

(ii) The person who is uttering this utterance is exhausted.  
 both uttered by *s* on the same occasion (!): To find the truth value of the content of (ii) in *w'* we must first locate the same utterance in *w'* (if it exists there at all) and see who, if anyone, is uttering it. Since *s* could well be exhausted silently in *w'*, the two contents are not the same.

<sup>33</sup> J. Hintikka, J. Moravcsik, and P. Suppes, eds., *Approaches to Natural Language* (Dordrecht, 1973).

<sup>34</sup> David Kaplan, *Demonstratives* (Draft #2) mimeographed, UCLA Philosophy Department, 1977.

<sup>35</sup> This volume, pp. 401–412.

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## ON THE LOGIC OF DEMONSTRATIVES

DAVID KAPLAN

**I**N this paper I propose to outline briefly a few results of my investigations into the theory of demonstratives: words and phrases whose *intension* is determined by the contexts of their use.<sup>1</sup> Familiar examples of demonstratives are the nouns 'I', 'you', 'here', 'now', 'that', and the adjectives 'actual' and 'present'. It is, of course, clear that the *extension* of 'I' is determined by the context — if you and I both say 'I' we refer to different persons. But I would now claim that the *intension* is also so determined. The *intension* of an 'eternal' term (like 'The Queen of England in 1973') has generally been taken to be represented by a function which assigns to each possible world the Queen of England in 1973 of that world. Such functions would have been called *individual concepts* by Carnap.<sup>2</sup> It has been thought by some — myself among others — that by analogy, the *intension* of 'I' could be represented by a function from speakers to individuals (in fact, the identity function). And similarly, that the *intensions* of 'here' and 'now' would be represented by (identity) functions on places and times. The role of contextual factors in determining the *extension* (with respect to such factors) of a demonstrative was thought of as analogous to that of a possible world in determining the *extension* of 'The Queen of England in 1973' (with respect to that possible world). Thus an enlarged view of an *intension* was derived. The *intension* of an expression was to be represented by a function from certain factors to the *extension* of the expression (with respect to those factors). Originally such factors were simply possible worlds, but as it was noticed that the so-called tense operators exhibited a structure highly analogous to that of the modal operators, the factors with respect to which an *extension* was to be determined were enlarged to include moments of time. When it was noticed that contextual factors were required to determine the *extension* of sentences containing demonstratives, a still more general notion was developed and called an "index." The *extension* of an expression was to be determined with respect to an index. The *intension* of an expression was that function which assigned to every index, the *extension* at that index. Here is a typical passage.

The above example supplies us with a statement whose truth value is not constant but varies as a function of  $i \in I$ . This situation is easily appreciated in the context of time-dependent statements; that is, in the case where  $I$  represents the instants of time. Obviously the same statement can be true at one moment and false at another. For more general situations one must not think of the  $i \in I$  as anything as simple as instants of time or even possible worlds. In general we will have

$$i = \langle w, t, p, a, \dots \rangle$$

where the index  $i$  has many *coordinates*: for example,  $w$  is a *world*,  $t$  is a *time*,  $p = \langle x, y, z \rangle$  is a (3-dimensional) *position* in the world,  $a$  is an *agent*, etc. All these coordinates can be varied, possibly independently, and thus affect the truth values of statements which have indirect reference to these coordinates. (From the Advice of a prominent logician.)

A sentence  $\Phi$  was taken to be logically true if true at every index (in every 'structure'), and  $\Box\Phi$  was taken to be true at a given index (in a given structure) just in case  $\Phi$  was true at every index (in that structure).<sup>3</sup> Thus the familiar principle of modal generalization: if  $\models \Phi$ , then  $\models \Box\Phi$ , is validated.

This view, in its treatment of demonstratives, now seems to me to have been technically wrong (though perhaps correctable by minor modification) and, more important, conceptually misguided.

Consider the sentence

(1) I am here now.

It is obvious that for many choices of index — i.e., for many quadruples  $\langle w, x, p, t \rangle$  where  $w$  is a possible world,  $x$  is a person,  $p$  is a place, and  $t$  is a time — (1) will be false. In fact, (1) is true only with respect to those indices  $\langle w, x, p, t \rangle$  which are such that in the world  $w$ ,  $x$  is located at  $p$  at the time  $t$ . Thus (1) fares about on a par with

(2) David Kaplan is in Los Angeles on April 21, 1973.

(2) is contingent, and so is (1).

But here we have missed something essential to our understanding of demonstratives. Intuitively, (1) is deeply, and in some sense universally, true. One need only understand the meaning of (1) to know that it cannot be uttered falsely. No such guarantees apply to (2). A *Logic of Demonstratives* that does not reflect this intuitive difference between (1) and (2) has bypassed something essential to the logic of demonstratives.

Here is a proposed correction. Let the class of indices be narrowed to include only the *proper* ones — namely, those  $\langle w, x, p, t \rangle$  such that in the world  $w$ ,  $x$  is located at  $p$  at the time  $t$ . Such a move may have been intended originally since improper indices are like impossible worlds; no such contexts *could* exist and thus there is no interest in evaluating the extensions of expressions with respect to them. Our reform has the consequence that (1) comes out, correctly, to be logically true. Now consider

(3)  $\Box$ I am here now.

Since the contained sentence (namely (1)) is true at every proper index, (3) also is true at every proper index and thus also is logically true. (As would be expected by the aforementioned principle of modal generalization.)

But (3) should not be *logically* true, since it is false. It is certainly *not* necessary that I be here now. But for several contingencies, I would be working in my garden now, or even writing this in a location outside Los Angeles.

Perhaps enough has now been said to indicate that there are difficulties in attempting to assimilate the role of a *context* in a logic of demonstratives to that of a *possible world* in the familiar modal logics or a *moment of time* in the familiar tense logics.

I believe that the source of the difficulty lies in a conceptual confusion between two kinds of meaning. Ramifying Frege's distinction between sense and denotation, I would add two varieties of sense: content and character. The content of an expression is always taken *with respect to* a given context of use. Thus when I say

(4) I was insulted yesterday,

a specific content — *what I said* — is expressed. Your utterance of the same sentence, or mine on another day, would not express the same content. It is important to note that not just the truth value may change; what is said is itself different. Speaking today, my utterance of (4) will have a content roughly equivalent to that which

(5) David Kaplan is insulted on April 20, 1973

would have when spoken by you or anyone at anytime. Since (5) contains no demonstratives, its content is the same with respect to all contexts. This content is what Carnap called an 'intension' and what, I believe, has been often referred to as a 'proposition'. So my theory is that different contexts for (4) produce not just different truth values, but also different propositions.

Turning now to character, I call that component of the sense of an expression which determines how the content is determined by the context, the 'character' of an expression. Just as contents (or intensions) can be represented by functions from possible worlds to extensions, so characters can be represented by functions from contexts to contents. The character of 'I' would then be represented by *the function (or rule, if you prefer) that assigns to each context that content which is represented by the constant function from possible worlds to the agent of the context*. The latter function has been called an 'individual concept'. Note that the character of 'I' is represented by a function from contexts to individual *concepts*, not from contexts to individuals. It was the idea that a function from contexts to individuals could represent the intension of 'I' which led to the difficulties discussed earlier.

Now what is it that a competent speaker of English knows about the word 'I'? Is it the content with respect to some particular occasion of use? No. It is the character of 'I': the rule italicized above. Competent speakers recognize that the proper use of 'I' is — loosely speaking — to refer to the speaker. Thus that component of sense which I call 'character' is best identified with what might naturally be called 'meaning'.

To return, for a moment, to (1). The character (meaning) of (1) determines each of the following:

- (a) In different contexts, an utterance of (1) expresses different contents (propositions).
- (b) In most (if not all) contexts, an utterance of (1) expresses a contingent proposition.
- (c) In all contexts, an utterance of (1) expresses a true proposition (i.e., a proposition which is true at the world of the context).

On the basis of (c), we might claim that (1) is analytic (i.e., it is true solely by virtue of its meaning). Although as we see from (b), (1) rarely or never expresses a necessary proposition. This separation of analyticity and necessity is made possible — even, I

hope, plausible — by distinguishing the kinds of entities of which 'is analytic' and 'is necessary' are properly predicated: characters (meanings) are analytic, contents (propositions) are necessary.

The distinction between character and content was unlikely to be noticed before demonstratives came under consideration, because demonstrative-free expressions have a constant character, i.e., they express the same content in every context. Thus character becomes an uninteresting complication in the theory.

Although I have spoken above of contexts of utterance, my primary theoretical notion of *content with respect to a context* does not require that the agent of the context utter the expression in question. I believe that there are good reasons for taking this more general notion as fundamental.

I believe that my distinction between character and content can be used to throw light on Kripke's distinction between the a-priori and the necessary.<sup>4</sup> Although my distinction lies more purely within logic and semantics, and Kripke's distinction is of a more general epistemic metaphysical character, both seem to me to be of the same *structure*. (I leave this remark in a rather cryptic state.)

The distinction between content and character and the related analysis of demonstratives have certainly been foreshadowed in the literature (though they are original-with-me in the sense that I did not consciously extract them from prior sources). But to my knowledge they have not previously been cultivated to meet the standards for logical and semantical theories which currently prevail. In particular, Strawson's distinction between the significance (meaningfulness) of a sentence and the statement (proposition) expressed in a given use is clearly related.<sup>5</sup> Strawson recognizes that such sentences as "The *present* King of France is *now* bald" may express different propositions in different utterances, and he identifies the meaningfulness of the sentence with its potential for expressing a true or false proposition in some possible utterance. Although he does not explicitly discuss *the* meaning of the sentence, it is clear that he would not identify such a meaning with any of the propositions expressed by particular utterances. Unfortunately Strawson seems to regard the fact that sentences containing demonstratives can be used to express different propositions as immunizing such sentences against treatment by 'the logician'.

To convince myself that it is possible to conduct a consistent analysis of the semantics of demonstratives along the above lines, I have attempted to carry through the program for a version of first-order predicate logic. The result is the following Logic of Demonstratives. If my views are correct, the introduction of demonstratives into intensional logics will require more extensive reformulations than was thought to be necessary.

### THE LOGIC OF DEMONSTRATIVES

The *Language* LD is based on first-order predicate logic with identity and descriptions. We deviate slightly from standard formulations in using two sorts of variables, one sort for positions and a second sort for individuals other than positions (hereafter called simply 'individuals').

#### Primitive Symbols for Two Sorted Predicate Logic

0. Punctuation: (, )
1. (i) An infinite set of individual variables:  $\forall_i$   
(ii) An infinite set of position variables:  $\forall_p$
2. (i) An infinite number of m-n-place predicates, for all natural numbers m, n.

- (ii) The 1-0-place predicate: Exist
- (iii) The 1-1-place predicate: Located
3. (i) An infinite number of m-n-place i-functors (functors that form terms denoting individuals)  
(ii) An infinite number of m-n-place p-functors (functors that form terms denoting positions)
4. Sentential Connectives:  $\wedge, \vee, \neg, \rightarrow, \leftrightarrow$
5. Quantifiers:  $\forall, \exists$
6. Definite Description Operator: the
7. Identity: =

#### Primitive Symbols for Modal and Tense Logic

8. Modal Operators:  $\Box, \Diamond$
9. Tense Operators: F (it will be the case that)  
P (it has been the case that)  
G (one day ago, it was the case that)

#### Primitive Symbols for the Logic of Demonstratives

10. Three one place sentential operators: N (it is now the case that)  
A (it is actually the case that)  
Y (yesterday, it was the case that)
11. A one-place functor: dthat
12. An individual constant (0-0-place i-functor): I
13. A position constant (0-0-place p-functor): Here

The *well formed expressions* are of three kinds: formulas, position terms (p-terms), and individual terms (i-terms).

1. (i) If  $\alpha \in \forall_i$ , then  $\alpha$  is an i-term  
(ii) If  $\alpha \in \forall_p$ , then  $\alpha$  is a p-term
2. If  $\pi$  is an m-n-place predicate,  $\alpha_1 \dots \alpha_m$  are i-terms, and  $\beta_1 \dots \beta_n$  are p-terms, then  $\pi\alpha_1 \dots \alpha_m\beta_1 \dots \beta_n$  is a formula
3. (i) If  $\eta$  is an m-n-place i-functor,  $\alpha_1 \dots \alpha_m, \beta_1 \dots \beta_n$  as in 2., then  $\eta\alpha_1 \dots \alpha_m\beta_1 \dots \beta_n$  is an i-term  
(ii) If  $\eta$  is an m-n-place p-functor,  $\alpha_1 \dots \alpha_m, \beta_1 \dots \beta_n$  as in 2., then  $\eta\alpha_1 \dots \alpha_m\beta_1 \dots \beta_n$  is a p-term
4. If  $\Phi, \Psi$  are formulas, then  $(\Phi \wedge \Psi), (\Phi \vee \Psi), \neg\Phi, (\Phi \rightarrow \Psi), (\Phi \leftrightarrow \Psi)$  are formulas
5. If  $\Phi$  is a formula and  $\alpha \in \forall_i \cup \forall_p$ , then  $\forall\alpha\Phi, \exists\alpha\Phi$  are formulas
6. If  $\Phi$  is a formula, then  
(i) if  $\alpha \in \forall_i$ , then the  $\alpha\Phi$  is an i-term  
(ii) if  $\alpha \in \forall_p$ , then the  $\alpha\Phi$  is a p-term
7. If both  $\alpha, \beta$  are either i-terms or p-terms, then  $\alpha = \beta$  is a formula
8. If  $\Phi$  is a formula, then  $\Box\Phi, \Diamond\Phi$  are formulas
9. If  $\Phi$  is a formula, then  $F\Phi, P\Phi, G\Phi$  are formulas
10. If  $\Phi$  is a formula, then  $N\Phi, A\Phi, Y\Phi$  are formulas
11. (i) If  $\alpha$  is an i-term, then dthat  $\alpha$  is an i-term  
(ii) If  $\alpha$  is a p-term, then dthat  $\alpha$  is a p-term

### SEMANTICS FOR LD

Definition:  $\mathfrak{A}$  is an LD Structure iff there are  $\mathcal{C} \mathcal{W} \mathcal{U} \mathcal{P} \mathcal{T} \mathcal{J}$  such that

1.  $\mathfrak{A} = \langle \mathcal{C} \mathcal{W} \mathcal{U} \mathcal{P} \mathcal{T} \mathcal{J} \rangle$

2.  $\mathcal{C}$  is a nonempty set (the set of *contexts*, see 10 below)
3. If  $c \in \mathcal{C}$ , then
  - (i)  $c_A \in \mathcal{U}$  (the *agent* of  $c$ )
  - (ii)  $c_T \in \mathcal{T}$  (the *time* of  $c$ )
  - (iii)  $c_P \in \mathcal{P}$  (the *position* of  $c$ )
  - (iv)  $c_W \in \mathcal{W}$  (the *world* of  $c$ )
4.  $\mathcal{W}$  is a nonempty set (the set of *worlds*)
5.  $\mathcal{U}$  is a nonempty set (the set of all *individuals*, see 9 below)
6.  $\mathcal{P}$  is a nonempty set (the set of *positions*; common to all worlds)
7.  $\mathcal{T}$  is the set of integers (thought of as the *times*; common to all worlds)
8.  $\mathcal{J}$  is a function that assigns to each predicate and functor an appropriate *intension* as follows:
  - (i) If  $\pi$  is an  $m$ - $n$ -place predicate,  $\mathcal{J}_\pi$  is a function such that for each  $t \in \mathcal{T}$  and  $w \in \mathcal{W}$ ,  $\mathcal{J}_\pi(tw) \subseteq (\mathcal{U}^m \times \mathcal{P}^n)$
  - (ii) If  $\eta$  is an  $m$ - $n$ -place  $i$ -functor,  $\mathcal{J}_\eta$  is a function such that for each  $t \in \mathcal{T}$  and  $w \in \mathcal{W}$ ,  $\mathcal{J}_\eta(tw) \in (\mathcal{U} \cup \{\dagger\})^{(m \times n)}$   
(Note:  $\dagger$  is a completely alien entity, in neither  $\mathcal{U}$  nor  $\mathcal{P}$ , which represents an 'undefined' value of the function. In a normal set theory we can take  $\dagger$  to be  $\{\mathcal{U}, \mathcal{P}\}$ .)
  - (iii) If  $\eta$  is an  $m$ - $n$ -place  $p$ -functor,  $\mathcal{J}_\eta$  is a function such that for each  $t \in \mathcal{T}$  and  $w \in \mathcal{W}$ ,  $\mathcal{J}_\eta(tw) \in (\mathcal{P} \cup \{\dagger\})^{(m \times n)}$
9.  $i \in \mathcal{U}$  iff  $\exists t \in \mathcal{T} \exists w \in \mathcal{W} \langle i \rangle \in \mathcal{J}_{\text{Exist}}(tw)$
10. If  $c \in \mathcal{C}$ , then  $\langle c_A c_P \rangle \in \mathcal{J}_{\text{Located}}(c_T c_W)$
11. If  $\langle i p \rangle \in \mathcal{J}_{\text{Located}}(tw)$ , then  $\langle i \rangle \in \mathcal{J}_{\text{Exist}}(tw)$

## TRUTH AND DENOTATION IN A CONTEXT

We write:  $\models_{c_{tw}}^{\mathfrak{A}} \Phi$  for  $\Phi$  when taken in the context  $c$  (under the assignment  $f$  and in the structure  $\mathfrak{A}$  is true with respect to the time  $t$  and the world  $w$ ).

We write:  $|\alpha|_{c_{tw}}^{\mathfrak{A}}$  for *The denotation of  $\alpha$  when taken in the context  $c$  (under the assignment  $f$  and in the structure  $\mathfrak{A}$ ) with respect to the time  $t$  and the world  $w$ .*

In general we will omit the superscript ' $\mathfrak{A}$ ', and we will assume that the structure  $\mathfrak{A}$  is  $\langle \mathcal{C} \mathcal{W} \mathcal{U} \mathcal{P} \mathcal{T} \mathcal{J} \rangle$ .

Definition:  $f$  is an assignment (with respect to  $\langle \mathcal{C} \mathcal{W} \mathcal{U} \mathcal{P} \mathcal{T} \mathcal{J} \rangle$ ) iff  $\exists f_1 f_2 (f_1 \in \mathcal{U}^{\mathcal{V}_i} \& f_2 \in \mathcal{P}^{\mathcal{V}_p} \& f = f_1 \cup f_2)$

Definition:  $f_x^\alpha = (f \sim \{\langle \alpha f(\alpha) \rangle\} \vee \{\langle \alpha x \rangle\})$  (i.e., the assignment which is just like  $f$  except that it assigns  $x$  to  $\alpha$ )

For the following recursive definitions, assume that  $c \in \mathcal{C}$ ,  $f$  is an assignment,  $t \in \mathcal{T}$ , and  $w \in \mathcal{W}$ .

1. If  $\alpha$  is a variable,  $|\alpha|_{c_{tw}} = f(\alpha)$
2.  $\models_{c_{tw}} \pi \alpha_1 \dots \alpha_m \beta_1 \dots \beta_n$  iff  $\langle |\alpha_1|_{c_{tw}} \dots |\beta_n|_{c_{tw}} \rangle \in \mathcal{J}_\pi(tw)$
3. If  $\eta$  is neither  $I$  nor  $\text{Here}$  (see 12, 13 below), then

$$|\eta \alpha_1 \dots \alpha_m \beta_1 \dots \beta_n|_{c_{tw}} = \begin{cases} \mathcal{J}_\eta(tw) (\langle |\alpha_1|_{c_{tw}} \dots |\beta_n|_{c_{tw}} \rangle), & \text{if} \\ \text{none of } |\alpha_j|_{c_{tw}} |\beta_k|_{c_{tw}} \text{ are } \dagger, & \\ \dagger, & \text{otherwise} \end{cases}$$

4. (i)  $\models_{c_{tw}} (\Phi \wedge \Psi)$  iff  $\models_{c_{tw}} \Phi \& \models_{c_{tw}} \Psi$   
(ii)  $\models_{c_{tw}} \neg \Phi$  iff  $\sim \models_{c_{tw}} \Phi$   
etc.
5. (i) If  $\alpha \in \mathcal{V}_i$ , then  $\models_{c_{tw}} \forall \alpha \Phi$  iff  $\forall i \in \mathcal{U} \models_{c_{t, i}^{\alpha} tw} \Phi$   
(ii) If  $\alpha \in \mathcal{V}_p$ , then  $\models_{c_{tw}} \forall \alpha \Phi$  iff  $\forall p \in \mathcal{P} \models_{c_{t, p}^{\alpha} tw} \Phi$   
Similarly for  $\exists \alpha \Phi$
6. (i) If  $\alpha \in \mathcal{V}_i$ , then  $|\text{the } \alpha \Phi|_{c_{tw}} = \begin{cases} \text{the unique } i \in \mathcal{U} \text{ such that} \\ \models_{c_{t, i}^{\alpha} tw} \Phi, & \text{if there is such.} \\ \dagger & \text{otherwise} \end{cases}$   
(ii) Similarly for  $\alpha \in \mathcal{V}_p$
7.  $\models_{c_{tw}} \alpha = \beta$  iff  $|\alpha|_{c_{tw}} = |\beta|_{c_{tw}}$
8. (i)  $\models_{c_{tw}} \Box \Phi$  iff  $\forall w' \in \mathcal{W} \models_{c_{t, w'} tw} \Phi$   
(ii)  $\models_{c_{tw}} \Diamond \Phi$  iff  $\exists w' \in \mathcal{W} \models_{c_{t, w'} tw} \Phi$
9. (i)  $\models_{c_{tw}} F \Phi$  iff  $\exists t' \in \mathcal{T}$  such that  $t' > t$  and  $\models_{c_{t', w} tw} \Phi$   
(ii)  $\models_{c_{tw}} P \Phi$  iff  $\exists t' \in \mathcal{T}$  such that  $t' < t$  and  $\models_{c_{t', w} tw} \Phi$   
(iii)  $\models_{c_{tw}} G \Phi$  iff  $\models_{c_{(t-1)w} tw} \Phi$
10. (i)  $\models_{c_{tw}} N \Phi$  iff  $\models_{c_{(c_T)w} tw} \Phi$   
(ii)  $\models_{c_{tw}} A \Phi$  iff  $\models_{c_{(c_P)w} tw} \Phi$   
(iii)  $\models_{c_{tw}} Y \Phi$  iff  $\models_{c_{(c_T-1)w} tw} \Phi$
11.  $d$  that  $\alpha|_{c_{tw}} = |\alpha|_{c_{(c_T)w}}$
12.  $I|_{c_{tw}} = c_A$
13.  $\text{Here}|_{c_{tw}} = c_P$

Remark 1: Expressions containing demonstratives will, in general, express different concepts in different contexts. We call the concept expressed in a given context the *Content* of the expression in that context. The Content of a sentence in a context is, roughly, the proposition the sentence would express if uttered in that context. This description is not quite accurate on two counts. First, it is important to distinguish an *utterance* from a *sentence-in-a-context*. The former notion is from the theory of speech acts, the latter from semantics. Utterances take time, and utterances of distinct sentences cannot be simultaneous (i.e., in the same context). But to develop a logic of demonstratives it seems most natural to be able to evaluate several premises and a conclusion all in the same context. Thus the notion of  $\Phi$  being true in  $c$  and  $\mathfrak{A}$  does not require an utterance of  $\Phi$ . In particular,  $c_A$  need not be uttering  $\Phi$  in  $c_W$  at  $c_T$ . Second, the truth of a proposition is not usually thought of as dependent on a time as well as a possible world. The time is thought of as fixed by the context. If  $\Phi$  is a sentence, the more usual notion of the proposition expressed by  $\Phi$ -in- $c$  is what is here called the Content of  $N\Phi$  in  $c$ .

Where  $\Gamma$  is either a term or a formula,

we write:  $\{\Gamma\}_{c_{tw}}^{\mathfrak{A}}$  for *The Content of  $\Gamma$  in the context  $c$  (under the assignment  $f$  and in the structure  $\mathfrak{A}$ ).*

- Definition: (i) If  $\Phi$  is a formula,  $\{\Phi\}_{ct}^{\mathfrak{A}}$  = that function which assigns to each  $t \in \mathcal{T}$  and  $w \in \mathfrak{W}$  Truth, if  $\frac{\mathfrak{A}}{ctw} \Phi$ , and Falsehood otherwise.  
(ii) If  $\alpha$  is a term,  $\{\alpha\}_{ct}^{\mathfrak{A}}$  = that function which assigns to each  $t \in \mathcal{T}$  and  $w \in \mathfrak{W}$ ,  $|\alpha|_{ctw}^{\mathfrak{A}}$ .

Remark 2:  $\frac{\mathfrak{A}}{ctw} \Phi$  iff  $\{\Phi\}_{ct}^{\mathfrak{A}}(tw) = \text{Truth}$ . Roughly speaking, the sentence  $\Phi$  taken in the context  $c$  is *true with respect to*  $t$  and  $w$  iff the proposition expressed by  $\Phi$ -in-the-context- $c$  would be true at the time  $t$  if  $w$  were the actual world. In the formal development of pages 406 and 407 it was smoother to ignore the conceptual break marked by the notion of *Content in a context* and to directly define *truth in a context with respect to a possible time and world*. The important conceptual role of the notion of Content is partially indicated by the following two definitions.

Definition:  $\Phi$  is true in the context  $c$  (in the structure  $\mathfrak{A}$ ) iff for every assignment  $f$ ,  $\{\Phi\}_{ct}^{\mathfrak{A}}(c_T, c_W) = \text{Truth}$ .

Definition:  $\Phi$  is valid in LD ( $\models \Phi$ ) iff for every LD structure  $\mathfrak{A}$  and every context  $c$  of  $\mathfrak{A}$ ,  $\Phi$  is true in  $c$  (in  $\mathfrak{A}$ ).

Remark 3:  $\models (\alpha = d\text{that } \alpha)$ ,  $\models N(\text{Located } I, \text{Here})$ ,  $\models \text{Exist } I$ ,  $\sim \models \Box(\alpha = d\text{that } \alpha)$ ,  $\sim \models \Box N(\text{Located } I, \text{Here})$ ,  $\sim \models \Box(\text{Exist } I)$ . In the converse direction we have the usual results in view of the fact that  $\models (\Box\Phi \rightarrow \Phi)$ .

Definition: If  $\alpha_1 \dots \alpha_n$  are all the free variables of  $\Phi$  in alphabetical order, then the closure of  $\Phi = AN \forall \alpha_1 \dots \alpha_n \Phi$ .

Definition:  $\Phi$  is closed iff  $\Phi$  is equivalent (in the sense of Remark 12) to its closure.

Remark 4: If  $\Phi$  is closed, then  $\Phi$  is true in  $c$  (and  $\mathfrak{A}$ ) iff for every assignment  $f$ , time  $t$ , and world  $w \in \frac{\mathfrak{A}}{ctw} \Phi$ .

Definition: Where  $\Gamma$  is either a term or a formula, the Content of  $\Gamma$  in the context  $c$  (in the structure  $\mathfrak{A}$ ) is stable iff for every assignment  $f$ ,  $\{\Gamma\}_{ct}^{\mathfrak{A}}$  is a constant function. (i.e.,  $\{\Gamma\}_{ct}^{\mathfrak{A}}(tw) = \{\Gamma\}_{ct}^{\mathfrak{A}}(t'w')$ , for all  $t, t', w, w'$  in  $\mathfrak{A}$ ).

Remark 5: Where  $\Phi$  is a formula,  $\alpha$  is a term, and  $\beta$  is a variable, each of the following has a stable Content in every context (in every structure):  $AN\Phi$ ,  $d\text{that } \alpha, \beta, I, \text{Here}$ .

If we were to extend the notion of Content to apply to operators, we would see that all demonstratives have a stable Content in every context. The same is true of the familiar logical constants although it does not hold for the modal and tense operators (not, at least, according to the foregoing development).

Remark 6: That aspect of the meaning of an expression which determines what its Content will be in each context, we call the *Character* of the expression.

Although a lack of knowledge about the context (or perhaps about the structure) may cause one to mistake the Content of a given utterance, the Character of each well-formed expression is determined by rules of the language (such as rules 1–13 on pages 406, 407 of this paper) which are presumably known to all competent speakers. Our notation  $\{\Phi\}_{ct}^{\mathfrak{A}}$  for the Content of an expression gives a natural notation for the Character of an expression, namely  $\{\Phi\}$ .

Definition: Where  $\Gamma$  is either a term or a formula the *Character* of  $\Gamma$  is that function which assigns to each structure  $\mathfrak{A}$ , assignment  $f$ , and context  $c$  of  $\mathfrak{A}$ ,  $\{\Gamma\}_{ct}^{\mathfrak{A}}$ .

Definition: Where  $\Gamma$  is either a term or a formula, the *Character* of  $\Gamma$  is stable iff for every structure  $\mathfrak{A}$ , and assignment  $f$  the Character of  $\Gamma$  (under  $f$  in  $\mathfrak{A}$ ) is a constant function. (i.e.,  $\{\Gamma\}_{ct}^{\mathfrak{A}} = \{\Gamma\}_{c't}^{\mathfrak{A}}$  for all  $c, c'$  in  $\mathfrak{A}$ ).

Remark 7: A formula or term has a stable Character iff it has the same Content in every context (for each  $\mathfrak{A}, f$ ).

Remark 8: A formula or term has a stable Character iff it contains no essential occurrence of a demonstrative.

Remark 9: The logic of demonstratives determines a sublogic of those formulas of LD which contain no demonstratives. These formulas (and their equivalents which contain inessential occurrences of demonstratives) are exactly the formulas with a stable Character. The logic of demonstratives brings a new perspective even to formulas such as these. The sublogic of LD which concerns only formulas of stable Character is not identical with traditional logic. Even for such formulas, the familiar Principle of Necessitation (if  $\models \Phi$ , then  $\models \Box\Phi$ ) fails. And so does its tense logic counterpart: if  $\models \Phi$ , then  $\models (\neg P\neg\Phi \wedge \neg F\neg\Phi \wedge \Phi)$ . From the perspective of LD, validity is truth in every possible context. For traditional logic, validity is truth in every possible circumstance. Each possible context determines a possible circumstance, but it is not the case that each possible circumstance is part of a possible context. In particular, the fact that each possible context has an agent implies that any possible circumstance in which no individuals exist will not form a part of any possible context. Within LD, a possible context is represented by  $\langle \mathfrak{A}, c \rangle$  and a possible circumstance by  $\langle \mathfrak{A}, t, w \rangle$ . To any  $\langle \mathfrak{A}, c \rangle$ , there corresponds  $\langle \mathfrak{A}, c_T, c_W \rangle$ . But it is not the case that to every  $\langle \mathfrak{A}, t, w \rangle$  there exists a context  $c$  of  $\mathfrak{A}$  such that  $t = c_T$  and  $w = c_W$ . The result is that in LD such sentences as  $\exists x \text{Exist } x$  and  $\exists x \exists p \text{Located } x, p$  are valid, although they would not be so regarded in traditional logic, at least not in the neotraditional logic that countenances empty worlds. Using the semantical developments of pages 406–407, we can define this traditional sense of validity (for formulas which do not contain demonstratives) as follows. First note that by Remark 7, if  $\Phi$  has a stable Character,

$$\frac{\mathfrak{A}}{ctw} \Phi \text{ iff } \frac{\mathfrak{A}}{c'tw} \Phi$$

Thus for such formulas we can define,

$\Phi$  is true at  $tw$  (in  $\mathfrak{M}$ ) iff for every assignment  $f$  and every context  $c \models_{\mathfrak{M}w} \Phi$

The neotraditional sense of validity is now definable as follows:

$\models \Phi$  iff for all structures  $\mathfrak{M}$ , times  $t$ , and worlds  $w$ ,  $\Phi$  is true at  $tw$  (in  $\mathfrak{M}$ ).

(Properly speaking, what I have called the neotraditional sense of validity is the notion of validity now common for a quantified S5 modal tense logic with individual variables ranging over possible individuals and a predicate of existence.) Adding the subscript 'LD' for explicitness, we can now state some results.

- (i) If  $\Phi$  contains no demonstratives,  
if  $\models \Phi$ , then  $\models_{\text{LD}} \Phi$
- (ii)  $\models_{\text{LD}} \exists x \text{ Exist } x$ , but  $\not\models \exists x \text{ Exist } x$

Of course  $\Box \exists x \text{ Exist } x$  is not valid even in LD. Nor are its counterparts,  $\neg F \neg \exists x \text{ Exist } x$  and  $\neg P \neg \exists x \text{ Exist } x$ .

This suggests that we can transcend the context-oriented perspective of LD by generalizing over times and worlds so as to capture those possible circumstances  $\langle \mathfrak{M}, t, w \rangle$  which do not correspond to any possible contexts  $\langle \mathfrak{M}, c \rangle$ . We have the following result.

- (iii) If  $\Phi$  contains no demonstratives,  
 $\models \Phi$  iff  $\models_{\text{LD}} \Box (\neg F \neg \Phi \wedge \neg P \neg \Phi \wedge \Phi)$ .

Although our definition of the neotraditional sense of validity was motivated by consideration of demonstrative-free formulas, we could apply it also to formulas containing essential occurrences of demonstratives. To do so would nullify the most interesting features of the logic of demonstratives. But it raises the question, can we express our new sense of validity in terms of the neotraditional sense? This can be done:

- (iv)  $\models_{\text{LD}} \Phi$  iff  $\models \text{AN } \Phi$

Remark 10: Rigid designators (in the sense of Kripke) are terms with a stable Content. Since Kripke does not discuss demonstratives, his examples all have, in addition, a stable Character (by Remark 8). Kripke claims that for proper names  $\alpha, \beta$  it may happen that  $\alpha = \beta$ , though not a priori, is nevertheless necessary. This, in spite of the fact that the names  $\alpha, \beta$  may be introduced by means of descriptions  $\alpha', \beta'$  for which  $\alpha' = \beta'$  is not necessary. An analogous situation holds in LD. Let  $\alpha', \beta'$  be definite descriptions (without free variables) such that  $\alpha' = \beta'$  is not a priori, and consider the (rigid) terms:  $d\text{that } \alpha'$ ,  $d\text{that } \beta'$ , which are formed from them. We know that

$$\models (d\text{that } \alpha' = d\text{that } \beta' \leftrightarrow \alpha' = \beta').$$

Thus, if  $\alpha' = \beta'$  is not a priori, neither is  $d\text{that } \alpha' = d\text{that } \beta'$ . But, since  $\models [d\text{that } \alpha' = d\text{that } \beta' \rightarrow \Box(d\text{that } \alpha' = d\text{that } \beta')]$ , it may happen that  $d\text{that } \alpha' = d\text{that } \beta'$  is necessary. The converse situation can also be illustrated in LD. Since  $(\alpha = d\text{that } \alpha)$  is valid (see Remark 3), it is surely capable of being known a priori. But if  $\alpha$  lacks a stable Content (in some context  $c$ ),  $\Box(\alpha = d\text{that } \alpha)$  will be false.

Remark 11: Our 0-0-place i-functors are not proper names, in the sense of Kripke, since they do not have a stable Content. But they can easily be converted by means of the stabilizing influence of  $d\text{that}$ . Even  $d\text{that } \alpha$  lacks a stable Character. The process by which such expressions are converted into expressions with a stable Character is 'dubbing' — a form of definition in which context may play an essential role. The means to deal with such context-indexed definitions is not available in our object language.

There would, of course, be no difficulty in supplementing our language with a syntactically distinctive set of 0-0-place i-functors whose semantics requires them to have both a stable Character and a stable Content in every context. Variables already behave this way; what is wanted is a class of constants that behave, in these respects, like variables.

The difficulty comes in expressing the definition. My thought is that when a name, like 'Bozo', is introduced by someone saying, in some context  $c^*$ , "Let's call the Governor, 'Bozo'", we have a context-indexed definition of the form:  $A =_{c^*} \alpha$ , where  $A$  is a new constant (here, 'Bozo') and  $\alpha$  is some term whose denotation depends on context (here, 'the Governor'). The intention of such a dubbing is, presumably, to induce the semantical clause: for all  $c \{A\}_{c^*}^{\mathfrak{M}} = \{\alpha\}_{c^*}$ . Such a clause gives  $A$  a stable Character. The context indexing is required by the fact that the Content of  $\alpha$  (the 'definiens') may vary from context to context. Thus the same semantical clause is not induced by taking either  $A = \alpha$  or even  $A = d\text{that } \alpha$  as an axiom.

I think it likely that such definitions play a practically (and perhaps theoretically) indispensable role in the growth of language, allowing us to introduce a vast stock of names on the basis of a meager stock of demonstratives and some ingenuity in staging of demonstrations.

Perhaps such introductions should not be called 'definitions' at all, since they essentially enrich the expressive power of the language. What a nameless man may express by 'I am hungry' may be inexpressible in remote contexts. But once he says "Let's call me 'Bozo,'" his Content is accessible to us all.

Remark 12: The strongest form of logical equivalence between two formulas  $\Phi$  and  $\Phi'$  is sameness of Character,  $\{\Phi\} = \{\Phi'\}$ . This form of synonymy is expressible in terms of validity.

$$\{\Phi\} = \{\Phi'\} \text{ iff } \models \Box [\neg F \neg (\Phi \leftrightarrow \Phi') \wedge \neg P \neg (\Phi \leftrightarrow \Phi') \wedge (\Phi \leftrightarrow \Phi')]$$

[Using Remark 9 (iii) and dropping its condition, which was stated only to express the intended range of applicability of  $\models$ , we have:  $\{\Phi\} = \{\Phi'\}$  iff  $\models (\Phi \leftrightarrow \Phi')$ .] Since definitions of the usual kind (as opposed to dubbings) are intended to introduce a short expression as a mere abbreviation of a longer one, the Character of the defined sign should be the same as the Character of the definiens. Thus, within LD, definitional axioms must take the form indicated above.

Remark 13: If  $\beta$  is a variable of the same sort as the term  $\alpha$  but is not free in  $\alpha$ , then  $\{\text{dthat } \alpha\} = \{\text{the } \beta \text{ AN}(\beta = \alpha)\}$ . Thus for every formula  $\Phi$ , there can be constructed a formula  $\Phi'$  such that  $\Phi'$  contains no occurrence of *dthat* and  $\{\Phi\} = \{\Phi'\}$ .

Remark 14: *Y* (yesterday) and *G* (one day ago) superficially resemble one another in view of the fact that  $\models (Y\Phi \leftrightarrow G\Phi)$ . But the former is a demonstrative whereas the latter is an iterative temporal operator. "One day ago it was the case that one day ago it was the case that John yawned" means that John yawned the day before yesterday. But "Yesterday it was the case that yesterday it was the case that John yawned" is only a stutter.

### POSSIBLE REFINEMENTS

1. The primitive predicates and functors of first-order predicate logic are all taken to be extensional. Alternatives are possible.
2. Many conditions might be added on  $\mathcal{P}$ ; many alternatives might be chosen for  $\mathcal{T}$ . If the elements of  $\mathcal{T}$  do not have a natural relation to play the role of  $<$ , such a relation must be added to the structure.
3. When  $K$  is a set of LD formulas,  $K \models \Phi$  is easily defined in any of the usual ways.
4. Aspects of the contexts other than  $c_A$ ,  $c_P$ ,  $c_T$ , and  $c_W$  would be used if new demonstratives (e.g., pointings, *You*, etc.) were added to the language. (Note that the subscripts A, P, T, W are external parameters. They may be thought of as functions applying to contexts, with  $c_A$  being the value of A for the context  $c$ .)
5. Special continuity conditions through time might be added for the predicate *Exists*.
6. If individuals lacking positions are admitted as agents of contexts, 3(iii) of page 406 should be weakened to  $c_P \in \mathcal{P} \cup \{\dagger\}$ . It would no longer be the case that  $\models$  *Located I, Here*. If individuals also lacking temporal location (disembodied minds?) are admitted as agents of contexts, a similar weakening is required of 3(ii). In any case it would still be true that  $\models$  *Exist I*.

### FOOTNOTES

<sup>1</sup> This paper was originally composed in two parts. The formal Logic of Demonstratives was first presented at the Irvine Summer Institute in the Philosophy of Language in 1971. It was expanded in 1973. The initial discursive material was written on April 20, 1973, as part of a research proposal. This paper was intended as a companion piece to and progress report on the material in "Dthat" (this volume). A more extensive presentation occurs in my manuscript *Demonstratives*.

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<sup>2</sup> Rudolf Carnap, *Meaning and Necessity* (Chicago, 1947).

<sup>3</sup> Or possibly, just in case  $\Phi$  was true at every index that differed from the given index only in the possible world coordinate.

<sup>4</sup> Saul Kripke, "Naming and Necessity," in *Semantics of Natural Language*, eds. D. Davidson and G. Harman (Dordrecht, Holland, 1972).

<sup>5</sup> Peter Strawson, *Introduction to Logical Theory* (New York, 1952).