furthermore the induction assumption holds for arbitrary $w \in W$,

the above must hold as well.

[Case 7] A is of the form $\Diamond_\pi B$. This case is analogous to the previous one. $\square$

Appendix C

A Generic Syntax–Semantics Interface

The interface translates a given syntactic derivation tree into a set of target language expressions based on rewrite rules and some information passed as tags from the syntax to the interface. The input to the interface consists of an arbitrary-branching derivation tree whose nodes contains lists of *tags* and target language schemes. The rules are *tree rewriting rules*. The construction algorithm applies these rules to the given input tree, rewrites it by the rules to a set of trees, and these are subsequently flattened.

I. Intermediate Language IML

Base Entities.   A *tag* is a sequence of alphabetic letters and possibly an integer index and possibly an integer substitution index. We write TAG1|2 for the tag TAG with index 1 and substitution index 2. A tag starting with ':' is *local*, any other tag is *global*. A tag ending in '?' is an *a-tag*, any other tag is a *b-tag*.[1]   A *specification* is one of the following form where SPEC is a specification and JUN1 and JUN2 are the logical standard connectives as in FOLC:

(C.1) SPEC := (JUN1 SPEC) | (JUN2 SPEC SPEC) | TAG

A substitution *marker* is an integer number. A direction sign is either of the symbols ':' (local), '/' (right), or '\' (left). A *matcher* is of the form dM−, sM=S−, dM, or dM=S, where M is a marker, d is a direction sign, S is a specification, and −, = are taken as a literal symbols. A matcher ending in '-' is *deleting*, any other matcher is *non-deleting*. The type of a matcher is the type of its direction sign, i.e. local, left, or right. A matcher without specification may not be local. A target language *scheme* consists of sequences of one or more of the following: (1) arbitrary payload, here written as target language strings, (2) tags, (3) markers, and (4) matchers. An *expression* is a pair written as list [TAGS SCMS], where TAGS is a list of tags and SCMS is a list of schemes. Lists are generally written here with round or square parentheses.

Matching.   A tag t *matches* a tag u (Case 1) if t that has an index: t consists of the same letter sequence as u, and t and u have the same index, or (Case 2) if t doesn't have an index: t and u consist of the same letter sequence. Otherwise t doesn't match u. An expression e *matches* a specification s if. . .

1. T matches any of the tags in e, in case s is a simple tag T

2. T matches neither of the tags in e, in case s is of the form (**not** T), where T is a simple tag

3. It is not the case that e matches A, in case s is of the form (**not** A), where A is a complex boolean specification

4. e matches A and B, in case s is of the form (**and** A B)

The other cases are definable in the standard way for boolean connectives.

---

[1]The letters may be taken as shortcuts for *anaphoric* and *binder* respectively, which comes close to their purpose.

II. Rules

There are four sorts of rules with domain DOM, and left LHS, and right hand side RHS specification respectively.

1. DOM: LHS < RHS   *Maximal Left Shift*

2. DOM: LHS << RHS   *Left Shift*

3. DOM: LHS <<$_*$ RHS   *Permuting Left Shift*

4. DOM: LHS <$_*$ RHS   *Permuting Maximal Left Shift*

To ease understanding, Figure C.1 depicts some examples of how trees can be rewritten by these rules, where for simplicity the node name is taken as a member in the list of tags at each node.

III. Tree Rewriting

Figure C.2 lays out how the rules work. The dashed lines indicate that there may be intervening child nodes, as long as the constraints given in round numbers aren't violated, and the indices in the figure are computed in ascending order from left to right and top to bottom. The Raise Left rewriting step makes sure that an LHS (without intervening LHS, RHS, or DOM) that is embedded into an RHS within the rule domain is moved outside the RHS directly under DOM and immediately before (Case 1) the RHS dominating LHS in case of an << rule, and (Case 2) the first RHS within the domain in case of an < rule. The Shift Left rewriting step ensures that any LHS nodes are moved immediately before (Case 1) the last RHS node which precedes them in case of an << rule, and (Case 2) the first preceding RHS within the domain in case of an < rule. If more than one LHS is moved, the linear precedence order of the LHS nodes is preserved, except for the $_*$ variants which yield all permutations of the LHS nodes at their respective locations. There may be arbitrary sister nodes to any of the RHS or LHS nodes that aren't specified in the diagrams; they aren't affected by rules unless they match one. Notice that a rule domain in a tree may not cross its own matching nodes as boundary, i.e. for example the domain of a rule with rule domain S at a given S node n_1 in a given derivation tree will only extend down to the immediate parent of the next lower S node n_2 dominated by n_1, but not further below. It is, however, possible that RHS=DOM such that LHS is adjuncted leftmost immediately below DOM.

IV. The Algorithm

The following auxiliary accessor functions are assumed.

- $spec(m)$ takes a matcher and returns its specification

- $num(m)$ takes a matcher and returns its marker

- $tags(e)$ takes an expression or a tree node and returns its tags
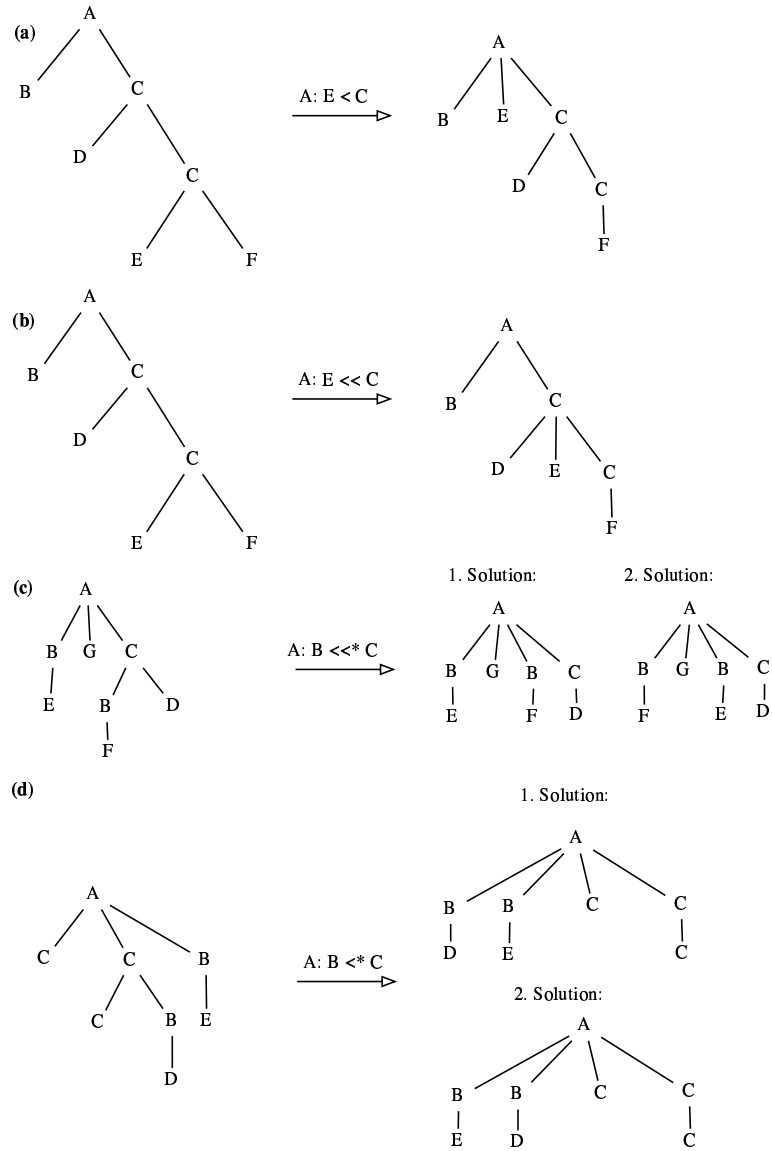
Figure C.1: Examples of rule applications, where node names are taken as tags for simplicity.

Rule < and <*: *k=1*
Rule << and <<*: *k=j*

DOM

①

RHS_j

②

LHS_1 ... LHS_i

(a)

(b)

Conditions

① no intervening *DOM* or *RHS* node
② no intervening *DOM*, *RHS, or LHS* node
③ immediate left-right precedence

DOM

①   ②

RHS_j   ①   *LHS_1 ... LHS_i*

DOM

②   ①

LHS_1 ... LHS_i   ③   *RHS_k*

DOM

②   ①

LHS_1 ... LHS_i   ③   *RHS_k*
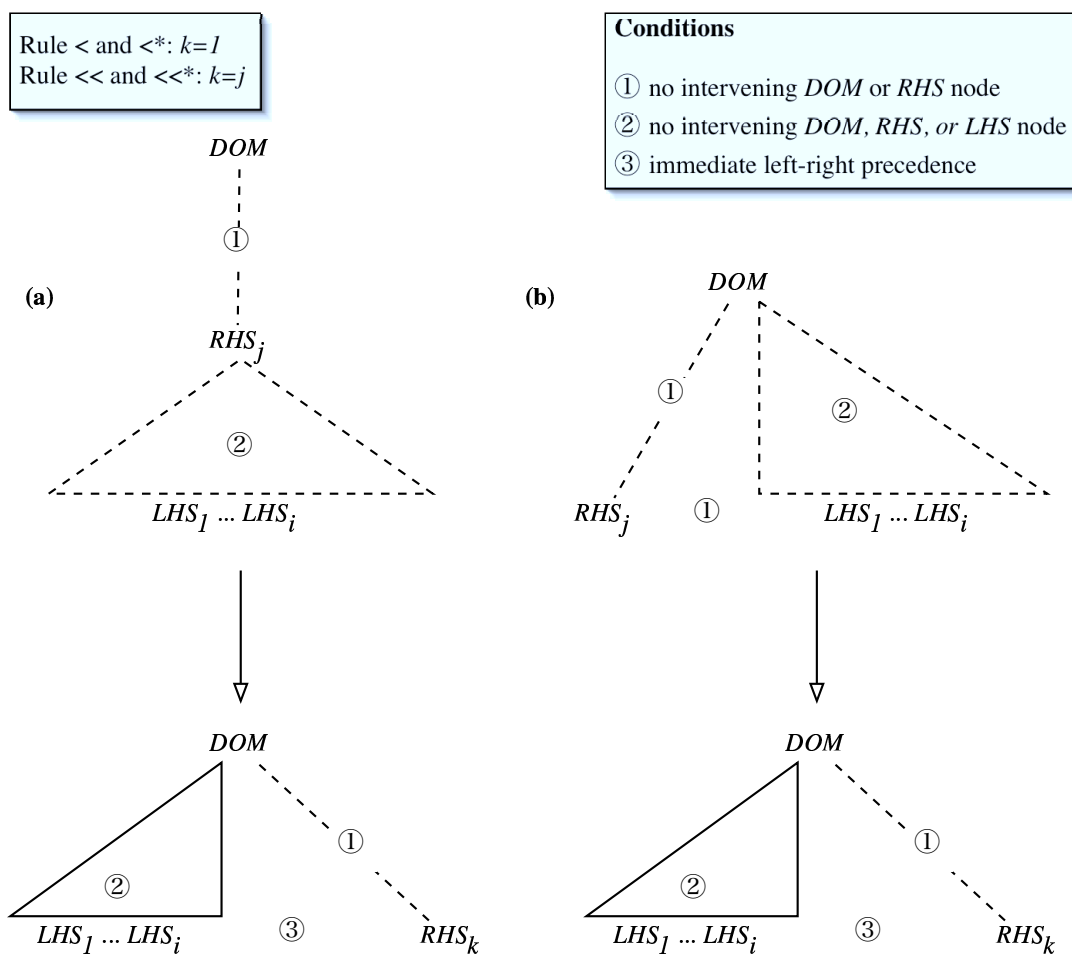
Figure C.2: Tree rewrite rules (a) Raise Left and (b) Shift Left..

- $scm(e)$ takes an expression and returns its list of schemes

- $first(E)$ and $last(E)$ return the first and the last position of a list respectively, $nth(E, n)$ returns the element at position n in E

Function $Synsem$. *Comment: This is the main function that rewrites a tree into a set of possibly nested IML expressions. First, local tags are indexed to the nearest matching tag, then global tags are indexed to the previous matching tag, then the tree is rewritten according to the rules, global indices are adjusted again since they might have moved, and the flattened result is composed according to left/right/local matchers. The result is a set of lists of IML expressions whose schemes may possibly contain other IML expressions. The final step of recursively extracting the list of possibly nested target language schemes out of each of those lists is omitted, since it is trivial.*

Take a derivation tree ϕ and a list of rules R, return a set of lists of target language schemes. The derivation tree must be a tree that contains a list of tags at some nodes and some target language schemes at some lexical nodes.

> **Case 1:** Each lexical node has only one or zero target language schemes. The result of processing the input tree ϕ given a list R is then the following set, where nil is the empty list.

$$\{\psi' \mid \psi' = Compose(Flatten(GlobalBind(\psi), nil))),$$
$$\text{where } \psi \in Rewrite(\{GlobalBind(LocalBind(\phi))\}, R)\} \qquad \text{(C.2)}$$

> **Case 2:** Some lexical nodes of the input trees contain more than one target language scheme (semantical ambiguity). Then the result set has to be computed like in Case 1 for all trees resulting from different combinations of target language schemes at lexical nodes, where only one target language scheme is chosen at a time at each lexical node.

Function $Rewrite$. *Comment: Processes all trees in the input set and combines the result in a flat set.*

Take a set of trees Γ and a list of rules R, return the following set of trees:

$$\bigcup_{\phi \in \Gamma} RewriteTree(\phi, R) \qquad \text{(C.3)}$$

Function $RewriteTree$. *Comment: If a tag at a node n is a domain of a rule, then the rule is applied to the trees that are the result of processing all the child trees of n, and respectively new trees are constructed out of these results with n as the parent node. The tree is processed bottom-up, first applying the rules with domains matching at lower nodes before applying those matching at higher nodes, where the results at each level are combined into new trees.*

Take a tree ϕ and a list of rules R, return a set of trees. Start with root node of ϕ.

with node n in ϕ:

> **let** Γ be the set of trees obtained by combining all the results in $Rewrite(\{m_1\}, R)$, $\ldots$, $Rewrite(\{m_i\}, R)$ for the child subtrees $m_1, \ldots, m_i$ of n into new trees with n as root.
>
> **let** R' be the rules in R whose domain specification matches some tags at n.
>
> **if** R' is empty, then **return** Γ
>
> **else return** the set $ApplyRules(\Gamma, R')$.

Function $ApplyRule$. *Comment: Applies $Reorder$ to all trees in the set of input trees. $Reorder$ yields a singleton in case of a non-permuting rule and may contain several trees in case of a permuting rule.*

Take a set of trees Γ and a rule, return the following set of trees:

$$\bigcup_{\phi \in \Gamma} Reorder(\phi, r) \tag{C.4}$$

Hereby, $Reorder(\phi, r)$ is the set of trees obtained by rewriting ϕ by the rule r according to the rewriting steps in Figure C.2 and described above.

Function $ApplyRules$. *Comment: Applies each rule in the input list once from left to right, so rule order matters.*

Take a set of trees Γ and a list of rules R, return a set of trees as follows:

$$ApplyRules(\Gamma, R) = \begin{cases} \Gamma \text{ if } R = nil \text{ (or signal an error)}, \\ ApplyRule(\Gamma, r_1) \text{ if } R = [r_1], \\ ApplyRule(ApplyRule(\Gamma, r_{i-1}), r_i) \text{ if } R = [r_1 \ldots r_n], \\ \text{for } 2 \leq i \leq n \end{cases} \tag{C.5}$$

Function $LocalBind$. *Preorder traverses the tree and destructively modifies tags, such that each local a-tag gets the index of the b-tag that is nearest in the tree. A-tags correspond to variables not yet bound, whereas b-tags correspond to variables introduced and bound by a binder target language scheme.*

Take a tree ϕ, return a tree. Let there be two storages A and B that stores pairs of tags and integers with the tag as key. Let c be an integer counter.

> **with** node n in ϕ from top to down, left to right:
>
> > **let** $c := c + 1$
> >
> > **for each** local tag t at n that doesn't have an index yet:
> >
> > > **if** t is a b-tag, then give it a new, unique index and put $\langle t, c \rangle$ into B

     else put $\langle t, c \rangle$ into A

  for each $\langle a, n \rangle \in A$:

    if there is a pair $\langle b, m \rangle \in B$ such that a matches b and $\min_{\langle b,m \rangle \in B} |n - m|$, then

      set the index of a to the index of b

    else do nothing

Function $GlobalBind$.   *Comment: Gives each a-tag the index of the last preceding matching b-tag if available. Destructively modifies the tags.*

Take a tree ϕ, return a tree. Let B be a storage for tags that allows one to retrieve the latest tag t_1 (last in, first out) given some tag t_2 that matches t_1. Preorder traverse the tree and modify tags as follows:

  with node n in ϕ from top to down, left to right:

    for each global tag t at n:

      if t is a b-tag, then give t a new, unique index and store t in B

      else if B contains a tag t' such that t matches t', then give t the index of t',

        else do nothing.

Function $Flatten$.   *Comment: Merges all tags at higher nodes into the list of tags of target language schemes dominated by the higher nodes and flattens the tree (not optimized), returning a list of IML expressions.*

Take a tree ϕ and a list of tags T, return a list E of IML expressions. Preorder traverse the tree and collect the result as follows, where $\oplus$ is list concatenation.

  with current node n:

    let $T' := T \oplus tags(n)$

    if n is terminal, then **return** the list $[[T' \, S]]$, where S is the lexical schemes at n

    else return $Flatten(m_1, T') \oplus \cdots \oplus Flatten(m_i, T')$, for all children $m_1, \ldots, m_i$

      of n

Function $Substitute$.   *Comment: A helper function that replaces all instances of a matcher that occur in the schemes of an expression e by an expression e', where the sort of the matcher is taken into account.*

Take an expression e, an expression e', a matcher m, and return an expression.

  let S' be the list of schemes obtained from $scm(e)$ by replacing m and all occurrences

    of (Case 1) $\backslash i$ if m is a left matcher, (Case 2) $/i$ if m is a right matcher, and (Case

    3) $:i$ if m is a local matcher, by e', where $i = num(m)$

  return the expression $[tags(e) \, S']$

Function $Match$. *Comment: Destructively modifies a list of expressions E, if applicable, by going through the list from left to right, finding expressions to the left, right, or nearest that match a matcher at the given position, and replacing the matchee with the matching expression. For simplicity, deleting matchers mark a position as deleted and it is assumed that this marking is done internally and ignored by other list processing functions than the ones used here.*

Take a list of expressions E and return a boolean value. Side effect: Destructively modify E as follows.

> **let** flag:=false
>
> **for** $i := i + 1$ from position $first(E)$ to position $last(E)$:
>
> > **if** there is an expression e in E at position i, then
> >
> > > **let** M be the list of matchers $m_1, \ldots, m_k$ in $scm(e)$ sorted by their marker in ascending order
> > >
> > > **for each** matcher m in M from left to right:
> > >
> > > > **if** m is a matcher with specification, then
> > > >
> > > > > **let** k be the position of the next e' in E such that $spec(m)$ matches e' (Case 1) to the left if m is a left matcher, (Case 2) to the right if m is a right matcher, or (Case 3) nearest either to the right or to the left if m is a local matcher; -1 if no match was found.
> > > >
> > > > **else** m is a plain matcher without specification, so
> > > >
> > > > > **if** m is a left matcher, then **let** k be the position of the next item to the left that is not $deleted$, -1 if there is none
> > > > >
> > > > > **else let** k be the position of the next item to the right that is not $deleted$, -1 if there is none
> > > >
> > > > **if** $k > -1$ then
> > > >
> > > > > **let** $flag := true$
> > > > >
> > > > > **let** E be modified such that e at i is substituted by $Substitute(e, nth(E, k), m)$
> > > > >
> > > > > **if** m is a deleting matcher, then mark position k in E as $deleted$, **else** do nothing (non-deleting matcher)
> > > >
> > > > **else** do nothing or signal an error (no match was found, but there was a matcher requiring one)
> >
> > **else** do nothing (the position has already been marked for deletion)
>
> **return** $flag$

Function $FinalReplace$. *Comment: This function replaces markers in the target language schemes that are just an integer number with the respective tag that has the same substitution index. This is done, because for simplicity some tag names are used as target language variable names.*

Take a list of expressions E, return a list of expressions.

let $R := nil$

for each e in E

    let e' be the expression $[tags(e)\, s']$, where s' is the list of schemes that is like $scm(e)$, except that each simple marker n has been replaced by the substitution tag in $tags(e)$ with substitution index n and each expression e'' in it has been replaced by $FinalReplace(e'')$

    let $E' := E' \oplus [e']$

return E'

Function $Compose$.   *Comment: Substitutes matchers for the respective matching expressions, until no more substitutions are applicable, and finally replaces substitution markers by the respective tags with the same substitution index.*

Take a list of expressions E, return a list of expressions.

    let E' be a copy of E

    loop while $Match(E') = true$

    return $FinalReplace(E')$

V. Examples

The following examples below are devised for demonstrating how the machinery works, not as examples of an adequate part of a syntax–semantics interface for English. The rules used below are chosen ad hoc, and, although they should be fairly compatible with contemporary syntactic theory, no claim about the adequacy of the derivation trees is made either. For clarity, the results will sometimes be given as lists of target language schemes already extracted from the IML expressions.

Example 1.   The following list of rules is used.

```
(R1)     S:             NP  << VP        ; simple SVO rule
(R2)     S:             SOP << S         ; operator rule
(R3)     S:             NP  <  DCOMP1    ; de dicto rule
```

(C.6) Alice believes that it was necessary that Bob loved Carol.

Figures C.3–C.5 depict the tree transformations and initial binding steps.
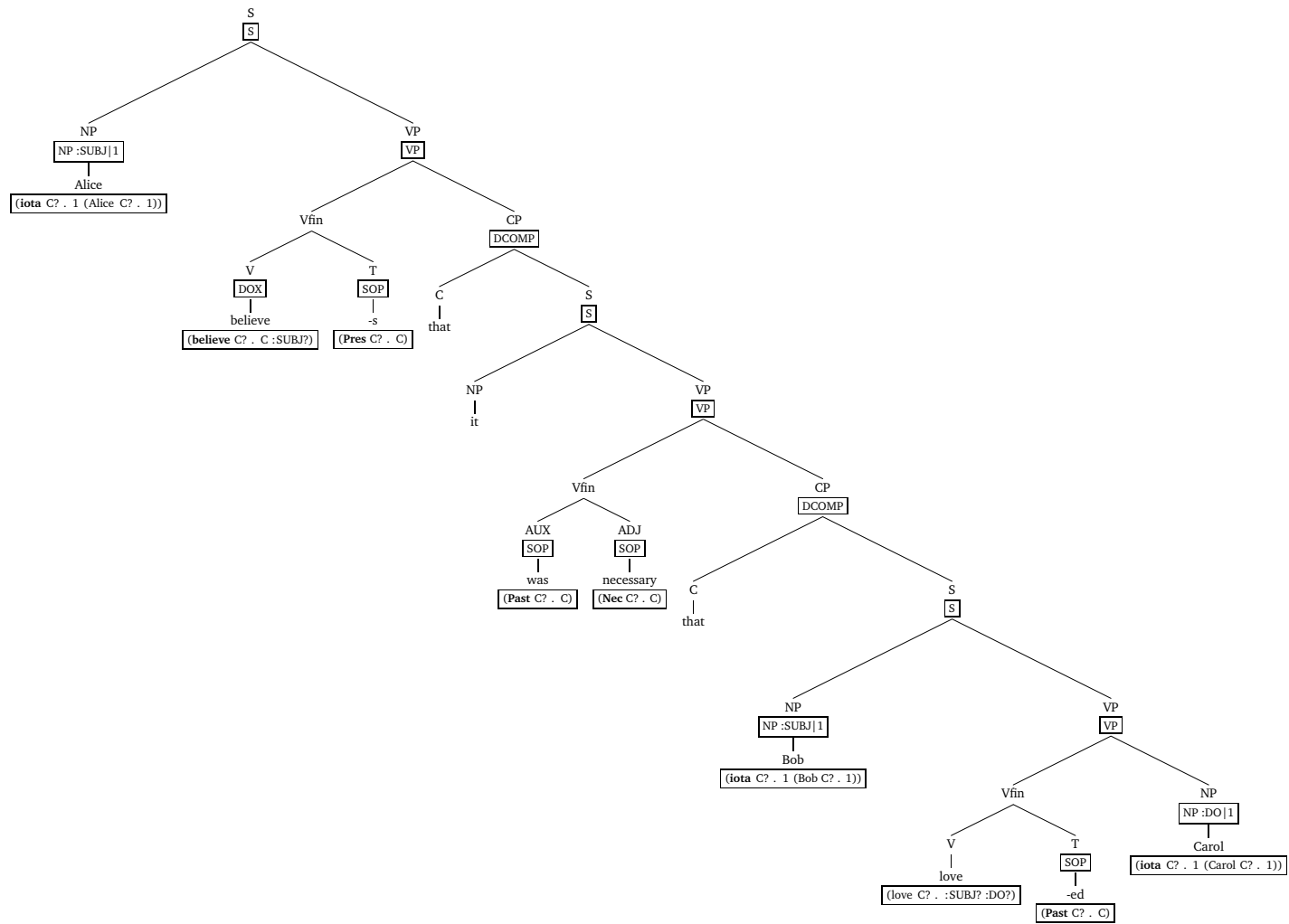
Figure C.3: Input derivation tree.
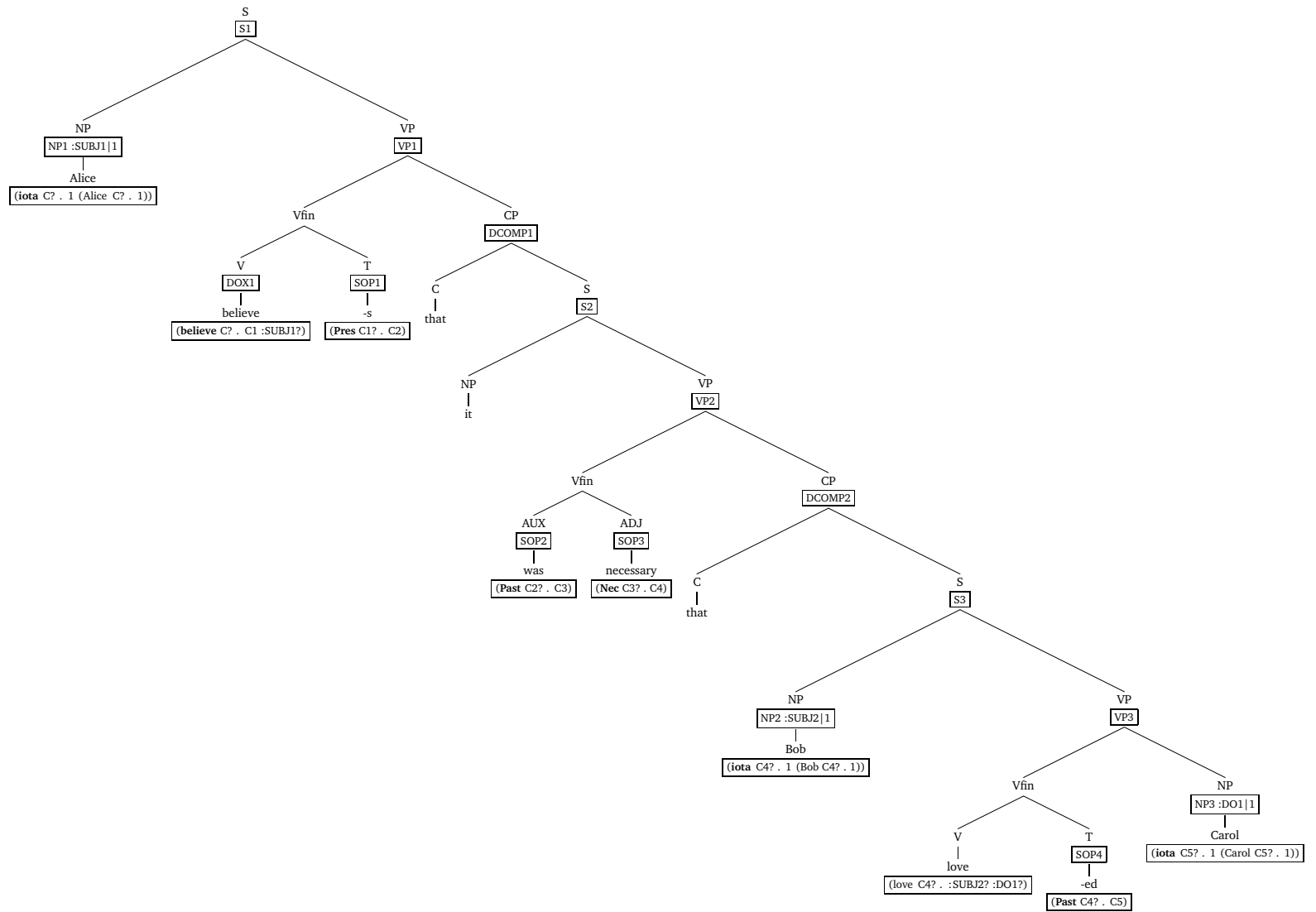
Figure C.4: Input derivation tree after local and first global binding.
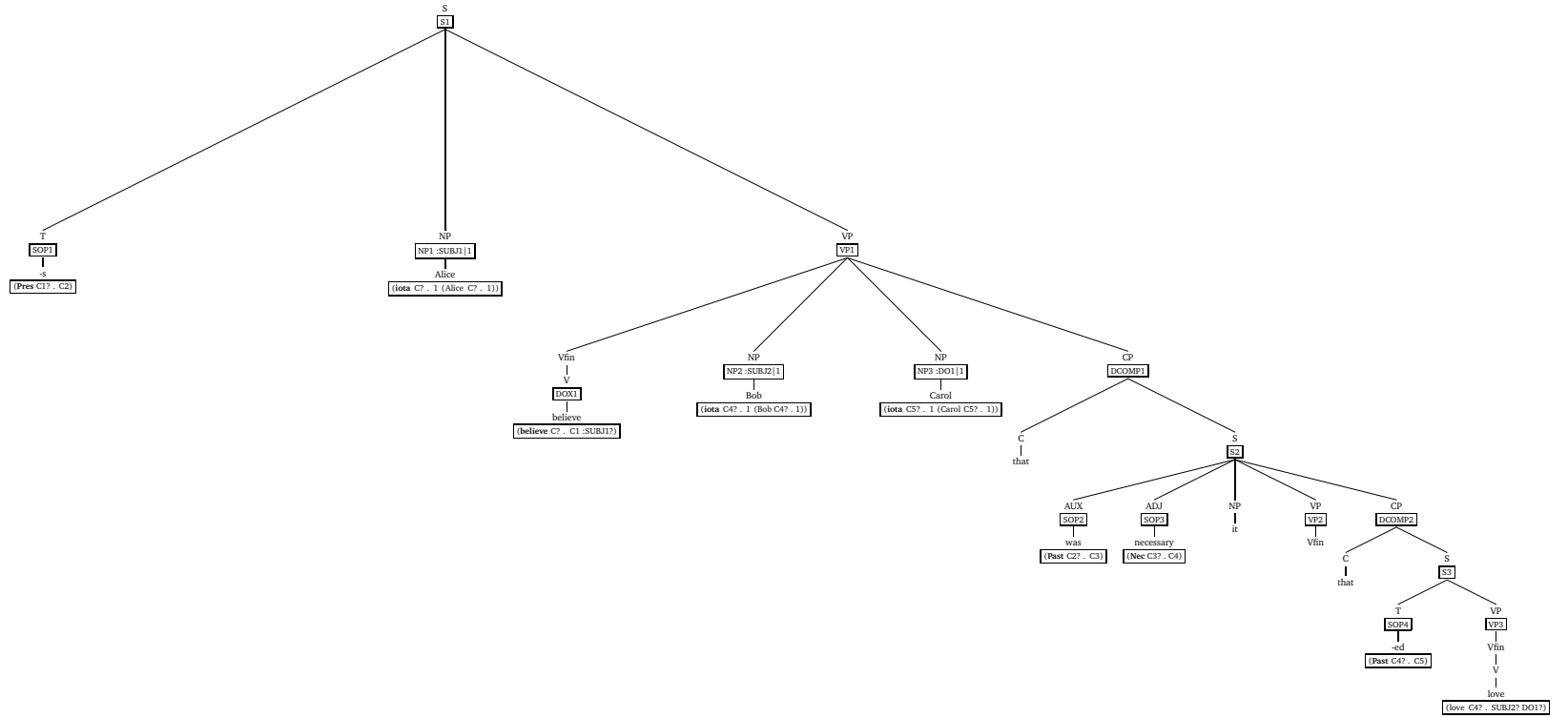
Figure C.5: The only solution tree after rewriting and before second global binding.

In the final flattening and global binding step the free global variables are simply rebound to their direct antecedent. The final result will be a singleton set containing a list of expressions with the following schemes:

```
(Pres  C?  .  C1)
(iota  C1?  .  :SUBJ1  (Alice  C1?  .  :SUBJ1))
(believe  C1?  .  C2  :SUBJ1?)
(iota  C2?  .  :SUBJ2  (Bob  C2?  .  :SUBJ2))
(iota  C2?  .  :DO1  (Carol  C2?  .  :DO1))
(Past  C2?  .  C3)
(Nec  C3?  .  C4)
(Past  C4?  .  C5)
(love  C5?  .  :SUBJ2?  :DO1?)
```

Example 2. Rules R1 and R2 are used, but instead of R3 the following de re rule is taken:

(R4)   S: NP < DOX   ; *de re rule*

For example C.6 with derivation tree C.3 the algorithm will compute the following single list of schemes extracted from the singleton solution set:

```
(Pres  C?  .  C1)
(iota  C1?  .  :SUBJ1  (Alice  C1?  .  :SUBJ1))
(iota  C1?  .  :SUBJ2  (Bob  C1?  .  :SUBJ2))
(iota  C1?  .  :DO1  (Carol  C1?  .  :DO1))
(believe  C1?  .  C2  :SUBJ1?)
(Past  C2?  .  C3)
(Nec  C3?  .  C4)
(Past  C4?  .  C5)
(love  C5?  .  :SUBJ2?  :DO1?)
```

Example 3.

(C.7) Ich glaube, dass ich jetzt allen Seemännern hier ein Bier kaufe.
      'I believe that I buy every sailor here a beer now.'

The following auxiliary definition is used:

```
(BeerUnit CVAR  .  DVAR)
      :=        (exists  CVAR  .  DVAR)
                (Container  CVAR  .  DVAR)
                (forall  CVAR  .  X)
                (implies  (contain  CVAR  .  DVAR)
                          (Beer  CVAR  .  X))
```

Figure C.6 shows the input derivation tree with semantic schemes from the lexicon and the respective tags from the syntax. The following rules are used, which are a bit more fine-grained than the previous ones:

```
(R1')    S:        NQ      <<    VP      ; SVO rule, non−quantifier NP
(R2')    S:        Q       <<*   VP      ; SVO rule, quantifier NP
(R3')    S:        SMOD    <<    S       ; sentential modifier rule
(R4')    S:        TEMP    <<    S       ; tense rule
```

These yield the following solution.

```
(Pres C? . C1)
(iota C1? . :SUBJ1 (Speaker C1? . :SUBJ1))
(believe C1? . C2 :SUBJ1?)
(Pres C2? . C3)
(Here C3? . C4)
(Jetzt C4? . C5)
(iota C5? . :SUBJ2 (Speaker C5? . :SUBJ2))
(all C5? . :IO1 (sailor C5? . :IO1))
(exists C5? . :DO1)
(BeerUnit C5? . :DO1)
(buy3 C5? . :SUBJ2? :DO1? :IO1?)
```

Another solution is this one:

```
(Pres C? . C1)
(iota C1? . SUBJ1 (Speaker C1? . :SUBJ1))
(believe C1? . C2 :SUBJ1?)
(Pres C2? . C3)
(Here C3? . C4)
(Jetzt C4? . C5)
(iota C5? . :SUBJ2 (Speaker C5? . :SUBJ2))
(exists C5? . :DO1)
(BeerUnit C5? . :DO1)
(all C5? . :IO1 (sailor C5? . :IO1))
(buy3 C5? . :SUBJ2? :DO1? :IO1?)
```

The former solution is presumably preferred by the sailors.

```
                                    S
                                   ┌─┐
                                   │S│
                                   └─┘
                    ┌────────────────────────────┐
                   NP                             VP
              ┌──────────────┐                  ┌──┐
              │NP NQ :SUBJ|1 │                  │VP│
              └──────────────┘                  └──┘
                    │                 ┌──────────────────┐
                   Ich               Vfin                CP
        ┌────────────────────────┐ ┌─────────┐        ┌──────┐
        │(iota C? . 1 (Speaker C? . 1))│ │         │        │DCOMP │
        └────────────────────────┘      V        T  └──────┘
                                   ┌─────┐  ┌────┐  ┌───────────┐
                                   │DOX  │  │TEMP│   C           S
                                   └─────┘  └────┘   │          ┌─┐
                                      │        │    dass        │S│
                                   glaube   ┌─────────┐         └─┘
                              ┌────────────┐│(Pres C? . C)│
                              │(believe C? . C :SUBJ?)│
                              └────────────┘
```
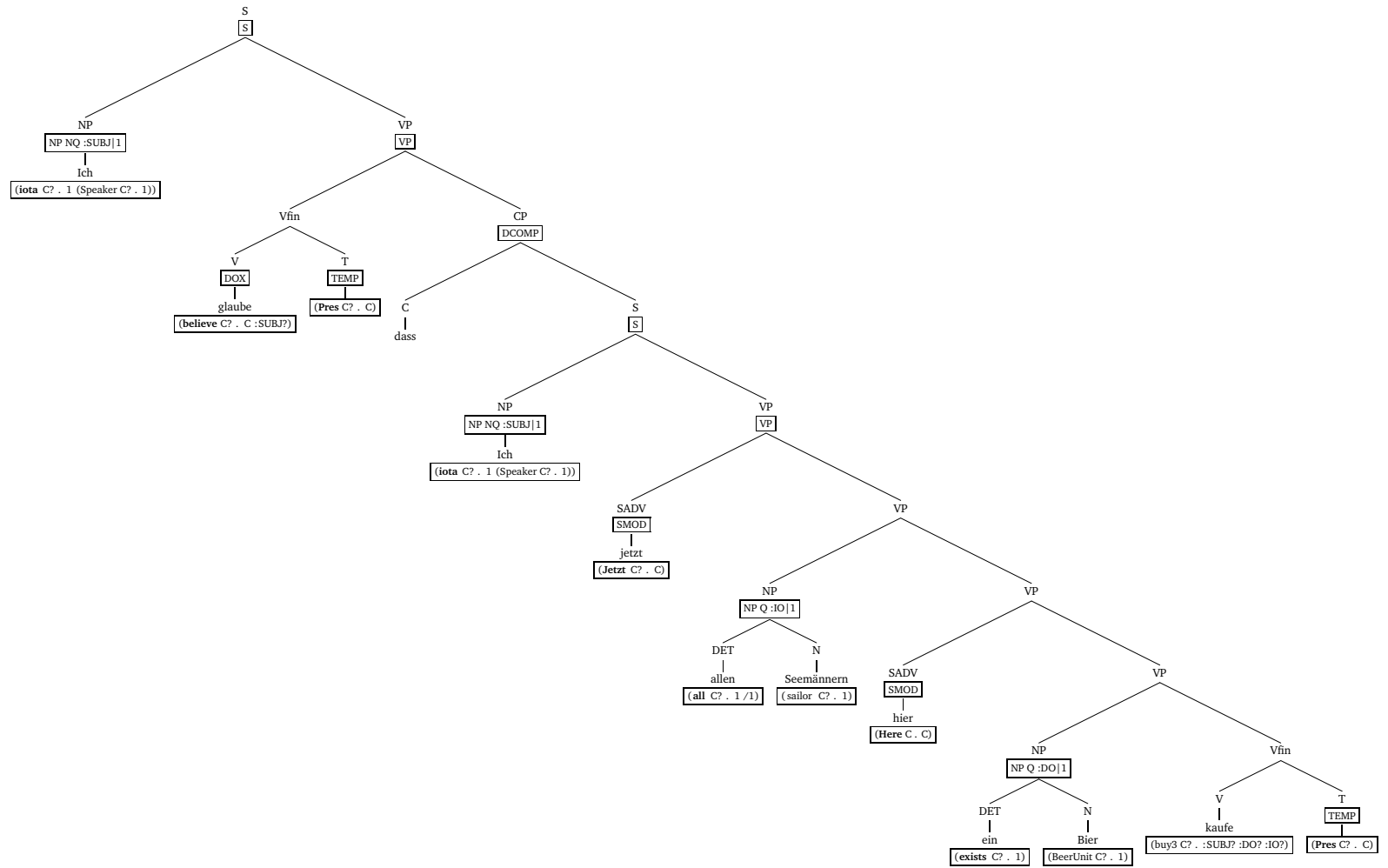
Figure C.6: Input derivation tree for example C.7.
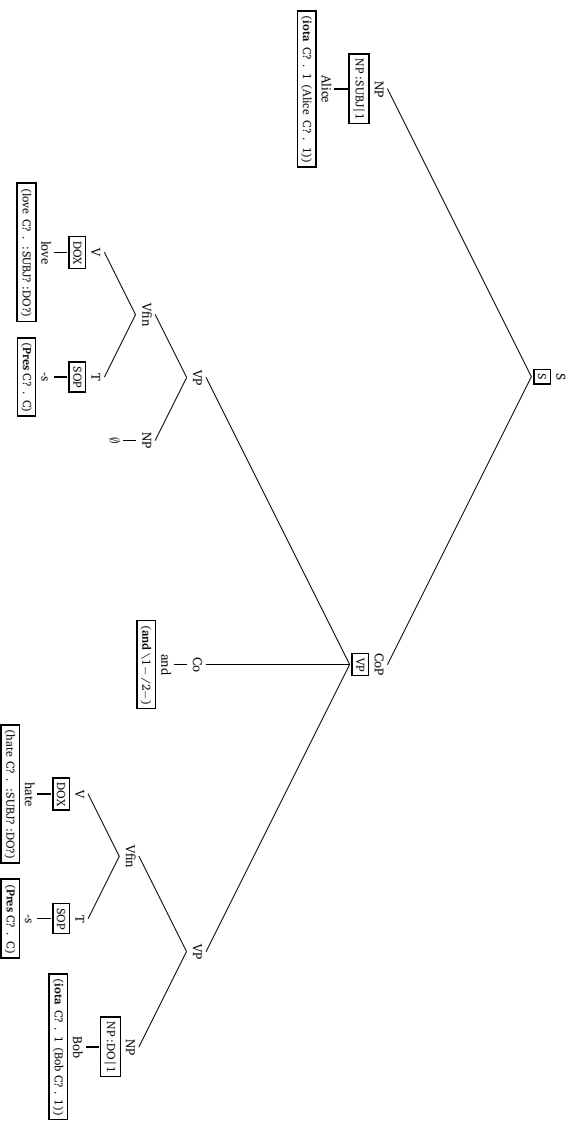
Figure C.7: Input derivation tree for example C.8.

Example 4.

(C.8) Alice loves and hates Bob.

Ordinary VP-coordination works in FOLC out of the box. Rules used are R1 and R2. The analysis is more or less independent of the actual syntactic analysis of coordination; the *Synsem* mapping would apply the same way to practically any alternative constituent structure one may assume under the hood for the coordinative structure, as long as the VP tag is passed up from the coordinated VPs. Moving the tense operators uniformly in front is a crude simplification, though, as some combinations of tenses are admitted in VP-coordinate structures. Here is the result of rewriting the input tree in Figure C.7 by R1 and R2.

```
(Pres  C1)
(Pres  C1  .  C2)
(iota  C2  .  :SUBJ1  (Alice  C2  .  SUBJ1))
(iota  C2  .  :DO1  (Bob  C2  .  :DO1))
(and   (love  C2  .  :SUBJ1?  :DO1?)
       (hate  C2  .  :SUBJ1?  :DO1?))
```

Example 5.

(C.9) Alice loves Bob. He loves her, too.

Rules used are R1 and R2, and only the last steps of the linear case are considered.

```
[(SOP) (Pres C1)]
[(NP SG FEM :SUBJ1|1) (iota C1? . 1 (Alice C1? . 1))]
[(NP SG MASK :DO1|1) (iota C1? . 1 (Bob C1? . 1))]
[(VP) (love C1? . :SUBJ1 :DO1)]
[(SOP) (Pres C1 C2)]
[(NP :SUBJ2|1) \1=(and NP SG MASK)]
[(NP :DO2|1) \1=(and NP SG FEM)]
[(VP) (love C1? . :SUBJ2 :DO2)]
```

This yields the following result.

```
[(SOP) (Pres C1)]
[(NP SG FEM :SUBJ1|1) (iota C1? . 1 (Alice C1? . 1))]
[(NP SG MASK :DO1|1) (iota C1? . 1 (Bob C1? . 1))]
[(VP) (love C1? . :SUBJ1 :DO1)]
[(SOP) (Pres C1 C2)]
[(NP :SUBJ2|1) (iota C1? . 1 (Alice C1? . 1))]
[(NP :DO2|1) (iota C1? . 1 (Bob C1? . 1))]
[(VP) (love C1? . :SUBJ2 :DO2)]
```

VI. Comments

1. Parts of *Synsem* have been formulated as destructive algorithms. Purely functional, non-destructive versions would be more desirable.

2. Permutations don't have to be computed in memory. They can be computed on demand and implemented efficiently, for example by using lazy streams or generators as data structures. A more advanced version would implement ways to sort the permuted results according to heuristics for getting preferred readings first. Dealing with semantic ambiguities ought to be extended to take into account heuristics for getting preferred readings first, too.

3. If it can be shown for some source language and some set of rules that the global binding mechanism outlined above is generally adequate, then all binders of context variables in the target language could alternatively be implemented as modal operators. Yet it seems likely that more complicated binding mechanisms are needed.

4. For a more realistic treatment of normal (non-E-type) pronouns replacements for all combinations of matching matchers instead of just the nearest ones need to be computed. If there is more than one matching antecedent or subsequent, anaphora resolution heuristics come into play that require ordering of possible results by a ranking.

5. Assuming rich enough sets of tags and rules, all expressions of the source language may be reordered in any conceivable way. The goal is, however, to find a general and minimum set of rules and tags for a given source language and a given target language that transforms derivation trees into adequate target language expressions by using as much of the already available syntactic structure as feasible.

6. The above interface is not meant as a full-fledged solution, but only as a suggestion. Apart from actually implementing it, some future research is needed to deal with more complicated structures. For example, an NP-modifying relative clause cannot be dealt with easily in the given framework, because there's no simple means to put the whole semantics of a relative clause into the NP's quantifier restriction. This limitation shows that there is also a need for semantic construction mechanisms that operate already at derivation tree-level, i.e. there is a need for more complex tree rewriting steps.

Index

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