

# ‘You’ and ‘I’ in modal logic

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## Abstract

The article discusses the interpretation of indexicals within the framework of quantified modal logic. The dominant theory on this topic is Kaplan’s two-dimensional analysis. Since its appearance in 1977, Kaplan’s analysis has been challenged on various grounds. I will argue that by revising the way of modelling the objects we refer to in conversation, we can account for counterexamples to Kaplan’s theory, while maintaining Kaplan’s basic insights concerning the meaning of ‘you’ and ‘I’.

**Keywords:** Indexical expressions, two-dimensional semantics, rigid designators, deferred reference, methods of identifications.

## 1 Introduction

### 1.1 Basic properties of indexicals

Our primary intuition concerning indexical expressions like ‘you’ and ‘I’ is that their interpretation is relative to the context of use. Distinct occurrences of indexicals may have distinct referents in distinct contexts. ‘I’ refers to the speaker in the context of utterance, ‘today’ refers to the day in the context of utterance, so (1) can mean (1-a), if used by David Kaplan on 26 March 1977; or (1-b), if used by Maria Aloni on 27 April 2016.

- (1) I am tired today.
  - a. David Kaplan is tired on 26 March 1977.
  - b. Maria Aloni is tired on 27 April 2016.

A second property of indexicals is that they typically occur in contingent *a priori* statements. Kripke (1972) argued that *necessary* and *a priori* are distinct notions. Kaplan (1989) showed that by using indexicals we can give compelling examples of truths where these notions do not coincide. A statement like (2) is contingent, I could have been somewhere else, but at the same time it is *a priori*, no empirical investigation is needed to attest its truth.

- (2) I am here today.

A third alleged property of indexicals, which will be subject to scrutiny in this article, is that they appear to be insensitive to intensional operators. One classical example illustrating this property is (3) from Kaplan (1989, p. 199):

- (3) It is possible that in Pakistan, in five years, only those who are actually here now are envied.

Kaplan observed that the indexicals ‘actually’, ‘here’ and ‘now’ are naturally interpreted with respect to the actual utterance situation despite the presence of the shifting modal, spatial and temporal operators.<sup>1</sup>

An effective way to illustrate the property Kaplan had in mind is by contrasting indexicals with definite descriptions. An example like (4) is typically ambiguous between the readings paraphrased in (4-a) and (4-b).

- (4) The president of the US could have been a Republican.
- a. Barack Obama could have been a Republican  
*De re*:  $\exists x[x = \textit{the president} \wedge \Diamond Rx]$
  - b. A Republican (Romney) could have won the last elections  
*De dicto*:  $\Diamond \exists x[x = \textit{the president} \wedge Rx]$

Modal logic provides us with a perspicuous way to represent this ambiguity. Reading (4-a) is captured by a *de re* representation with the definite description ‘the president’ occurring outside of the scope of the modal operator, while reading (4-b) is captured by a *de dicto* representation with ‘the president’ occurring within the scope of the possibility operator. Two comments are at place at this point. First, throughout the paper I will refer to the *de re/de dicto* distinction as a syntactic distinction rather than a metaphysical one. Secondly, definite descriptions will be left unanalysed until section 4. Nothing I am going to say in this article hinges on which particular analysis of definite descriptions is assumed.

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<sup>1</sup>Potential counterexamples to this specific claim, however, have been recently presented in the linguistic literature, e.g. Hunter (2013), who provides a number of examples of anaphoric uses of the expressions ‘actually’, ‘here’ and ‘now’, where these words are interpreted with respect to the context created by the preceding discourse, rather than the actual utterance situation. As an illustration consider the following:

- (i) And what would terrify the right, of course, is the likelihood that genuine socialized medicine would **actually** win that competition.
- (ii) All over England folk began to hear of the wonderful saint who lived alone in the desert island, [...] He built a house by the landing-place on the island for his visitors to stay in, and **here**, too, his monks would come on festivals to have a talk with him.
- (iii) Brutally, the banks knowingly gamed the system to grow their balance sheets ever faster and with even less capital underpinning them in the full knowledge that everything rested on the bogus claim that their lending was **now** much less risky.

I will not discuss anaphoric uses of indexicals in this article though and, therefore, to avoid possible ambiguity, in what follows I will exclusively focus on ‘you’ and ‘I’, which arguably don’t have such anaphoric uses.

Now contrast (4) with (5) where an indexical rather than a definite is used. It is often observed that (5) is not ambiguous in the same way as (4) is. The most plausible candidate for a *de dicto* reading for (5) is (5-b), but such a reading does not seem to be available for these cases.

- (5) I could have been a Republican. (used by Barack Obama)  
 a. Barack Obama could have been a Republican  
 b. #A Republican could have been speaking

There is one strategy to account for these facts which Kaplan mentions, but quickly dismisses. We could assume that indexicals are descriptions of a special kind, namely the kind that always has primary scope in the sense of Russell (1905).

This strategy is illustrated in (6). ‘I’ is translated as *the speaker*, but with the assumption of an additional mechanism that prevents the *de dicto* representation (6-b) to be generated:

- (6) I could have been a Republican. (used by Obama)  
 ‘Obama could have been a Republican’  
 a. *De re*:  $\exists x[x = \textit{the speaker} \wedge \Diamond Rx]$   
 b. #*De dicto*:  $\Diamond \exists x[x = \textit{the speaker} \wedge Rx]$

Such a strategy has been recently implemented within DRT where indexicals have been analysed as presupposition triggers (like definites) with a preference for global resolution rather than local resolution (e.g. Zeevat, 1999; Hunter and Asher, 2005).

There is however a problem for this strategy discussed by Maier (2009) echoing Kripke. Consider the two sentences in (7):

- (7) a. The speaker is speaking. [necessary]  
 b. I am speaking. [contingent]  
 c.  $\exists x[x = \textit{the speaker} \wedge Sx]$

While (7-a) is necessary truth, (7-b), although a priori, is merely contingent. An analysis which characterises the distinction between ‘I’ and ‘the speaker’ exclusively in terms of scope has no way to distinguish between the two sentences: since there is no scoping operator, they are both represented as (7-c).

Kaplan’s own strategy to deal with these facts is his celebrated two-dimensional analysis. The next section presents one way of implementing Kaplan’s strategy in the framework of quantified modal logic.

## 1.2 A Kaplanian two-dimensional analysis ( $2D_K$ )

In a two-dimensional semantics expressions are interpreted with respect to two parameters: a context  $c$  and a world of evaluation  $w$ . Assuming a language of quantified modal logic  $\mathcal{L}$  (with two special terms *you* and *I*) and a standard Kripke model  $M = \langle W, R, D, I \rangle$  for  $\mathcal{L}$ , a context based on  $M$  is a tuple consisting

of the actual speaker of the utterance, the actual addressee, the actual world and possibly more.

**Definition 1 (Contexts in  $2D_K$ )** Given a model  $M = \langle W, R, D, I \rangle$ , a context  $c$  based on  $M$  is a tuple  $\langle s_c, a_c, \dots, w_c \rangle$ , where

- (i)  $s_c, a_c \in D$  and  $w_c \in W$ ;
- (ii)  $s_c = \llbracket \textit{the speaker} \rrbracket_{M,c,w_c,g}$  and  $a_c = \llbracket \textit{the addressee} \rrbracket_{M,c,w_c,g}$ .

The expression  $\llbracket \alpha \rrbracket_{M,c,w,g}$  denotes the semantic value of  $\alpha$  when used in context  $c$  and evaluated with respect to world  $w$  (and assignment  $g$ ). While the interpretation of non-indexical expressions is stable from context to context, the interpretation of indexicals can vary relative to the context parameter: ‘I’ refers to  $s_c$ , the speaker in context  $c$ , ‘you’ to  $a_c$ , the addressee in  $c$ , as in the following definition:<sup>2</sup>

**Definition 2 (Indexicals in  $2D_K$ )**

$$\begin{aligned} \llbracket I \rrbracket_{M,c,w,g} &= s_c && (\textit{the speaker in } c) \\ \llbracket \textit{you} \rrbracket_{M,c,w,g} &= a_c && (\textit{the addressee in } c) \end{aligned}$$

As it is easy to see, this analysis gives us a ready account of the basic properties of indexicals (their context dependence and their appearance in contingent a priori statements), but it also provides an explanation of the fact that indexicals do not give rise to genuine *de re-de dicto* ambiguities. This is illustrated in (8).

- (8) I could have been a Republican. (used by Obama)  
‘Obama himself could have been a Republican’
  - a. *De re*:  $\exists x[x = I \wedge \Diamond Rx]$
  - b. *De dicto*:  $\Diamond \exists x[x = I \wedge Rx]$

Since indexical  $I$  is interpreted on the basis of the context parameter, its semantic value remains stable even though we shift from one world to the other, so both logical representations (8-a) and (8-b) express the same meaning. This prediction of Kaplan’s analysis relies on at least three assumptions:

1. Modals cannot shift the context parameter;
2. Indexicals are directly referential and, therefore, rigid designators;
3. Variables are rigid designators (‘the paradigm of direct reference’).

Assumptions 1 and 2 are essential otherwise the *de dicto* representation in (8-b) would possibly generate other readings. Assumption 3 is essential otherwise the *de re* representation in (8-a) would possibly generate other readings.

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<sup>2</sup>See Appendix for a full characterisation of system  $2D_K$ .

I won't further discuss assumption 1. If we confine ourselves to English, our data are compatible with the assumption that modals cannot manipulate the context parameter (see however Schlenker, 2003; Anand, 2006; Maier, 2009, for challenges to assumption 1 based on cross-linguistic data). I will challenge, however, assumptions 2 and 3: I will argue against a treatment of indexicals and variables as rigid designators. Kaplan talks about direct reference, I will talk about rigidity, which is a technical modal logic notion. I will argue that Kaplan's main intuition about the genuinely referential nature of indexicals is not incompatible with a non-rigid account of these expressions, if a number of conditions are satisfied.

Once we drop assumptions 2 and 3, the resulting modal logic will be one which apparently overgenerates with respect to examples like (8): many more readings of the sentence will be predicted than observed. In the last part of the article I propose a pragmatic rather than a logical/semantic account of the interaction between indexicals and modals, which, in terms of general constraints on pragmatic resolutions, will avoid such an overgeneration. The main motivation for a pragmatic account comes from a number of examples of so-called descriptive uses of indexical expressions.

### 1.3 Descriptive uses of indexicals

Consider first the following scenario. In the middle of the presidential campaign, Obama asks his secretary via WhatsApp permission to access confidential documents describing the democratic strategy. His secretary complies with his request, but later, during a security awareness meeting, Obama approaches him:<sup>3</sup>

- (9) Why did you give me access to the files? You should be more careful! I could have been a Republican.

Obama's intended meaning in this case is not (10-a), but rather (10-b).

- (10) I could have been a Republican. (used by Obama)  
 a. Obama himself could have been a Republican  
 b. A Republican could have sent you the WhatsApp message

Reading (10-b), however, is not predicted by a Kaplanian analysis. As we just saw, both representations in (11) generate reading (10-a):

- (11) a. *De re*:  $\exists x[x = I \wedge \Diamond Rx]$   
 b. *De dicto*:  $\Diamond \exists x[x = I \wedge Rx]$

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<sup>3</sup>This example has the same structure of (i) from Hans Kamp as reported in Maier (2009, p. 285):

- (i) Why did you open the door without checking? You should be more careful! I could have been a burglar.

It seems clear that only a pragmatic account can be flexible enough to accommodate these extraordinary cases, while maintaining Kaplan’s basic intuitions with respect to the ordinary cases considered above.

Example (9) has the same structure as the well-known cases of deferred reference discussed by Nunberg (1993).

- (12) *Condemned prisoner*: I am traditionally allowed to order whatever I like for my last meal. [Nunberg 1993, p. 20]

What the speaker intends to say is ‘a condemned prisoner is not allowed to order whatever he likes for his last meal’, but somehow he can use an indexical to convey such descriptive meaning. Again Kaplan’s logical/semantic account of the interaction between indexicals and modals is not flexible enough to account for these cases.

Similarly, a Kaplanian analysis has problems with another class of examples involving indexicals in 3rd person attitude reports. Consider the following scenario:

- (13) *Context*: Miss Jones, the new director of Lorenzo’s school, would assent to ‘Lorenzo’s mother is Spanish’. She further has no idea who Lorenzo’s mother is. Lorenzo’s mother name is Maria. Maria reports to her husband: [Aloni 2001, 2005]

- (14) Miss Jones believes that I am Spanish. [true]

Maria’s intended meaning in this case is not (15-a), but rather (15-b).

- (15) Miss Jones believes that I am Spanish.  
 a. Miss Jones would assent to ‘This individual (pointing at Maria) is Spanish’  
 b. Miss Jones would assent to ‘Lorenzo’s mother is Spanish’

Reading (15-b), however, is again not predicted by the Kaplanian analysis presented above, where both representations in (16) generate reading (15-a):

- (16) a. *De re*:  $\exists x[x = I \wedge \Box Sx]$   
 b. *De dicto*:  $\Box \exists x[x = I \wedge Sx]$

In what follows we will defend an analysis that is flexible enough to account for these cases. On the semantic side, the interpretation of referential expressions (variables, indexicals) will be relativised to contextually selected methods of identification. If a perceptually-based method of identification is contextually operative, both representations in (16) will express meaning (15-a). If a descriptive method of identification is contextually operative, both representations in (16) can express meaning (15-b). By assuming that perceptually-based methods are the default choice, while descriptive methods can be operative only if certain conditions apply, we derive the descriptive uses of indexicals discussed in this section, but also their extraordinary nature.

The rest of the article is structured as follows: The next section presents first two more arguments against a Kaplanian analysis, which motivate a non-rigid analysis of indexicals, and then considers, but dismisses, a first attempt to model indexicals as non-rigid designators in a classical two-dimensional modal logic. Section 3 motivates Aloni’s (2001) non-classical version of quantified modal logic, as better equipped to model reference in situations of partial information. Section 4 proposes a novel analysis of indexicals within a two-dimensional version of Aloni’s (2001) quantified modal logic, where the interpretation of referential expressions (variables, indexicals) is relativised to contextually selected methods of identification. Section 5 concludes by spelling out the principles governing the contextual selection of a method of identification and provides a pragmatic explanation of the examples of interactions between indexicals and modals discussed above.

## 2 Against rigidity

### 2.1 Motivating examples

In this section we discuss two more examples that can be presented against a Kaplanian analysis, which involve uses of indexicals in situation of partial information. Both examples can be used to justify an analysis of indexicals as non-rigid designators. The first is Richard’s (1983) classical phone booth example:

Consider A – a man stipulated to be intelligent, rational, a competent speaker of English, etc.– who both sees a woman, across the street, in a phone booth, and is speaking to a woman through a phone. He does not realise that the woman to whom he is speaking – B, to give her a name – is the woman he sees. He perceives her to be in some danger – a run-away steamroller, say, is bearing down upon her phone booth. A waves at the woman; he says nothing into the phone. (Richard, 1983, p. 439)

In this situation, A would assent to ‘she is in danger’, but not to ‘you are in danger’, so (17-a) would be true, if used by A, while (17-b) would be false:<sup>4</sup>

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<sup>4</sup>As one reviewer observed, my justification of the falsity of (17-b) employs a (context-relativized) principle of strong disquotation, while (Kripke, 1979, p. 258) has argued that such principle leads to outright contradiction – for example, it allows us to conclude that Pierre believes that London is pretty and that Pierre does not believe that London is pretty in a situation in which Pierre believes that ‘Londres’ and ‘London’ name two different cities, only the former being pretty. First of all, I would like to contest Kripke’s conclusion that strong disquotation leads to contradictory results. The two sentences (i) ‘Pierre believes that London is pretty’ and (ii) ‘Pierre does not believe that London is pretty’ are contradictory in the situation described by Kripke only in theories which fail to recognize that our interpretation of referential expressions depends on the assumed (possibly non-descriptive) method of identification. In the analysis of belief reports defended in Aloni (2005b) (and here in section 4), logical (*de re*) translations of sentences (i) and (ii) can both be true if interpreted with re-

- (17) a. I believe she is in danger. [true]  
 b. I believe you are in danger. [false]

A Kaplanian analysis, which takes both ‘you’ and ‘she’ to refer in a rigid way, doesn’t have a ready way to account for these basic intuitions.

A similar case involving ‘I’ can be constructed adapting a scenario discussed by Santorio (2012). Imagine Rudolf Lingens and Gustav Lauben are amnesiacs: each of them knows that he is one of the two, but doesn’t know which. Both could then truly assert each of the following sentences:

- (18) a. I might be Rudolf Lingens. [true]  
 b. I might be Gustav Lauben. [true]

Again a Kaplanian analysis of indexicals cannot account for these cases (unless one assumes that proper names are non-rigid designators).

Rudolf Lingens, Gustav Lauben and Mister A from Richard’s example are all predicted to have inconsistent beliefs by a Kaplanian analysis. But our three characters are not insane, they just miss some crucial information about the individuals they are referring to via their indexical expressions (like Kripke’s Pierre, they ‘lack information, not logical acumen’, Kripke, 1979, p. 257). Dropping epistemic rigidity for indexicals (and/or proper names) would give us a ready account of these cases. In the following section we investigate what it takes to define a two-dimensional analysis of indexicals that models them as non-rigid designators.

## 2.2 Two-dimensional semantics w/o rigidity: first attempt

Assuming again standard Kripke models  $M = \langle W, R, D, I \rangle$ , a context could be defined as providing *individuating functions* (or individual concepts), rather than objects, as in the following definition where  $\mathbf{s}_c$  and  $\mathbf{a}_c$  are elements of  $D^W$ , rather than  $D$ .

**Definition 3 (Contexts in  $2D_R$ )** *Given a model  $M = \langle W, R, D, I \rangle$ , a context  $c$  based on  $M$  is a tuple  $\langle \mathbf{s}_c, \mathbf{a}_c, \dots, w_c \rangle$  where*

(i)  $\mathbf{s}_c, \mathbf{a}_c \in D^W$ ;

(ii)  $\mathbf{s}_c(w_c) = \llbracket \text{the speaker} \rrbracket_{M,c,w_c,g}$  and  $\mathbf{a}_c(w_c) = \llbracket \text{the addressee} \rrbracket_{M,c,w_c,g}$ .

On this analysis,  $\mathbf{s}_c$  and  $\mathbf{a}_c$  are functions from possible worlds to individuals (clause (i)), which must satisfy the extra condition that *the value* that  $\mathbf{s}_c$  assigns to  $w_c$  is the speaker in  $w_c$  and *the value* that  $\mathbf{a}_c$  assigns to  $w_c$  is the addressee in  $w_c$  (clause (ii)). Thus,  $\mathbf{s}_c(w_c) = \llbracket \text{the speaker} \rrbracket_{M,c,w_c,g}$  and

spec to two different conceptual covers. Secondly, even without strong disquotation, it seems plausible to assume that (17-b) would be false in Richard’s situation. At any rate, there is a clear intuitive contrast between (17-a) and (17-b), which any account of indexicals should be able to capture. The theory presented in section 4 will capture this contrast by predicting that (17-a) and (17-b) can be assigned different truth values in Richard’s situation, if we allow for a shift of method of identification.



- SI**  $t = t' \rightarrow (\phi[t] \rightarrow \phi[t'])$  (substitutivity of identicals)  
**EG**  $\phi[t] \rightarrow \exists x\phi[x]$  (existential generalisation)

In a Kaplanian system ( $2D_K$ ), **SI** and **EG** are validated, if  $t$  and  $t'$  are variables or indexicals, but would be invalidated if  $t$  or  $t'$  would stand for a definite description (let  $\iota yPy$  denote in  $w$  the unique  $P$  in  $w$ , if there is one;  $\emptyset$ , otherwise; see Appendix for the other relevant semantic rules).

- (23)  $\models_{2D_K} y = x \rightarrow (\phi[y] \rightarrow \phi[x])$  (**SI**, variables)  
 $\models_{2D_K} \phi[y] \rightarrow \exists x\phi[x]$  (**EG**, variables)  
(24)  $\models_{2D_K} you/I = x \rightarrow (\phi[you/I] \rightarrow \phi[x])$  (**SI**, indexicals)  
 $\models_{2D_K} \phi[you/I] \rightarrow \exists x\phi[x]$  (**EG**, indexicals)  
(25)  $\not\models_{2D_K} \iota yPy = x \rightarrow (\phi[\iota yPy] \rightarrow \phi[x])$  (**SI**, definites)  
 $\not\models_{2D_K} \phi[\iota yPy] \rightarrow \exists x\phi[x]$  (**EG**, definites)

The intuition formalised by  $2D_K$  is that indexicals like variables are genuinely referential expressions, while definite descriptions aren't. In the system presented in the present section ( $2D_R$ ), in contrast, **SI** and **EG** are validated for variables, but not for indexicals or definite descriptions.<sup>5</sup>

- (26)  $\models_{2D_R} y = x \rightarrow (\phi[y] \rightarrow \phi[x])$  (**SI**, variables)  
 $\models_{2D_R} \phi[y] \rightarrow \exists x\phi[x]$  (**EG**, variables)  
(27)  $\not\models_{2D_R} you/I = x \rightarrow (\phi[you/I] \rightarrow \phi[x])$  (**SI**, indexicals)  
 $\not\models_{2D_R} \phi[you/I] \rightarrow \exists x\phi[x]$  (**EG**, indexicals)  
(28)  $\not\models_{2D_R} \iota yPy = x \rightarrow (\phi[\iota yPy] \rightarrow \phi[x])$  (**SI**, definites)  
 $\not\models_{2D_R} \phi[\iota yPy] \rightarrow \exists x\phi[x]$  (**EG**, definites)

The following tables summarise the relevant facts:

$2D_K$	<b>SI</b>	<b>EG</b>	$2D_R$	<b>SI</b>	<b>EG</b>
variables	<b>yes</b>	<b>yes</b>	variables	<b>yes</b>	<b>yes</b>
indexicals	<b>yes</b>	<b>yes</b>	indexicals	no	no
definites	no	no	definites	no	no

While in a Kaplanian semantics, indexicals are predicted to behave like variables, in  $2D_R$ , they are modelled as definite descriptions. The  $2D_R$  classification, however, blurs the intuitive difference between indexicals and definites illustrated by the first Obama example discussed in the introductory section. While (29) is naturally ambiguous, (30) requires a very specific context to give rise to a descriptive reading:

- (29) The president of the US could have been a Republican.

<sup>5</sup>Aa as attentive reviewer observed, if we assume that indexicals never fail to refer in a context (i.e.  $\iota xSpeaker(x)$  and  $\iota xAddressee(x)$  are always assigned a value in  $D$  with respect to any  $c$  and  $w_c$ ), then, since descriptions can instead fail to refer (be empty), we predict a logical difference between descriptions and indexicals also in  $2D_R$ : namely **EG** can fail in first order logic alone for descriptions, but not for indexicals.

- a. Barack Obama could have been a Republican
  - b. A Republican could have won the last elections
- (30) I could have been a Republican. (used by Obama)
- a. Obama could have been a Republican
  - b. #A Republican could have been speaking

In ordinary circumstances, (30) simply means (30-a). In  $2D_R$ , however, nothing prevents  $s_c$  to be equivalent to  $\lambda w. \llbracket the\ speaker \rrbracket_w$ , so *de dicto* (31-b) could mean (30-b):

- (31) a. *De re*:  $\exists x[x = I \wedge \diamond \phi[x]]$   
 b. *De dicto*:  $\diamond \exists x[x = I \wedge \phi[x]]$

To avoid this counterintuitive result, we could try to ban descriptive concepts like ‘the speaker’ from our contexts, while allowing only perceptually-based concept (‘the woman over there’). Such an approach could still account for Richard’s and Santorio’s examples, where (non-rigid) perceptually-based concepts are operative, while it will not overgenerate readings for ordinary cases like (30). The problem with this strategy, however, is that if indexicals can only be assigned perceptually-based concepts, we lose our explanation of Nunberg-like descriptive uses of indexicals and the intended reading of (32) can no longer be generated:

- (32) (Why did you send me the password?) I could have been a Republican.  
 ‘A Republican could have sent you the WhatsApp message’

Eventually I will defend a pragmatic account of the difference between (30) and (32). But first I will propose a new way of modelling the objects we refer to in conversation. Motivation for this new logic of reference comes from cases of quantification in situations of partial information. A two-dimensional version of the resulting semantics will allow us to distinguish between indexicals and definite descriptions, while allowing an account of both Richard-like and Nunberg-like cases.

### 3 Reference in situations of partial information

Imagine the following situation. In front of you lie two face-down cards. One is the Ace of Hearts, the other is the Ace of Spades, but you don’t know which is which. You have to choose one card: if you choose the Ace of Hearts you win \$10, if you choose the Ace of Spades you lose \$10. Now consider the following sentence:

- (33) You know which card is the winning card.

Is this sentence true or false in the given situation? On the one hand, the sentence is true: you know that the Ace of Hearts is the winning card. If someone interested in the rules of the game asked you ‘Which card is the winning



Intuitively, (35) does not represent a proper perspective over the relevant domain of individuals: as far as we know, the card on the left might be the Ace of Spades. If so: (i) one card (the Ace of Spades) would be counted twice; and (ii) another card (the Ace of Hearts) would not be identified at all.

In order to account for the ‘yes and no’ cases discussed above, Aloni (2001, 2005b) proposed a non-classical variant of quantified modal logic where the evaluation of formulas is relativised to a contextual parameter that assigns conceptual covers to variables as their domain of quantification. Building on (Hintikka, 1962), formula (37) can be used as the logical representation of (36). The variable  $z_n$  in (37) is indexed by a CC-index  $n \in N$  ranging over conceptual covers. The evaluation of (37) varies relative to the contextually selected value of  $n$  as illustrated in (38).

- (36) You know which card is the winning card.  
(37)  $\exists z_n \Box z_n = c$   
(38) a. False, if  $n \mapsto \{\text{on-the-left, on-the-right}\}$   
b. True, if  $n \mapsto \{\text{ace-of-spades, ace-of-hearts}\}$   
c. Trivial, if  $n \mapsto \{\text{the-winning-card, the-losing-card}\}$

A further crucial feature of Aloni’s quantified modal logic, is that differently indexed variables  $x_n$  and  $y_m$  can range over different conceptual covers. This feature allows perspicuous representations of traditionally problematic cases including examples like (39) and Quine’s (1956) double vision cases as in (40).

- (39) a. You don’t know which card is which.  
b.  $\forall x_n \forall y_m \Diamond x_n = y_m$   
(40) a. Ralph believes Ortcutt to be a spy and Ralph believes Ortcutt not to be a spy.  
b.  $\exists x_n (x_n = o \wedge \Box Sx_n) \wedge \exists x_m (x_m = o \wedge \Box \neg Sx_m)$

When we talk about concepts, we implicitly assume two different levels of ‘objects’: the individuals (in  $D$ ) and the ways of referring to these individuals (in  $D^W$ ). An essential feature of the intuitive relation between the two levels of the individuals and of their representations is that to one element of the first set correspond many elements of the second: one individual can be identified in many different ways. What characterises a set of representations of a certain domain is this cardinality mismatch, which expresses the possibility of considering an individual under different perspectives, which may coincide in one world and not in another. Individuals, on the other hand, do not split or merge once we move from one world to the other. Now, since the elements of a conceptual cover also cannot merge or split (by uniqueness), they behave like individuals in this sense, rather than representations. On the other hand, a conceptual cover is not barely a set of individuals, but encodes information on how these individuals are specified. We thus can think of covers as sets of individuals each identified in one specific way. In the next section I will propose to let Kaplanian contexts map indexicals to elements of a conceptual cover rather than to plain

individuals. By allowing different conceptual covers to be operative on different occasions, we will be able to account for the counterexamples to Kaplan’s theory, without failing to account for the intuition that indexicals denote genuine individuals, rather than ways of specifying these individuals.

## 4 Two-dimensional semantics under cover

In this section we present a two-dimensional version of Aloni’s (2001; 2005b) quantified modal logic with conceptual covers, where expressions are interpreted with respect to a perspective (assigning CC-indices to conceptual covers) and two world parameters, with the first world playing the role of a Kaplanian context. By extending the language with CC-indexed indexical terms  $you_n$  and  $I_n$ , whose interpretation will depend on both the context-world and the adopted conceptual cover, the resulting logic will capture the basic properties of indexicals, but also their descriptive uses (including Nunberg’s cases) and their interpretation in situations of partial information (Richard’s and Santorio’s examples).

### 4.1 Language

We assume a set  $\mathcal{C}$  of individual constants, a set  $\mathcal{P}$  of predicates, and an enumerable set  $\mathcal{V}_N$  of CC-indexed individual variables. Then we define the terms  $t$  and formulas  $\phi$  of our *language*  $\mathcal{L}_{CC}$  by the following BFN:

$$\begin{aligned} t &:= c \mid x_n \mid you_n \mid I_n \mid \iota x_n \phi \\ \phi &:= Pt, \dots, t \mid t = t \mid \neg \phi \mid (\phi \wedge \phi) \mid \exists x_n \phi \mid \Box \phi \end{aligned}$$

where  $c \in \mathcal{C}$ ,  $x_n \in \mathcal{V}_N$ , and  $P \in \mathcal{P}$ .

The usual abbreviations for  $\vee$  (‘disjunction’),  $\rightarrow$  (‘implication’),  $\leftrightarrow$  (‘bi-implication’),  $\forall$  (‘universal quantifier’) and  $\Diamond$  (‘possibility’) apply.

### 4.2 Semantics

A *model* for  $\mathcal{L}_{CC}$  is a quintuple  $\langle W, R, D, I, C \rangle$  in which  $W$  is a non-empty set of possible worlds;  $R$  is a relation on  $W$ ;  $D$  is a non-empty set of individuals;  $I$  is an interpretation function which assigns for each  $w \in W$  an element  $I_w(c)$  of  $D$  to each individual constant  $c$  in  $\mathcal{C}$ , and a subset  $I_w(P)$  of  $D^m$  to each  $m$ -ary predicate  $P$  in  $\mathcal{P}$ ; and  $C$  is a set of conceptual covers over  $(W, D)$ .

Given a model  $M = \langle W, R, D, I, C \rangle$ , a *perspective*  $\wp$  is a function that maps every CC-index  $n \in N$  to some conceptual cover in  $C$ .

**Definition 6 (Perspectives)** *Given a set of CC-indices  $N$  and a model  $M = \langle W, R, D, I, C \rangle$ , a perspective  $\wp$  is a function such that  $\forall n \in N : \wp(n) \in C$ .*

Given a certain perspective  $\wp$ , an assignment function  $g_\wp$  maps every variable  $x_n$  to some individual concept in  $\wp(n)$ .

**Definition 7 (Assignment functions)** Given a set of variables  $\mathcal{V}_N$ , a model  $M = \langle W, R, D, I, C \rangle$ , and a perspective  $\wp$ , an assignment function  $g_\wp$  is a function that maps every variable  $x_n$  in  $\mathcal{V}_N$  to some individual concept in  $\wp(n)$ .

Thus, a variable  $x_n$  is assigned a value in two steps. First,  $\wp$  determines the conceptual cover  $\wp(n)$  that  $x_n$  ranges over, and then  $g_\wp$  maps  $x_n$  to some individual concept in  $\wp(n)$ . We will adopt the usual notation  $g_\wp[x_n/c]$  to refer to the assignment  $h_\wp$  which is like  $g_\wp$  with the exception that it maps  $x_n$  to  $c$ .

Well-formed expressions in  $\mathcal{L}_{CC}$  are interpreted in models with respect to a perspective-dependent assignment function  $g_\wp$  and two worlds  $v, w \in W$ , with the first world  $v$  playing the role of a Kaplanian context. Individual constants and variables are interpreted as follows:

**Definition 8 (Individual Constants and Variables)**

$$\begin{aligned} \llbracket c \rrbracket_{M,v,w,g_\wp} &= I_w(c) \\ \llbracket x_n \rrbracket_{M,v,w,g_\wp} &= g_\wp(x_n)(w) \end{aligned}$$

Individual constants are interpreted as in classical quantified modal logic. Variables  $x_n$ , instead, range over concepts in  $\wp(n)$  rather than plain individuals in  $D$ . Note however that the denotation  $\llbracket x_n \rrbracket_{M,v,w,g_\wp}$  of a variable  $x_n$  with respect to a world of evaluation  $w$  is not the concept  $g_\wp(x_n) \in \wp(n)$ , but rather the value  $g_\wp(x_n)(w)$  of the concept  $g_\wp(x_n)$  in  $w$ , i.e. an individual in  $D$ . Thus, variables do not refer to concepts, but to individuals. However, they do refer in a non-rigid way: different individuals can be their value in different worlds. The same holds for indexical terms  $you_n$  and  $I_n$ , which are assigned elements  $\alpha$  of a pragmatically selected conceptual cover  $\wp(n)$ , but refer to individuals  $\alpha(w)$  when interpreted with respect to a world of evaluation  $w$ . Which  $\alpha \in \wp(n)$  an indexical term is assigned to crucially depends on the context-world  $v$ :  $I_n$  is assigned the unique  $\alpha \in \wp(n)$  that maps  $v$  to the speaker in  $v$ ;  $you_n$  is assigned the unique  $\alpha \in \wp(n)$  that maps  $v$  to the addressee in  $v$ ; that there are such unique  $\alpha$ s is guaranteed by the existence and uniqueness condition on conceptual covers (under the assumption that there is a unique speaker/addressee in context-world  $v$ ).

**Definition 9 (Indexicals)**

$$\begin{aligned} \llbracket I_n \rrbracket_{M,v,w,g_\wp} &= \alpha(w), \text{ where } \alpha \in \wp(n) \ \& \ \alpha(v) = \llbracket ix_m \text{Speaker}(x_m) \rrbracket_{M,v,v,g_\wp} \\ \llbracket you_n \rrbracket_{M,v,w,g_\wp} &= \alpha(w), \text{ where } \alpha \in \wp(n) \ \& \ \alpha(v) = \llbracket ix_m \text{Addressee}(x_m) \rrbracket_{M,v,v,g_\wp} \end{aligned}$$

The denotation of an indexical, given a perspective  $\wp$ , will depend on both the context-parameter  $v$  and the world of evaluation  $w$ : the context-world  $v$ , with perspective  $\wp$ , determines the concept  $\alpha$ , since  $\alpha$  is the unique element of the cover  $\wp(n)$  which maps the context-world  $v$  to the actual speaker/addressee in  $v$ ; the world of evaluation  $w$  provides the argument of  $\alpha$ . Note that the denotation of  $I_n/you_n$ ,  $\alpha(w)$ , needs not be speaking/hearing in  $w$ , if  $w \neq v$ .

The descriptions  $ix_m \text{Speaker}(x_m)$  and  $ix_m \text{Addressee}(x_m)$ , employed in our analysis of indexicals, are interpreted according to the following definition:

**Definition 10 (Descriptions)**

$$\begin{aligned} \llbracket \iota x_n \phi \rrbracket_{M,v,w,g_\varphi} &= c(w), \text{ if } c \text{ is the unique element of } \wp(n) \text{ s.t. } M, v, w \models_{g_\varphi[x_n/c]} \phi; \\ &= \emptyset, \text{ otherwise.} \end{aligned}$$

To determine  $\llbracket \iota x_n \phi \rrbracket_{M,v,w,g_\varphi}$ , we have to check whether there is a unique concept  $c \in \wp(n)$  such that  $M, v, w \models_{g_\varphi[x_n/c]} \phi$ . If we can find such a unique  $c$ , then the value of  $\llbracket \iota x_n \phi \rrbracket_{M,v,w,g_\varphi}$  is  $c(w)$ . Otherwise the description is empty. The interpretation of formulas  $\phi$  is given in the following definition:

**Definition 11 (Formulas)**

$$M, v, w \models_{g_\varphi} P t_1, \dots, t_n \quad \text{iff} \quad \langle \llbracket t_1 \rrbracket_{M,v,w,g_\varphi}, \dots, \llbracket t_n \rrbracket_{M,v,w,g_\varphi} \rangle \in I_w(P) \quad (1)$$

$$M, v, w \models_{g_\varphi} t_1 = t_2 \quad \text{iff} \quad \llbracket t_1 \rrbracket_{M,v,w,g_\varphi} = \llbracket t_2 \rrbracket_{M,v,w,g_\varphi} \quad (2)$$

$$M, v, w \models_{g_\varphi} \neg \phi \quad \text{iff} \quad \text{not } M, v, w \models_{g_\varphi} \phi \quad (3)$$

$$M, v, w \models_{g_\varphi} (\phi \wedge \psi) \quad \text{iff} \quad M, v, w \models_{g_\varphi} \phi \text{ and } M, v, w \models_{g_\varphi} \psi \quad (4)$$

$$M, v, w \models_{g_\varphi} \Box \phi \quad \text{iff} \quad \forall w' : w R w' \Rightarrow M, v, w' \models_{g_\varphi} \phi \quad (5)$$

$$M, v, w \models_{g_\varphi} \exists x_n \phi \quad \text{iff} \quad \exists c \in \wp(n) : M, v, w \models_{g_\varphi[x_n/c]} \phi \quad (6)$$

Formulas are interpreted in models  $M$  with respect to a perspective-dependent assignment function  $g_\varphi$  and two worlds  $v, w \in W$ . The context-world parameter  $v$  only plays a role in the interpretation of formulas containing indexicals terms. Modals shift the world of evaluation  $w$  parameter while leaving the context-world  $v$  unchanged (clause 5). Quantifiers range over elements of contextually determined conceptual covers, rather than over individuals *simpliciter* (clause 6). All other clauses are standard.

Logical validity is defined as ‘real-world validity’ (Humberstone, 2004).

**Definition 12 (Logical validity)**

$$\begin{aligned} M \models \phi &\quad \text{iff} \quad \forall v \in W, \forall g_\varphi : M, v, v \models_{g_\varphi} \phi \\ \models_{2DC} \phi &\quad \text{iff} \quad \forall M : M \models \phi \end{aligned}$$

### 4.3 Applications

#### 4.3.1 Basic properties, non-rigidity and descriptive uses

The basic properties of indexicals and their appearance in contingent a priori statements are accounted for as in Kaplan.

$$(41) \quad \text{I am the speaker.} \quad (\text{contingent a priori})$$

$$(42) \quad \text{The speaker is the speaker.} \quad (\text{necessary a priori})$$

Example (42) is necessary and a priori, because the following are both validated:

$$(43) \quad \models_{2DC} \iota x_n \text{Speaker}(x_n) = \iota x_m \text{Speaker}(x_m) \quad (\text{a priori})$$

$$(44) \quad \models_{2D_{CC}} \Box \iota x_n \text{Speaker}(x_n) = \iota x_m \text{Speaker}(x_m) \quad (\text{necessary})$$

Example (41), in contrast, is contingent a priori, because, given our notion of validity, (45) is logically valid, while (46) isn't.

$$(45) \quad \models_{2D_{CC}} I_n = \iota x_m \text{Speaker}(x_m) \quad (\text{a priori})$$

$$(46) \quad \not\models_{2D_{CC}} \Box I_n = \iota x_m \text{Speaker}(x_m) \quad (\text{but not necessary})$$

(45) is logically valid, because for all models  $M$ , worlds  $v$ , and assignments  $g_\varphi$ :  $\llbracket I_n \rrbracket_{M,v,v,g_\varphi} = \llbracket \iota x_m \text{Speaker}(x_m) \rrbracket_{M,v,v,g_\varphi}$  by definition. (46) instead is not valid because  $\llbracket I_n \rrbracket_{M,v,w,g_\varphi}$  need not be speaking in  $w$ , and so need not be equivalent to  $\llbracket \iota x_m \text{Speaker}(x_m) \rrbracket_{M,v,w,g_\varphi}$ .

The present semantics also allows us a ready account of indexicals in situations of partial information, as in Santorio's and Richard's examples.

The following principle is not valid in  $2D_{CC}$ , and this allows us to account for Santorio's amnesiacs cases:

$$(47) \quad \not\models_{2D_{CC}} I_n = a \rightarrow \Box I_n = a$$

Indexicals are typically assigned elements of perceptually-based conceptual covers, which, however, don't need be sets of constant functions.

Also the following principle is invalidated in the present semantics, since  $n$  and  $m$  can be mapped to two different conceptual covers:

$$(48) \quad \not\models_{2D_{CC}} \text{you}_n = x_m \rightarrow \Box \text{you}_n = x_m$$

This allows us to account for Richard's phone booth example, with  $x_m$  standing for *she*, assuming the availability of two different perceptually-based covers (visual vs auditory).

Finally, we show how descriptive uses of indexicals are captured in  $2D_{CC}$ . Consider again the WhatsApp example:

$$(49) \quad \begin{array}{l} \text{(Why did you send me the password?) I could have been a Republican.} \\ \text{'A Republican could have sent you the WhatsApp message'} \\ \text{a. } \textit{De re}: \exists x_n [x_n = I_m \wedge \Diamond R x_n] \quad (\text{only } n \text{ relevant here}) \\ \text{b. } \textit{De dicto}: \Diamond \exists x_n [x_n = I_m \wedge R x_n] \quad (\text{only } m \text{ relevant here}) \end{array}$$

Since both variables and indexicals can refer in a non-rigid way, the descriptive intended meaning of (49) can be captured in  $2D_{CC}$  via either (i) the *de re* or (ii) the *de dicto* representation. Let  $\alpha$  be the concept  $\lambda w \llbracket \textit{the sender of the WhatsApp message} \rrbracket_w$ . In case (i), the intended meaning follows if we assume that  $x_n$  ranges over a cover containing  $\alpha$ , so  $\alpha \in \wp(n)$ ; in case (ii), the intended meaning follows if we assume that the indexical  $I_m$  is assigned the concept  $\alpha$ , so  $\alpha \in \wp(m)$ . Similar explanations can be given for all examples discussed in Section 1.3. Notice that the value of a CC-index  $n$  matters only when an  $n$ -indexed term ( $x_n/I_n/\text{you}_n$ ) occurs free in the scope of a modal operator (see Aloni, 2016, for a proof). So in (49-a) only the value of  $n$  matters, and in (49-b) only the value of  $m$ .

### 4.3.2 Logic of reference

Substitutivity of identicals and existential generalisation fail in general in  $2D_{CC}$ :

$$(50) \quad \not\models_{2D_{CC}} x_n = y_m \rightarrow (\phi[x_n] \rightarrow \psi[y_m])$$

$$(51) \quad \not\models_{2D_{CC}} \phi[y_m] \rightarrow \exists x_n \phi[x_n]$$

But restricted forms of these principles are validated for variables and indexicals, while would fail for definite descriptions:

$$(52) \quad \begin{array}{l} \models_{2D_{CC}} x_n = y_n \rightarrow (\phi[x_n] \rightarrow \psi[y_n]) \\ \models_{2D_{CC}} I_n = y_n \rightarrow (\phi[I_n] \rightarrow \psi[y_n]) \end{array} \quad (\mathbf{SI}_n, \text{ variables/indexicals})$$

$$(53) \quad \begin{array}{l} \models_{2D_{CC}} \phi[y_n] \rightarrow \exists x_n \phi[x_n] \\ \models_{2D_{CC}} \phi[I_n] \rightarrow \exists x_n \phi[x_n] \end{array} \quad (\mathbf{EG}_n, \text{ variables/indexicals})$$

$$(54) \quad \begin{array}{l} \not\models_{2D_{CC}} \iota x_n P x_n = y_n \rightarrow (\phi[\iota x_n P x_n] \rightarrow \phi[y_n]) \\ \not\models_{2D_{CC}} \phi[\iota y_n P y_n] \rightarrow \exists x_n \phi[x_n] \end{array} \quad \begin{array}{l} (\mathbf{SI}_n, \text{ descriptions}) \\ (\mathbf{EG}_n, \text{ descriptions}) \end{array}$$

The validities in (52) and (53) rely on the uniqueness and existence conditions on conceptual covers respectively ( $\mathbf{EG}_n$  for indexical  $I_n$  further relies on the assumption that each world contains a unique speaker). As in  $2D_K$ , but in contrast to  $2D_R$ , in the newly proposed semantics indexicals behave as variables and not as definite descriptions.

$2D_K$	<b>SI</b>	<b>EG</b>	$2D_R$	<b>SI</b>	<b>EG</b>	$2D_{CC}$	<b>SI<sub>n</sub></b>	<b>EG<sub>n</sub></b>
variables	<b>yes</b>	<b>yes</b>	variables	<b>yes</b>	<b>yes</b>	variables	<b>yes</b>	<b>yes</b>
indexicals	<b>yes</b>	<b>yes</b>	indexicals	no	no	indexicals	<b>yes</b>	<b>yes</b>
definites	no	no	definites	no	no	definites	no	no

The intuitive contrast between indexicals and descriptions, however, is still not fully accounted for. Consider again our Obama examples. While (55) is naturally ambiguous, (56) requires a very specific context to give rise to a descriptive reading:

(55) The president of the US could have been a Republican.

- a. Barack Obama could have been a Republican
- b. A Republican (Romney) could have won the last elections

(56) I could have been a Republican. (used by Obama)

- a. Obama could have been a Republican (in ordinary circumstances)
- b. A Republican could have sent you the WhatsApp message (in WhatsApp scenario)

In the following section we will propose a pragmatic explanation of these phenomena. The contextual selection of a conceptual cover will be regulated by general pragmatic principles, which will prevent descriptive covers to be at work in ordinary cases, while being possibly operative in extraordinary circumstances (as in the WhatsApp scenario).

## 5 Pragmatic Theory

On the present account, referential expressions (variables, indexicals) are perspective-sensitive expressions, their logical representation involves CC-indices  $n$  whose value needs to be pragmatically supplied. It is well-known however that pragmatic accounts often run the risk of overgeneration. For example, consider again our Obama sentence used in a neutral context:

- (57) I could have been a Republican. (used by Obama)
- a. Obama could have been a Republican
  - b. A Republican could have been speaking

Nothing prevents  $x_n$  or  $I_m$  in (58) to be assigned to  $\lambda w.[[the\ speaker]]_w$ , so both *de re* and *de dicto* (58-a-b) could mean (57-b), against intuitions:

- (58) a. *De re*:  $\exists x_n[x_n = I_m \wedge \Diamond Rx_n]$   
 b. *De dicto*:  $\Diamond \exists x_n[x_n = I_m \wedge Rx_n]$

What this example shows is that the resolution process of cover indices needs to be suitably constrained. Following Aloni (2001), the present section discusses some factors that we take to play a role in this process.

### 5.1 Constraints on pragmatic resolution

We assume that there are certain default choices for the resolution of cover indices, from which however we can sometimes deviate. Deviation from the default choices though is costly and only justified if needed in order to comply with Gricean principles of conversation. More precisely, we assume the following:

**Definition 13 (Constraints on pragmatic resolution)**

1. *CC-indices by default are mapped to a perceptually-based cover (if application criteria apply) or naming (if application criteria apply);<sup>6</sup>*
2. *Resolution to a non-default salient cover is possible but licensed (i) only if it is needed in order to avoid trivial, contradictory or irrelevant meanings, and (ii) only if the obtained content could not have been expressed by a more perspicuous/effective form.*

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<sup>6</sup>A proper description of the application criteria for a perceptually-based identification and naming is beyond the scope of this article, but roughly they seem to relate to the application criteria of demonstratives and proper names: perceptually-based identification requires the relevant individuals to be in the perceptual surroundings of the interlocutors, as proper uses of demonstratives do, while identification by naming requires the availability of *shared* names for these individuals. When talking to a stranger you don't refer to your son as 'John', but you refer to president of the US as 'Obama' because only the latter can be assumed to be a shared name. Similarly, only when shared names are available, naming can be adopted as identification method.

In previous work, these constraints have been shown to explain contextual interpretations of a wide range of expressions including belief attributions, questions, concealed questions, *knowing who* constructions and epistemic modals (Aloni, 2001, 2005a; Aloni and Roelofsen, 2011). The assumed preference for perceptually-based identification methods and naming (default choices) over descriptive methods (non-default) directly relates to the ranking of referential devices discussed in Gundel *et al.* (1993) and can be justified by salience, but also by economy considerations:<sup>7</sup> whenever available identification by ostension seems to be the most salient method of identification, and whenever possible pointing and naming are less costly than full-fledged linguistic descriptions.

## 5.2 Illustrations

**Default resolutions: indexicals vs definite descriptions** In a neutral context deviation from default resolutions are unjustified (clause 1 in Definition 13). Like Kaplan, we predict a contrast between examples like (59), containing an indexical, and (60), containing a definite description. Only the latter are predicted to be ambiguous by our pragmatic theory.

No ambiguity arises for (59) because both *de re* and *de dicto* representations depend on the operative conceptual cover, which, in ordinary cases, is predicted to be perceptually-based by our pragmatic theory.

- (59) I could have been Republican. (used by Obama)  
‘Obama himself could have been a Republican’
- a. *De re*:  $\exists x_n[x_n = I_m \wedge \Diamond Rx_n]$
  - b. *De dicto*:  $\Diamond \exists x_n[x_n = I_m \wedge Rx_n]$
- ⇒ Optimal resolution:  $n, m$  assigned *perceptually-based cover*

Example (60), instead, is predicted to be ambiguous: the *de re* representation (60-a) is perspective-dependent and, in ordinary cases, receives a non-descriptive interpretation (assuming that Obama is not in the perceptual surroundings of the interlocutors, naming is predicted as operative here); the *de dicto* representation (60-b), in contrast, expresses a descriptive meaning irrespective of the operative cover.

- (60) The president of the US could have been a Republican.
- a. *De re*:  $\exists x_n[x_n = \iota y_m Py_m \wedge \Diamond Rx_n]$   
‘Obama could have been a Republican’  
⇒ Optimal resolution:  $x_n$  ranges over *naming cover*
  - b. *De dicto*:  $\Diamond \exists x_n[x_n = \iota y_m Py_m \wedge Rx_n]$   
‘A Republican could have won the last elections’  
⇒ (values of  $n, m$  irrelevant here)

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<sup>7</sup>In any case the preference for perceptually grounded methods of identification does not seem to have anything to do with an alleged epistemological advantage of perception versus other methods of knowledge acquisition.

**Deviations and blocking effects: the WhatsApp example** Deviations from default resolutions are licensed if necessary to avoid violation of Gricean principles of conversation (clause 2(i) in Definition 13). This gives us an explanation of the WhatsApp example. A descriptive reading is predicted here because a default resolution would have led to a violation of the Maxim of Relevance.

- (61) (Why did you send me the password?) I could have been a Republican.  
 ‘A Republican could have sent you the WhatsApp message’
- a. *De re*:  $\exists x_n[x_n = I_m \wedge \diamond Rx_n]$   
 b. *De dicto*:  $\diamond \exists x_n[x_n = I_m \wedge Rx_n]$   
 $\Rightarrow$  Optimal resolution:  $\lambda w[[the\ sender\ of\ the\ WhatsApp]]_w \in n, m$

Nunberg observed that such deferred reference readings are not available for definite descriptions. There is a contrast between (61) and (62); only the former allows a deferred reference interpretation.

- (62) (Why did you send me the password?) The speaker could have been a Republican.  
 # ‘A Republican could have sent you the WhatsApp message’
- a. *De re*:  $\exists x_n[x_n = \iota x_m Speaker(x_m) \wedge \diamond Rx_n]$   
 b. *De dicto*:  $\diamond \exists x_n[x_n = \iota x_m Speaker(x_m) \wedge Rx_n]$

The present pragmatic theory can account for this contrast in terms of blocking effects (clause 2(ii) in Definition 13). Note that the *de re* representation (62-a) would express the problematic content, if we resolved  $n$  to a cover containing the concept  $\lambda w[[the\ sender\ of\ the\ WhatsApp]]_w$ . However such a relevance-justified deviation, which was licensed for (61), is *blocked* for (62) by the availability of a more efficient/perspicuous form for the target content. Let us have a closer look. In the present semantics, all forms in (63-b) can be interpreted as expressing content (63-a).

- (63) a. Target *content*: ‘The sender of the WhatsApp could have been a Republican’  
 b. Alternative possible *forms*:  
 (i) The sender of the WhatsApp could have been a Republican.  
 (ii) I could have been a Republican.  
 (iii) The speaker could have been a Republican.

Interpretation (63-a), however, is blocked for form (iii) by the more efficient forms (i)-(ii). So no deferred reference meaning is predicted for sentences like (64):

- (64) (Why did you send me the password?) The speaker could have been a Republican.  
 # ‘A Republican could have sent you the WhatsApp message’  
 $\Rightarrow$  non-default resolution NOT licensed

On the other hand, nothing is strictly more effective than form (ii) given the circumstances of the utterance. The 1st personal pronoun ‘I’ is the preferred referential device for a speaker who wants to refer to herself (see Aloni, 2005a, for more discussion on the pragmatic principles ruling the choice of a referential device). So a deferred reference meaning is predicted for sentences like (65):

- (65) (Why did you send me the password?) I could have been a Republican.  
 ‘A Republican could have sent you the WhatsApp message’  
 ⇒ non-default resolution licensed

More specifically, the efficiency of a content-form pair is measured in terms of violation of soft constraints: while the content-form pair (a)-(iii) violates both an interpretation constraint (it requires a non-default resolution) and a generation constraints (it uses a non-default referential device (a description rather than a pronoun to refer to the speaker)), the other two pairs involve only one violation each: the pair (a)-(ii) requires a non-default resolution, while (a)-(i) uses a non-default referential device. So while (a)-(iii), which involves two violations, is blocked, the violations of the other two pairs balance each other and therefore (a)-(i) and a-(ii) are both predicted to be felicitous (see Aloni, 2005a, for a formalisation of this reasoning in the framework of bi-directional optimality).

Let me conclude this section with a general remark on how conceptual covers are employed in ordinary conversations. While conceptual covers formally specify a way to identify each individual in the domain of discourse, the examples discussed in this section clearly show that to determine, given a context, the semantic content of a particular sentence containing an indexical, we don’t need to have in mind a way of thinking of everything in the universe, it is enough to have established how to identify the relevant individuals. For example, consider again the WhatsApp case. It is easy to see that sentence (65), when used in the specified circumstances, would determine exactly the same proposition under any cover containing the concept  $\lambda w[[the\ sender\ of\ the\ WhatsApp]]_w$ . Under such a resolution, the relevant referential expression ( $I_m$  or  $x_n$ ) will refer to Obama in the actual world (the actual WhatsApp sender), but to alternative possible senders in other (counterfactual) possibilities. The expressed proposition then would be ‘that a Republican could have sent you the WhatsApp message’ irrespective to how individuals other than the speaker are identified. This shows that once you have established a way to identify the relevant individuals, in this case the speaker, you have enough information to determine the semantic content of a sentence (the set of possible worlds in which it is true), which is all you need to establish its truth value (or to update the common ground, as in Stalnaker, 1978).

## 6 Conclusion

By letting indexicals and variables refer to elements of contextually supplied conceptual covers and by formulating general constraints on these pragmatic selection procedures, we have proposed an account of indexicals which captures a number of cases that have been presented against a Kaplanian analysis, while maintaining Kaplan’s basic insights concerning the genuinely referential nature of ‘you’ and ‘I’.

A number of issues arise though from this proposal, the most urgent one concerns the nature of a context. In a cover-based two-dimensional semantics, the interpretation function is relativised to two contextual parameters: a perspective  $\wp$ , which arguably is an epistemic notion, and a context-world  $v$ , which, as in Kaplan, is an abstract representation of the physical environment in which a use of language takes place. But how do these two contextual parameters conceptually relate to each other? And how do they connect to Stalnaker’s notion of a common ground? These and other related questions, however, must be left to another occasion.

## Appendix

### The system $2D_K$

**Language** We assume a set  $\mathcal{C}$  of individual constants, a set  $\mathcal{P}$  of predicates, and an enumerable set  $\mathcal{V}$  of individual variables. Then we define the terms  $t$  and formulas  $\phi$  of our *language*  $\mathcal{L}$  by the following grammar:

$$\begin{aligned} t &:= c \mid x \mid \textit{you} \mid I \mid \iota x \phi(x) \\ \phi &:= Pt, \dots, t \mid t = t \mid \neg \phi \mid (\phi \wedge \phi) \mid \exists x \phi \mid \Box \phi \end{aligned}$$

where  $c \in \mathcal{C}$ ,  $x \in \mathcal{V}$ , and  $P \in \mathcal{P}$ .

The usual abbreviations for  $\vee$  (‘disjunction’),  $\rightarrow$  (‘implication’),  $\leftrightarrow$  (‘bi-implication’),  $\forall$  (‘universal quantifier’) and  $\diamond$  (‘possibility’) apply.

**Semantics** A *model* for  $\mathcal{L}$  is a quadruple  $\langle W, R, D, I \rangle$  in which  $W$  is a non-empty set of possible worlds;  $R$  is a relation on  $W$ ;  $D$  is a non-empty set of individuals;  $I$  is an interpretation function which assigns for each  $w \in W$  an element  $I_w(c)$  of  $D$  to each individual constant  $c$  in  $\mathcal{C}$ , and a subset  $I_w(P)$  of  $D^m$  to each  $m$ -ary predicate  $P$  in  $\mathcal{P}$ .

Given a set of variables  $\mathcal{V}$  and a model  $M = \langle W, R, D, I \rangle$ , an *assignment*  $g$  is a function that maps every  $x \in \mathcal{V}$  to some individual in  $D$ .

Given a model  $M = \langle W, R, D, I \rangle$ , a *context*  $c$  based on  $M$  is a tuple  $\langle s_c, a_c, \dots, w_c \rangle$ , where

- (i)  $s_c, a_c \in D$  and  $w_c \in W$ ;
- (ii)  $s_c = \llbracket \iota x \textit{ speaker}(x) \rrbracket_{M,c,w_c,g}$  and  $a_c = \llbracket \iota x \textit{ addressee}(x) \rrbracket_{M,c,w_c,g}$ .

Well-formed expressions in  $\mathcal{L}$  are interpreted in models  $M$  with respect to a assignment function  $g$ , a context  $c$  and a world  $w \in W$ .

**Definition 14 (Terms in  $2D_K$ )**

$$\begin{aligned} \llbracket c \rrbracket_{M,c,w,g} &= I_w(c) \\ \llbracket x \rrbracket_{M,c,w,g} &= g(x) \\ \llbracket I \rrbracket_{M,c,w,g} &= s_c \quad (\text{the speaker in } c) \\ \llbracket you \rrbracket_{M,c,w,g} &= a_c \quad (\text{the addressee in } c) \\ \llbracket \iota x \phi \rrbracket_{M,c,w,g} &= d, \text{ if } d \text{ is the unique element of } D \text{ s.t. } M, w \models_{g[x/d]} \phi; \\ &= \emptyset, \text{ otherwise.} \end{aligned}$$

**Definition 15 (Formulas in  $2D_K$ )**

$$\begin{aligned} M, c, w \models_g Pt_1, \dots, t_n &\text{ iff } \langle \llbracket t_1 \rrbracket_{M,c,w,g}, \dots, \llbracket t_n \rrbracket_{M,c,w,g} \rangle \in I_w(P) \\ M, c, w \models_g t_1 = t_2 &\text{ iff } \llbracket t_1 \rrbracket_{M,c,w,g} = \llbracket t_2 \rrbracket_{M,c,w,g} \\ M, c, w \models_g \neg\phi &\text{ iff } \text{not } M, c, w \models_g \phi \\ M, c, w \models_g (\phi \wedge \psi) &\text{ iff } M, c, w \models_g \phi \text{ and } M, c, w \models_g \psi \\ M, c, w \models_g \Box\phi &\text{ iff } \forall w' : wRw' \Rightarrow M, c, w' \models_g \phi \\ M, c, w \models_g \exists x\phi &\text{ iff } \exists d \in D : M, c, w \models_{g[x/d]} \phi \end{aligned}$$

**Definition 16 (Logical validity in  $2D_K$ )**

$$\begin{aligned} M \models \phi &\text{ iff } \forall c, g : M, c, w_c \models_g \phi \\ \models_{2D_K} \phi &\text{ iff } \forall M : M \models \phi \end{aligned}$$

The system  $2D_R$  differs from  $2D_K$  only in the treatment of contexts and indexicals (see definitions 3 and 4 in section 2.2).

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