

INTERPRETED LOGICAL FORMS*

In recent semantics literature, a number of authors (including Harman (1972), Higginbotham (1986, 1991), and Segal (1989)) have suggested that familiar semantic problems arising with propositional attitude verbs might be resolved by taking such predicates to express relations between agents and *interpreted logical forms* (ILFs). ILFs are annotated constituency graphs or phrase-markers whose nodes pair terminal and nonterminal symbols with a semantic value. Such objects in effect represent a semantic value together with its linguistic 'mode of presentation'.¹

In this paper, we present an explicit theory of interpreted logical forms (ILFs) – their construction and properties – and we argue that classical questions regarding propositional attitude semantics are indeed illuminated by these means. In Section 1, we introduce ILFs informally and then go on, in Section 2, to present our formal construction algorithm, embedding it within a recursive theory of truth for natural language of the kind advocated by Davidson (1984a). In Sections 3–5, we discuss the application of ILFs to issues involving substitutivity, demonstratives, general beliefs, and iterated attitude ascriptions. In Section 6, we briefly compare the account to other theories. Finally, in Section 7, we explore the relation of ILFs to belief ascriptions.

1. ILFs AND THE 'PROBLEM OF THE ATTITUDES'

ILFs are advanced in response to a familiar problem for extensional semantic theories posed by propositional attitude contexts. As noted by Frege (1892), such contexts appear to challenge the otherwise quite general principle that the reference of an expression is a function of the references of its subconstituent parts. The pairs in (1) and (2) give a standard example of the problem. Whereas substitution of the coreferring noun phrase *Frances Gumm* for *Judy Garland* preserves truth-value in nonattitudinal contexts like (1a,b), the same is not true in attitudinal contexts like (2a,b):

- (1)a. Judy Garland sang "Somewhere Over the Rainbow".

- (1)b. Frances Gumm sang “Somewhere Over the Rainbow”.
- (2)a. Max believes Judy Garland sang “Somewhere Over the Rainbow”.
- b. Max believes Frances Gumm sang “Somewhere Over the Rainbow”.

This behavior is observed broadly with expressions occurring in the scope of attitude verbs, and not just with proper names. Thus despite the fact that *xerox* and *photocopy* are coextensive predicates, from (3a) we cannot infer (3b). Similarly, although the common nouns *woodchuck* and *groundhog* refer to exactly the same members of genus *Marmota*, (4a) does not entail (4b):²

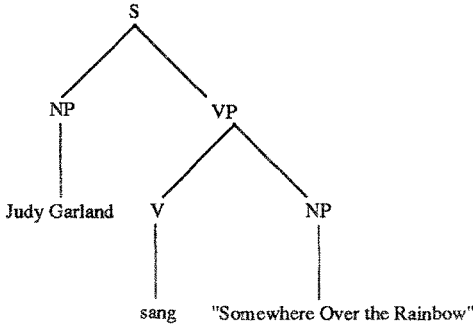
- (3)a. Max believes Mary xeroxed *War and Peace*.
- b. Max believes Mary photocopied *War and Peace*.
- (4)a. Max believes there is a woodchuck on the veranda.
- b. Max believes there is a groundhog on the veranda.

The leading idea of the ILF theory is that clausal complement-taking verbs express relations between agents and interpreted phrase-markers, in which each node has been paired with the semantic value assigned to it under some valuation predicate. These objects provide an account of failures of substitution in attitude contexts. We may illustrate the main idea with example (2a) (repeated below). On the ILF theory, *believe* will express a relation between Max and the ILF for the embedded clause *Judy Garland sang “Somewhere Over the Rainbow”*:

- (2a) Max believes Judy Garland sang “Somewhere Over the Rainbow”.

(5a) gives a standard syntactic representation for the embedded sentence. Furthermore, under a simple extensional semantic theory, the subparts of this tree might plausibly receive semantic values (or referents) as shown in (5b):

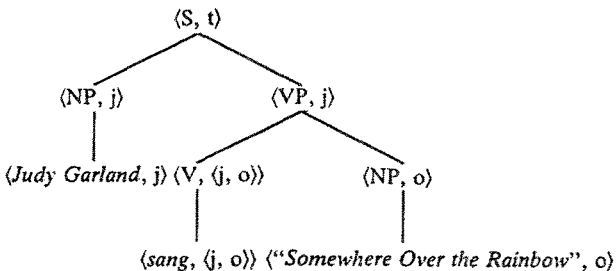
(5)a.



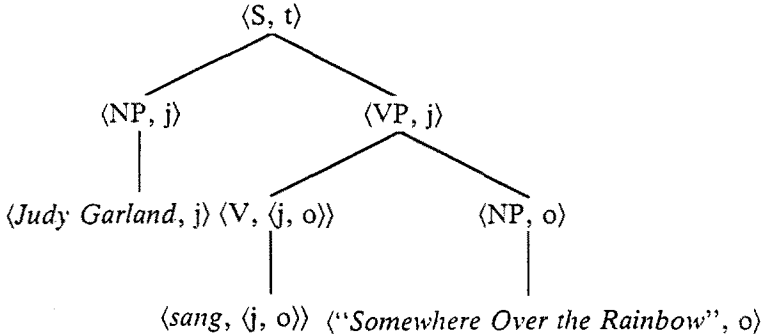
- b. i. *Judy Garland* refers to Judy Garland.
- ii. [_{NP} *Judy Garland*] refers to Judy Garland.
- iii. "*Somewhere Over the Rainbow*" refers to the song "*Somewhere Over the Rainbow*".
- iv. [_{NP} "*Somewhere Over the Rainbow*"] refers to the song "*Somewhere Over the Rainbow*".
- v. *sang* refers (in (5a)) to the pair ⟨*Judy Garland*, "*Somewhere Over the Rainbow*"⟩.
- vi. [_V *sang*] refers (in (5a)) to the pair ⟨*Judy Garland*, "*Somewhere Over the Rainbow*"⟩.
- vii. [_{VP} *sang* "*Somewhere Over the Rainbow*"] refers (in (5a)) to *Judy Garland*.
- viii. [_S *Judy Garland sang* "*Somewhere Over the Rainbow*"] refers to *t* (i.e., the sentence is true).

The ILF for the embedded clause is derived by pairing semantic values with their respective nodes in the syntactic tree, as in (6). Here *j* is the individual *Judy Garland/Frances Gumm*, and *o* is the song "*Somewhere Over the Rainbow*". The resulting object is analyzed as the second argument of *believe* in the final statement of truth-conditions, or T-sentence for the example given in (7):³

(6)

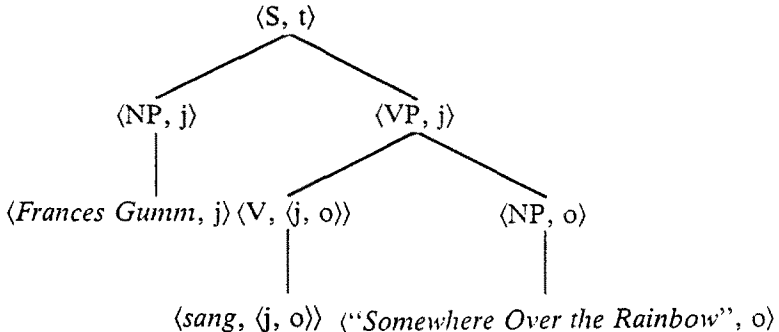


- (7) *Max believes Judy Garland sang "Somewhere Over the Rainbow"* is true iff Max believes



Recall now (2a,b), where the truth of the former, and the coreferentiality of *Judy Garland* and *Frances Gumm*, are insufficient to guarantee the truth of the latter. The ILF theory correctly predicts this result. As we have seen, (2a) receives the T-sentence in (7). By contrast, (2b) receives the T-sentence in (8):

- (8) *Max believes Frances Gumm sang "Somewhere Over the Rainbow"* is true iff Max believes



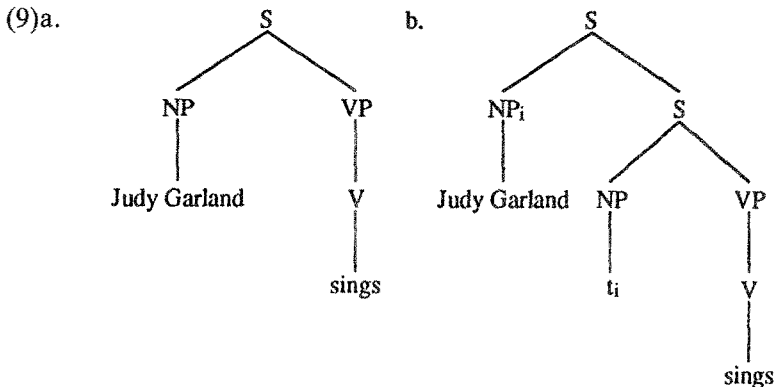
(7) and (8) are distinct T-sentences whose truth requires Max to stand in the belief-relation to different objects. The former requires that he believe an ILF containing the sub-ILF $\langle Judy\ Garland, j \rangle$, whereas the latter requires that he believe an ILF containing the sub-ILF $\langle Frances\ Gumm, j \rangle$. The ILF theory thus correctly distinguishes the two sentences semantically, as desired; neither entails the other.

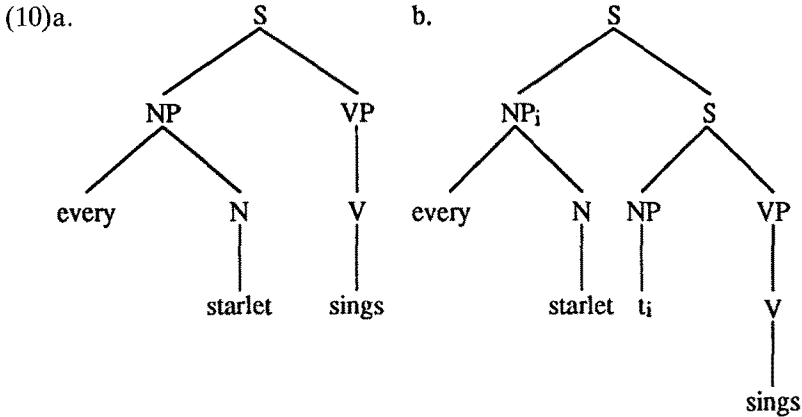
2. A FORMAL THEORY OF ILFs

We now present an explicit ILF theory of the attitudes, embedding it within a formal semantics for (a subportion of) English. Since ILFs partake of both form and reference, their definition evidently presupposes a syntax and a semantic theory for extensional contexts. We thus begin with a brief sketch of our background assumptions.

2.1. *Background Assumptions*

We assume a syntax embodying the basic tenets of the Extended Standard Theory, as developed in Chomsky (1981, 1986) and a large number of related works. Under this theory each sentence is assigned a pair of labeled phrase-markers representing its surface form (or S-structure) and its logical form (or LF).⁴ These two representations are related to one another by means of a movement operation that applies optionally in certain cases and obligatorily in others. For example, the sentence *Judy Garland sings* is assigned the S-structure in (9a), and is associated with two possible LFs according to whether the subject noun phrase optionally raises out of subject position or remains in situ. In the former case, the LF for *Judy Garland sings* is as in (9b); in the latter case, the LF for *Judy Garland sings* is identical to the S-structure (9a). A quantified sentence such as *Every starlet sings* is assigned a similar surface form (10a). However, the derivation of its LF involves obligatory raising of the quantified subject with attachment to S (10b). In both (9b) and (10b), the empty noun phrase in subject position (t_i) is the 'trace' left by raising and represents, in effect, a formal variable bound by the moved quantifier:





Representations like (9b) and (10b) are analogous to the familiar restricted quantifier form of first-order logic (e.g., [for some x_i : x_i = Judy Garland][sings(x_i)] and [every x_i : starlet(x_i)][sings(x_i)]). The movement that derives such representations may be viewed as a form of scope assignment.

For our semantic theory, we assume a general approach along the lines initiated by Davidson (1984a, 1984c), and developed by many subsequent authors (for example, Lycan (1984), Higginbotham (1985, 1986), Larson and Segal (forthcoming)). The core of this approach is a recursive theory of material truth, whose axioms assign semantic values to natural language expressions and yield familiar Tarskian T-sentences. We assume that these axioms apply to syntactic LFs as specified above, and have the general form shown in (11). The latter specifies a semantic value α for a constituent [$_x Y_1 \dots Y_n$] in terms of semantic values β_1, \dots, β_n for its immediate subconstituents $Y_1 \dots Y_n$ (respectively); as usual, all free variables are understood as universally quantified:

$$(11) \quad \text{Val}(\alpha, [_x Y_1 \dots Y_n], \sigma) \text{ iff } \dots, \text{Val}(\beta_1, Y_1, \sigma), \dots, \\ \text{Val}(\beta_n, Y_n, \sigma), \dots$$

(12) gives sample axioms of this form. (12a) states that any sentence S consisting of a subject NP and a predicate VP has the value t with respect to any sequence σ (i.e., the sentence is true with respect to σ) iff there is some individual x that is a semantic value of both the NP and the VP (wrt σ). (12b) states that an NP node dominating the name

Judy Garland has the value x (wrt σ) iff x is Judy Garland. (12d) states that a V node dominating the verb *sings* has the value x (wrt σ) iff x sings, and so on:

- (12)a. $\text{Val}(t, [{}_S \text{ NP VP}], \sigma)$ iff for some x , $\text{Val}(x, \text{NP}, \sigma)$ and $\text{Val}(x, \text{VP}, \sigma)$.
 b. $\text{Val}(x, [{}_{\text{NP}} \text{ Judy Garland}], \sigma)$ iff $x = \text{Judy Garland}$.
 c. $\text{Val}(x, [{}_{\text{VP}} \text{ V}], \sigma)$ iff $\text{Val}(x, \text{V}, \sigma)$.
 d. $\text{Val}(x, [{}_V \text{ sings}], \sigma)$ iff x sings.

Using the axioms in (12a–d) we may prove a T-sentence for the LF phrase-marker in (9a). The biconditionals allow us to derive (13a); substitution of identicals then yields the final T-sentence (13b):

- (13)a. $\text{Val}(t, [{}_S [{}_{\text{NP}} \text{ Judy Garland}] [{}_{\text{VP}} [{}_V \text{ sings}]]], \sigma)$ iff for some x , $x = \text{Judy Garland}$ and x sings.
 b. $\text{Val}(t, [{}_S [{}_{\text{NP}} \text{ Judy Garland}] [{}_{\text{VP}} [{}_V \text{ sings}]]], \sigma)$ iff Judy Garland sings.

A full set of axioms for interpreting the constructions shown in (9) and (10) is given in the Appendix (see Fragment L₀).⁵

2.2. Semantic Axioms for Embedded Clauses

Our formal proposal for an ILF theory of the attitudes extends the basic framework sketched above by adding three parts: (i) a semantic axiom for VPs containing a clause-embedding verb and a sentential complement, (ii) lexical axioms for clause-selecting verbs such as *believe*, *claim*, and *think*, and (iii) a recursive definition of ILFs.

The new VP axiom is given in (14). In prose this rule states that an individual x is a value of a VP containing a clause-embedding V and a complement S (wrt σ) iff there is some y such that $\langle x, y \rangle$ is a value of V and y is the ILF of S (wrt σ):

- (14) $\text{Val}(x, [{}_{\text{VP}} \text{ V S}], \sigma)$ iff for some y , $\text{Val}(\langle x, y \rangle, \text{V}, \sigma)$ and $y = []\text{S}[]$ wrt σ .

Note that under (14), ILFs (and the intensionality effects they bring) are not introduced by specific predicates, such as those involving thoughts and beliefs; rather they are introduced constructionally. ILFs appear in the truth-conditions whenever one has a VP containing a complement S.

Semantic axioms for clause-embedding verbs like *believe* and *think* are given in (15a–c). These embody the simple and familiar idea that such predicates are relational. In prose, (15a) states that a pair $\langle x, y \rangle$ is a value of the verb [_v *believes*] (wrt a sequence σ) iff x believes y ; and so on:

- (15)a. $\text{Val}(\langle x, y \rangle, [\text{v } \textit{believes}], \sigma)$ iff x believes y .
 b. $\text{Val}(\langle x, y \rangle, [\text{v } \textit{thinks}], \sigma)$ iff x thinks y .
 c. $\text{Val}(\langle x, y \rangle, [\text{v } \textit{claims}], \sigma)$ iff x claims y .

In the T-sentence derivation for a sentence containing one of these verbs, x will be the agent of the attitude and y will be an ILF.

Finally, (16) gives the general inductive definition of the *ILF of α with respect to a sequence σ* (abbreviated $[\]\alpha[\]$ wrt σ):⁶

- (16) DEFINITION: Let α be a phrase-marker with root S , let σ be a sequence, and let β be a sub-phrase-marker of α . Then:
- (i) If there is an x such that $\text{Val}(x, \beta, \sigma)$ is provable from $\text{Val}(t, \alpha, \sigma)$ under the axioms of L_0 , and for all y , $\text{Val}(y, \beta, \sigma)$ is provable from $\text{Val}(t, \alpha, \sigma)$ iff $y = x$, and:
- (a) β is a terminal node, then $[\]\beta[\] = \langle \beta, x \rangle$.
 (b) β is $[\text{v } \delta_1 \delta_2 \dots \delta_n]$ for $n \geq 1$, then
 $[\]\beta[\] = [\text{v } \delta_1 [\]\delta_2 [\] \dots [\]\delta_n [\]]$.
- (ii) If there is no x as defined in clause (i), and:
- (a) β is a terminal node, then $[\]\beta[\] = \langle \beta \rangle$.
 (b) β is $[\text{v } \delta_1 \delta_2 \dots \delta_n]$ for $n \geq 1$, then
 $[\]\beta[\] = [\text{v } [\]\delta_1 [\] \dots [\]\delta_n [\]]$.

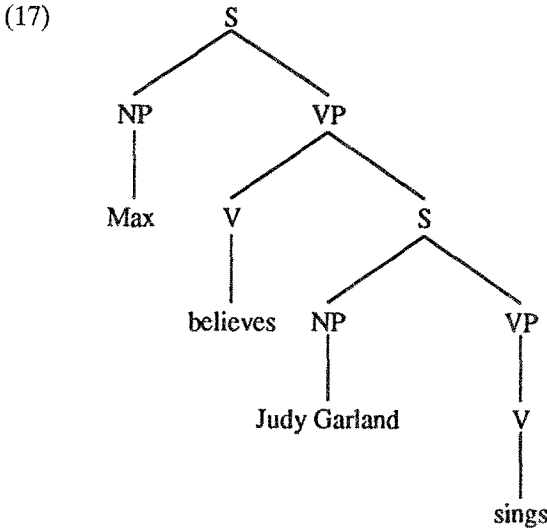
The underlying idea here is just the one introduced informally above: we assume a prior syntactic theory assigning structures to sentences, and a prior semantic theory assigning values to sentences and their subparts under the condition of truth. Assuming the truth of the sentence α whose ILF is to be constructed – that is, assuming $\text{Val}(t, \alpha, \sigma)$ – we can actually prove various subphrases of α to have specific values. The ILF for α is then defined recursively using the structure and the values so assigned. ILFs for simplex lexical items are defined in clause (ia); ILFs for more complex phrases are then built up from the former inductively, as specified in clause (ib).

Clause (ii) appears in the definition of ILFs to accommodate expressions that either fall outside the domain of Val , and hence receive no value in L_1 , or else fail to receive a unique value assignment (with

respect to a given sequence σ). Such elements demand some specific convention for construction of their ILFs, and here we claim that when an expression β fails to receive any value, or fails to receive a unique value, then the ILF for β is just the singleton sequence containing the expression β itself. We discuss applications of clause (ii) in detail in Section 3.2.

2.3. *A Sample T-sentence Derivation*

The content of these assumptions is most easily seen by considering a sample T-sentence derivation for the sentence *Max believes Judy Garland sings*, under the LF structure in (17):



Using axioms from (12), (14), and (15) we proceed as follows:

- (18)a. $\text{Val}(x, [s [_{NP} \text{Max}] [_{VP} [_{V} \text{believes}] [s \text{Judy Garland sings}]]], \sigma)$ iff for some x , $\text{Val}(x, [_{NP} \text{Max}], \sigma)$ and $\text{Val}(x, [_{VP} [_{V} \text{believes}] [s \text{Judy Garland sings}]], \sigma)$.
(by (12a))
- b. $\text{Val}(x, [_{NP} \text{Max}], \sigma)$ iff $x = \text{Max}$.
(by the counterpart of (12b))
- c. $\text{Val}(x, [_{VP} [_{V} \text{believes}] [s \text{Judy Garland sings}]], \sigma)$ iff for

- some y , $\text{Val}(\langle x, y \rangle, [\text{v believes}], \sigma)$ and
 $y = [][\text{s Judy Garland sings}][] \text{ wrt } \sigma$. (by (14))
- d. $\text{Val}(\langle x, y \rangle, [\text{v believes}], \sigma)$ iff x believes y . (by (15a))
- e. $\text{Val}(x, [\text{s} [\text{NP Max}] [\text{VP} [\text{v believes}] [\text{s Judy Garland sings}]]], \sigma)$ iff for some x, y , $x = \text{Max}$, x believes y , and
 $y = [][\text{s Judy Garland sings}][] \text{ wrt } \sigma$. (by (18a–d))
- f. $\text{Val}(x, [\text{s} [\text{NP Max}] [\text{VP} [\text{v believes}] [\text{s Judy Garland sings}]]], \sigma)$ iff Max believes $[][\text{s Judy Garland sings}][] \text{ wrt } \sigma$.
 (by (18e) and Substitution of Identicals)

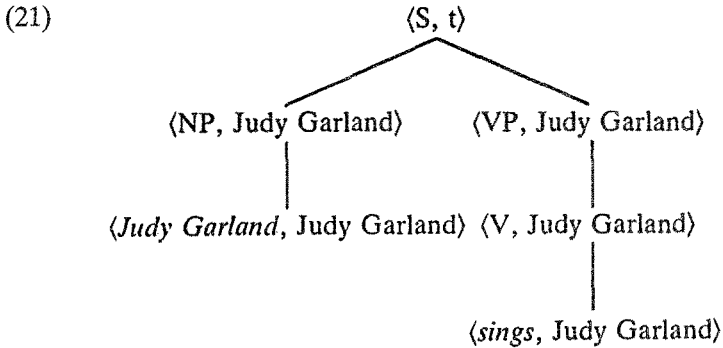
To complete this T-sentence we must determine the ILF $[][\text{s Judy Garland sings}][]$, applying the recursive definition in (16). We begin by using the results obtained in (12) and (13) for the embedded sentence *Judy Garland sings*:

- (19)a. $\text{Val}(t, [\text{s} [\text{NP Judy Garland}] [\text{VP} [\text{v sings}]]], \sigma)$ iff for some x ,
 $\text{Val}(x, [\text{NP Judy Garland}], \sigma)$ and $\text{Val}(x, [\text{VP} [\text{v sings}]]], \sigma)$.
 (by (12a))
- b. $\text{Val}(x, [\text{NP Judy Garland}], \sigma)$ iff $x = \text{Judy Garland}$.
 (by (12b))
- c. $\text{Val}(x, [\text{VP} [\text{v sings}]]], \sigma)$ iff $\text{Val}(x, [\text{v sings}], \sigma)$. (by (12c))
- d. $\text{Val}(x, [\text{v sings}], \sigma)$ iff x sings. (by (12d))

(19a–d) are all biconditionals stating the values that various expressions take when their containing sentence is true. Accordingly, these expressions can be associated with definite values under the assumption that *S* is in fact true. This assumption allows us to formally prove the following:

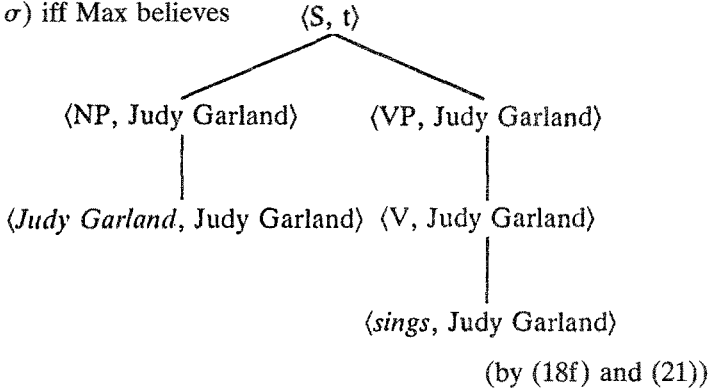
- (20)a. $\text{Val}(t, [\text{s} [\text{NP Judy Garland}] [\text{VP} [\text{v sings}]]], \sigma)$.
 b. $\text{Val}(\text{Judy Garland}, [\text{NP Judy Garland}], \sigma)$.
 c. $\text{Val}(\text{Judy Garland}, [\text{VP} [\text{v sings}]]], \sigma)$.
 d. $\text{Val}(\text{Judy Garland}, [\text{v sings}], \sigma)$.

We now derive the ILF for $[\text{s} [\text{NP Judy Garland}] [\text{VP} [\text{v sings}]]]$, recursively pairing the component expressions of *S* with the values that have been proved for them according to the algorithm in (16):



This allows us to complete the derivation, obtaining the desired T-sentence for the matrix sentence:

(22) Val(x, [_S [_{NP} Max] [_{VP} [_V believes] [_S Judy Garland sings]]], σ) iff Max believes



3. EQUIVALENCE OF ATTITUDE REPORTS

The assumption that ILFs are composed of linguistic forms and extralinguistic objects yields straightforward individuation criteria for ILFs: two ILFs will be distinct whenever they contain distinct forms or distinct objects. This in turn yields straightforward criteria for distinguishing attitude reports. Two attitude reports will be logically nonequivalent whenever their complement clauses are associated with ILFs that differ in either form or content.

3.1. *Attitudes Distinguished by Form*

Under the recursive definition in (16), the linguistic components of an ILF derive from the syntactic phrase-marker that is used to construct it. In current linguistic theory, phrase-markers include a variety of information concerning the gross and fine structure of lexical forms, their identity, the hierarchical structures into which they are arrayed, and dependency relations of various kinds that hold between them. Under the ILF theory, then, it follows that all of these syntactic features are potentially relevant for distinguishing the truth-conditions of attitude reports.

Examples of attitude reports distinguished by the gross shape of words have already been encountered with (2)–(4); and (23) is analogous. These are pairs that differ in the lexical items appearing in their complement clauses, but not in the semantic values of these items. The ILF theory correctly distinguishes their truth-conditions:

- (23)a. Kelly believes [St. Petersburg swings].
 b. Kelly believes [Leningrad swings].

Examples involving more subtle aspects of word form are also available. Linguistic theory views the lexical items in phrase-markers as including information about their segmental and supersegmental phonology.⁷ Since this phonological information is present, the ILF theory predicts it can give rise to distinct ILFs. Discussion of examples like (24) by Ludlow (1985) supports this prediction. Ludlow notes that the truth or falsity of (24) might easily depend on the pronunciation given to the word *Harvard*. Thus consider the case of an individual Jason, who is from New York and unfamiliar with Bostonian dialect patterns. The truth of (24) might well depend on how *Harvard* is pronounced, with (25a) true and (25b) false:

- (24) Jason believes [Harvard is a fine school].
 (25)a. Jason believes that [[harvard] is a fine school].
 b. Jason believes that [[hahvahd] is a fine school].

The articulation of morphemes into words and syntactic phrases is also a prominent feature of phrase-markers, and thus is also predicted to be able to distinguish the truth-conditions of attitude reports. This prediction is verified straightforwardly by examples like (26) and (28).

The truth of (26) may evidently depend on whether the subconstituent words of the complement clause are grouped as in (27a) or (27b). Similarly, the truth of (28) may depend on whether the subconstituent morphemes of the word *unlockable* are grouped as in (29a) or (29b):

- (26) Max believes old men and women are vulnerable.
- (27)a. Max believes [[[old men] and women] are vulnerable].
 b. Max believes [[old [men and women]] are vulnerable].
- (28) Kathrin thinks this door is unlockable.
- (29)a. Kathrin thinks [this door is [un[lockable]]].
 b. Kathrin thinks [this door is [[unlock]able]].

Under (29a), Kathrin is asserted to think that the door in question cannot be locked, whereas with (29b) she is asserted to think that the door can be unlocked.

Various dependency relations, including relations of antecedence and binding, are also widely assumed to be encoded in phrase-markers. Thus consider an example like (30); such sentences (discussed by Geach (1962)) are well known to possess two distinct interpretations according to whether John is asserted to be the only 'John's-mother-lover' or the only 'own-mother-lover'. In current syntactic theory, these two readings correspond to two distinct formal representations that differ according to whether the pronoun *his* is understood as bound by *John* or *only John*. This binding relation is indicated by coindexation as in (31), where (31a,b) correspond to the 'John's-mother-lover' and 'own-mother-lover' readings (respectively):⁸

- (30) Only John loves his mother.
- (31)a. [Only John_i]_j [t_j loves his_i mother].
 b. [Only John_i]_j [t_j loves his_j mother].

Since these numeral 'diacritics' are a part of syntactic representation, we predict that they may figure in the truth-conditions of attitude reports; and, once again, this prediction appears correct. Clearly, (32) may have different truth-values depending on whether Mary is taken to believe that John is the only 'John's-mother-lover' or the only 'own-mother-lover'. Under the ILF this difference of truth-conditions follows from the formal difference in ILFs in the two cases (33a,b):⁹

- (32) Mary believes only John loves his mother.
- (33)a. Val(t , *Mary believes* [[*only John*_{*i*}]_{*j*} [t_j loves his_{*i*} mother]], σ)
iff
Mary believes [][[*only John*_{*i*}]_{*j*} [t_j loves his_{*i*} mother]] [].
- b. Val(t , *Mary believes* [[*only John*_{*i*}]_{*j*} [t_j loves his_{*j*} mother]], σ)
iff
Mary believes [][[*only John*_{*i*}]_{*j*} [t_j loves his_{*j*} mother]] [].

The formal features relevant to the truth-conditions of attitude reports also plausibly include those distinguishing the identity of homophonous morphemes or lexical items. Consider the following examples:

- (34) Max believes [that is a bank].
(35) Max believes [Bill is a flier].

Evidently, we want to differentiate (34) as an assertion that Max believes some object to be a savings institution from (34) as an assertion that Max believes some object to be a fluvial embankment. Similarly, we will want to distinguish the the assertion that Max believes Bill to be an individual who flies, from the assertion that Max believes Bill to be an advertising circular (35). In a lexicon or dictionary, the relevant difference of sense would in each case correspond to a formal distinction: the words *bank* and *flier* would each receive two distinct lexical entries. This yields four formally distinct lexical objects, which we might represent with diacritics as *bank_I*, *bank_{II}*, *flier_I*, and *flier_{II}*. As part of the syntactic representation of a lexical item, these markings will be present in phrase-markers and so serve to discriminate the corresponding attitudes. That is, we will have four distinct ILFs in (34) and (35) according to whether *bank_I* vs. *bank_{II}* or *flier_I* vs. *flier_{II}* appears.

We believe that syntactic discrimination between homophones may furnish a plausible account of certain interesting cases noted by Kripke (1979). Consider the example of a single individual Paderewski, who is known by another individual, Ralph, in two distinct contexts: as the famous, flamboyant, symphony conductor, and as Ralph's reclusive upstairs neighbor. Ralph knows that both have the name *Paderewski*; what he does not know is that the two are one and the same individual. Under these circumstances it seems possible for both of the following to be true.

- (36)a. Ralph believes [Paderewski is shy].
 b. Ralph does not believe [Paderewski is shy].

The objects appearing in the ILFs for (36a,b) will be the same in both cases since *Paderewski* refers to a single individual. Hence if these attitude reports are to be distinguished at all, it seems their ILFs must be distinguished formally. We suggest that (36a,b) represent a case of homophony between what are in fact two syntactically distinct objects. That is, we suggest that there are actually two names here, *Paderewski_I* and *Paderewski_{II}*, and that the reports in (36) are distinguished analogously to those in (35).

Richard (1990) entertains a suggestion similar to this one but rejects it on grounds that *Paderewski* is surely unambiguous in our public language, the language of the belief report, and that Ralph's dialect is arguably identical with our own.¹⁰ Either of these assumptions may be challenged. Presumably, the grammar in which the report is couched can accommodate the general situation of a single entity bearing more than one name (*Frances Gumm/Judy Garland; Hesperus/Phosphorus/Venus*). Furthermore, given our discussion of (35), it presumably also has the resources to discriminate syntactically between homophones, say, through 'diacritics' like those distinguishing *bank_I* and *bank_{II}*. Taken together it then follows that the grammar of the report will have resources that allow a single entity to bear several names, all homophonous, but formally distinct. Accordingly, even if the name *Paderewski* is univocal for both the belief reporter and the interlocutor, we will nonetheless have the linguistic wherewithal to assign T-sentences to (36a,b) that do not amount to an assertion and its negation.

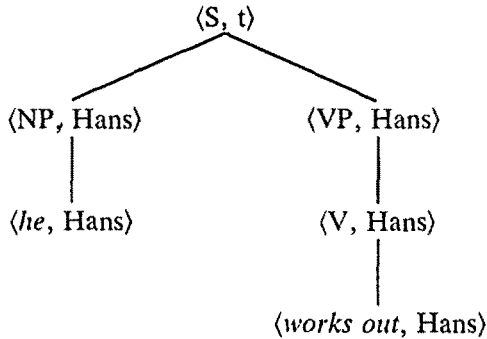
3.2. Attitudes Distinguished by Content

A simple case of attitude reports that are logically nonequivalent by virtue of containing distinct extralinguistic objects is the pair in (37a,b). Although the second sentence in each is identical in form, it is nonetheless possible for one to be true and the other false. Once again, the ILF theory correctly yields this result. The embedded complement in the second sentence of (37a) will receive the ILF in (38a), whereas the embedded complement in (37b) receives the ILF in (38b):¹¹

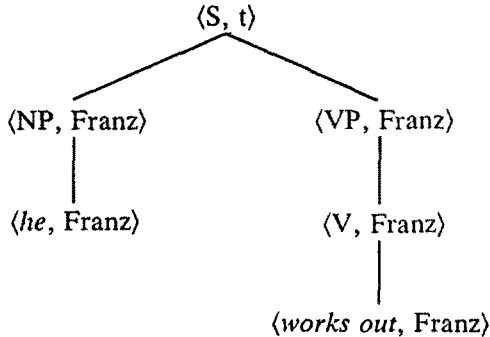
- (37)a. Hans is brawny. Arnold believes he works out. (*he* refers to Hans)

- b. Franz is brawny. Arnold believes he works out. (*he* refers to Franz)

(38)a. $\text{Val}(t, \text{Arnold believes he works out}, \sigma)$ iff Arnold believes



(38)b. $\text{Val}(t, \text{Arnold believes he works out } \sigma)$ iff Arnold believes



These are distinct T-sentences; neither logically entails the other.¹²

We believe that certain interesting examples involving demonstratives may also represent cases of attitude reports distinguished by content. Consider the following two situations in which it is dusk and I am standing with a friend and facing west.¹³ In the first situation, I point to the planet Venus, uttering the sentence in (39) at a normal rate, and gesturing twice. In the second, I point to Venus and utter the portion of (39) up to the first occurrence of *that planet*, but then proceed to speak very slowly so that, in the interval, the night passes and Venus once again becomes visible in the morning sky. I finish the sentence, gesturing now at the newly arisen planet.

- (39) Max believes that that planet is that planet.

It seems intuitively clear that, in the two situations just described, the truth-conditions of (39) should be distinguished analogously to the familiar pair in (40a,b) involving proper names for Venus. In the first, we ascribe to Max little more than a grasp of self-identity, whereas in the second, we ascribe to him belief about a significant empirical truth:

- (40)a. Max believes that Hesperus is Hesperus.
 b. Max believes that Hesperus is Phosphorus.

What is wanted is a way of distinguishing the complement of (39) qua a statement of self-identity and the complement of (39) qua a statement of significant empirical truth.

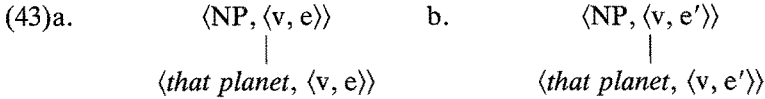
It is clear that to draw such a distinction, the ILF for the demonstrative *that planet* must be richer than what is given in (41a). Specifically, the ILF must involve some additional representational content a (41b), for example, a representation of sensory information: the-appearance-of-Venus-at-dusk or the-appearance-of-Venus-at-dawn, etc. Alternatively, the ILF for *that planet* must involve additional objectual content β (41c) (where 'v' denotes the planet Venus):¹⁴

- (41)a. $\langle \text{NP}, v \rangle$
 |
 $\langle \textit{that planet}, v \rangle$
- b. $\langle \langle \text{NP}, \alpha \rangle, v \rangle$
 |
 $\langle \langle \textit{that planet}, \alpha \rangle, v \rangle$
- c. $\langle \text{NP}, \langle v, \beta \rangle \rangle$
 |
 $\langle \textit{that planet}, \langle v, \beta \rangle \rangle$

We believe that the analysis of demonstratives proposed in Burge (1974) offers a promising approach along the line of (41c). In brief, Burge argues that the axioms for demonstrative constructions must accommodate the act or event of demonstration. For example, the T-sentence Burge assigns to *That dog is an animal* is as paraphrased in (42):¹⁵

- (42) For any e, p, x, t, if e is an act of reference by p to x at time t with *that* in *That dog is an animal*, then *That dog is an animal* is true wrt p and t iff the object that is x and that is a dog is an animal.

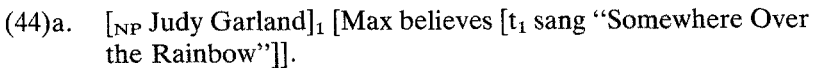
Abstracting from details, what is crucial to note in (42) is the presence of the event variable *e*, which ranges over acts of demonstration or reference by the speaker. Under Burge’s account, the semantic value of a demonstrative NP like *that dog* involves not only an object *x* but also an event *e*; that is, such expressions are relational, taking pairs $\langle x, e \rangle$ as their semantic values.¹⁶ Given this reanalysis of the semantic value for demonstratives, distinct T-sentences for (39) can now be assigned in the two situations described above. These will involve sub-ILFs for the demonstratives that do not differ in their linguistic form (*that planet*), or in the object demonstrated (Venus); but do differ in the second member of the pair $\langle x, e \rangle$. Each demonstrative will involve a different event, corresponding to a different act of demonstration.¹⁷



If this proposal is on the right track, then examples like (39) represent another case of attitudes distinguished by content.

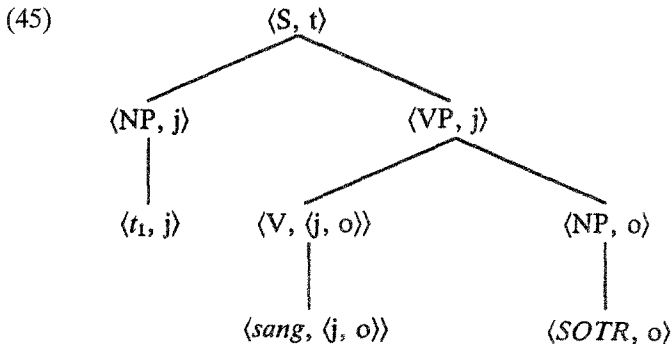
3.3. *Logically Equivalent Attitude Reports*

Although (14)–(16) impose rather strict conditions on the logical equivalence of attitude reports, equivalence nonetheless is still possible in certain cases within the ILF theory. In particular, two distinct attitude reports α and β will be logically equivalent when the following two conditions are met: (i) the values assigned to the subparts of the complement clauses of α and β are identical (that is, α and β differ at most in the forms of (some of) their subconstituent parts); and (ii) α and β are evaluated under structures in which their formally distinct (but coreferring) subparts are given scope out of the complement clauses, beyond the highest attitude verb. We illustrate once again with (2a,b). In the discussion above we considered LF representations of sentences in which their proper name subjects were confined to the subordinate clause. Suppose, however, that these sentences are assigned LFs in which the subordinate subject is optionally given broad scope:



- b. $[_{NP} \text{ Frances Gumm}]_1$ [Max believes [t_1 sang "Somewhere Over the Rainbow"]].

The clausal complements are now formally identical, both having the form: t_1 sang "Somewhere Over the Rainbow". Furthermore, the semantic value assigned to the trace t_1 will be the same in both cases: t_1 will denote the individual Judy Garland/Frances Gumm. Accordingly, the T-sentences for (2a) and (2b) will be identical, requiring Max to stand in the believe-relation to one and the same object (45).¹⁸



Hence under these structures, in which formally distinct but coreferring phrases are scoped out of the complement clause, the truth-conditions of (44a,b) are the same.

The scopal mechanism for producing truth-conditionally equivalent attitude reports will of course be constrained by whatever independent syntactic limitations exist on what can be 'moved' at LF and the distances such moved phrases may traverse. Under current syntactic theory, the possibilities for such movements are in fact quite limited. Thus although NPs like those in (2) are subject to movement over potentially large amounts of syntactic context, predicates like those in (3) are not.¹⁹ This means that (3a,b) are not predicted to have truth-conditions that are logically equivalent in virtue of *xerox* and *photocopy* having been scoped out of the complement clause:

- (46)a. $[_v \text{ xerox}]_1$ [Max believes [Mary t_1 War and Peace]].
 b. $[_v \text{ photocopy}]_1$ [Max believes [Mary t_1 War and Peace]].

Thus although a mechanism is available within the ILF theory that will yield equivalent T-sentences for distinct attitude reports, its purview is in fact quite restricted, given independent syntactic principles.

4. PURE SYNTACTIC BELIEF: GENERAL NPs AND EMPTY NAMES

On the theory proposed here, the ILF for an attitude report like (2a) (repeated below) contains specific individuals – in this case, the person *Judy Garland*, and the song “Somewhere Over the Rainbow”:

- (2a) Max believes *Judy Garland* sang “Somewhere Over the Rainbow”.

Our account thus implicitly accepts that the truth-conditions of such singular attitude reports – reports whose content clause contains a referring term – are object-dependent, in the sense that without the individuals the report could not have the truth-conditions that it does.²⁰ Under the ILF theory, without the individuals there could be no ILFs containing them, and hence no corresponding ILFs for agents to believe, think, claim, etc.

The object-dependence of (2a) evidently distinguishes it from examples like (47a), where *Judy Garland* is replaced by the general NP *some starlet* (and the latter is understood as being within the scope of the attitude verb), and from examples like (47b), where *Judy Garland* is replaced by the empty proper name *Orpheus*:

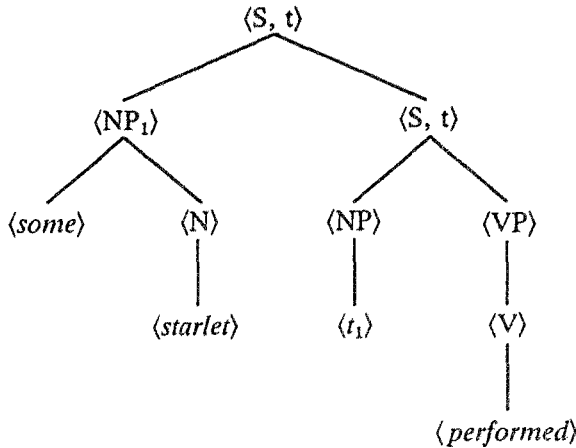
- (47)a. Max believes [some starlet performed].
b. Max believes [Orpheus performed].

Intuitively, we know that Max may believe that some starlet performed without holding beliefs about any particular individual: no particular starlet need exist for (47a) to be true. Likewise, since *Orpheus* was a mythological character, we know that Max simply cannot have beliefs about a particular individual for (47b) to be true. It is thus natural to ask how the ILF theory treats object-independence in attitude reports such as those involving quantificational NPs and empty proper names.²¹

Our general answer to this question is given through clause (ii) of the ILF formation rule in (16). When expressions of a complement clause are nonreferring, or nonuniquely referring, then their ILFs will involve only linguistic material and no objectual content. The attitude

verb will thus relate an agent to a purely syntactic object. The case of general NPs may be illustrated with the T-sentence for (47a), assuming narrow scope for the quantifier *some starlet*:

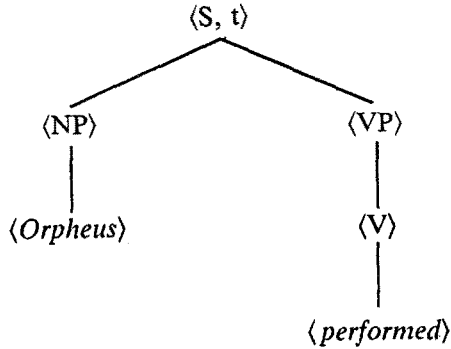
- (48) Val(t , *Max believes some starlet performed*, σ) iff Max believes



We assume a standard Tarskian account of quantification in which certain expressions are assigned no semantic values (i.e., are syncategorematic) and others are assigned values that vary in a systematic way.²² Instances of the former include quantified NPs and determiners like *some*; these are interpreted only in construction with other elements, and so fall outside the domain of Val as given by our axioms. By the algorithm in (16) (clause (ii)), they receive ILFs containing only linguistic material and no objectual content (specifically, $\langle NP_1 \rangle$, $\langle some \rangle$). Instances of the latter include the remaining expressions in (47). Under our axioms, the truth-conditions for the embedded complement in (47a) involve calculation over alternative sequences. The latter fix the values of various sentence constituents, including the formal variable t_1 , the common noun (*starlet*), the verb phrase (*performed*), and the verb (*performed*). As the sequences vary, so do the values assigned to these expressions; hence the latter receive no unique semantic value under the assumption that Val(t , S, σ). This means that their ILFs are also provided under (16) clause (ii).

Empty proper names yield a result similar to general NPs as illustrated by the T-sentence for (47b):

- (49)
- $\text{Val}(t, \text{Max believes Orpheus performed}, \sigma)$
- iff Max believes



Like syncategorematic elements, empty names such as *Orpheus* or *Prof. Moriarty* fall outside the domain of Val as given by our axioms, and hence are associated with no objects. The semantic value of β , assuming $\text{Val}(t, S, \sigma)$, is thus simply undefined for such expressions β . This entails that their ILFs (and the ILFs of expressions whose own values depend on them) are given through clause (ii) of (16).

These results yield truth-conditions for a general belief-report like (47a), and for a report involving an empty name like (47b); the truth of such examples is correctly represented as object-independent. Note, moreover, that they also entail commitment to the proposal made earlier that we be able to distinguish syntactically between otherwise homophonic names. Thus consider the case of a language containing two empty names, both pronounced *Cerberus*. The first purports to refer to a mythological three-headed dog guarding Hades. The second purports to refer to another nonexisting creature, say, a talking aardvark.²³ Intuitively, (50a) could be either true or false depending on which *Cerberus* was intended, hence two distinct ILFs must be made available. However, because the valuation predicate assigns neither name a semantic value, the ILFs cannot be distinguished by objectual content. The ILF theory may accommodate this result by assuming that the lexicon contains two formally distinct names, *Cerberus_I* and *Cerberus_{II}*, and that the relevant ILFs are distinguished syntactically (50b,c):

- (50)a. John believes [Cerberus talks].
 b. John believes [Cerberus_I talks].
 c. John believes [Cerberus_{II} talks].

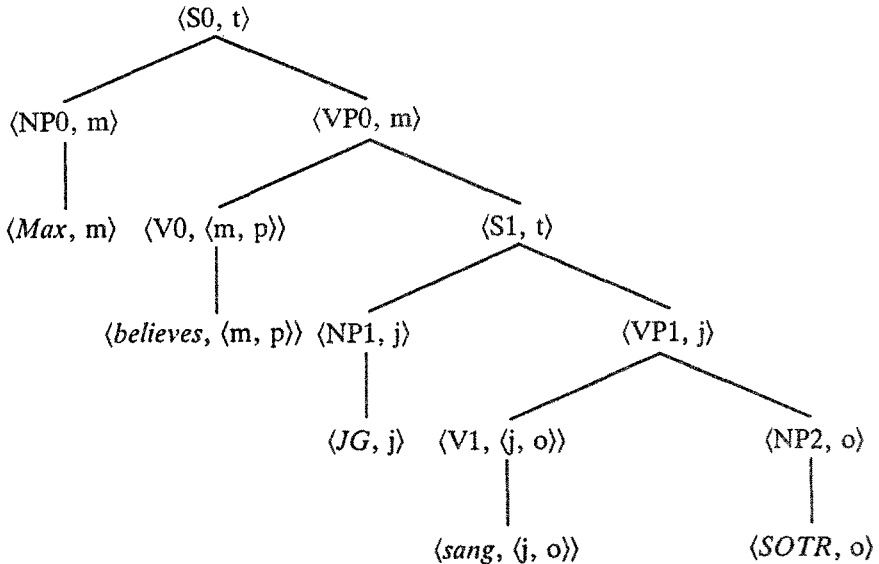
This will yield two distinct ILFs, as in the case of *Paderewski* discussed above.

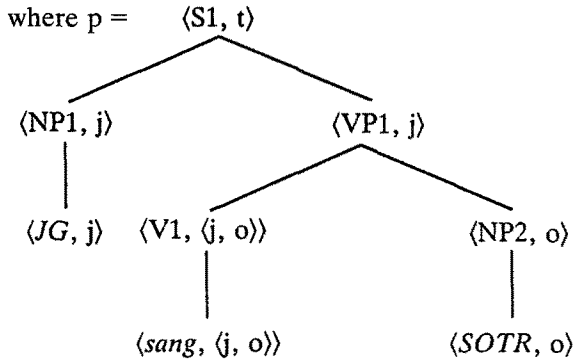
5. ITERATED ATTITUDE REPORTS

The algorithm for ILF construction given in (16) is fully recursive, successfully iterating with sentences that involve multiply embedded attitude reports. Furthermore, the resulting T-sentences appear to account correctly for familiar inferential properties of such examples.

To illustrate, a sentence like *Bill thinks Max believes Judy Garland sang "Somewhere Over the Rainbow"* receives the T-sentence shown in (51):

- (51) Val(t , *Bill thinks Max believes Judy Garland sang "Somewhere Over the Rainbow"*, σ) iff Bill thinks





Observe that the ILF for the larger embedded clause *Max believes Judy Garland sang "Somewhere Over the Rainbow"* contains the ILF for the smaller embedded clause *Judy Garland sang "Somewhere Over the Rainbow"* twice over. The latter appears as part of the value for the second argument of *thinks*: it is a subpart of the ILF for the larger embedded clause. But the ILF for *Judy Garland sang "Somewhere Over the Rainbow"* also appears as the value for the second argument of *believes*: it is the value p for the embedded verb.

This is the (weak) sense in which our version of the ILF theory encodes a 'hierarchy of senses' in multiply embedded attitude contexts. It does so not by producing 'ILFs of ILFs', but rather by using a given ILF a number of times. The ILFs for multiply embedded clauses appear both as the value for the second argument of their immediately embedding propositional attitude verb, and then as part of the value of the second argument of each higher embedding propositional attitude verb.²⁴

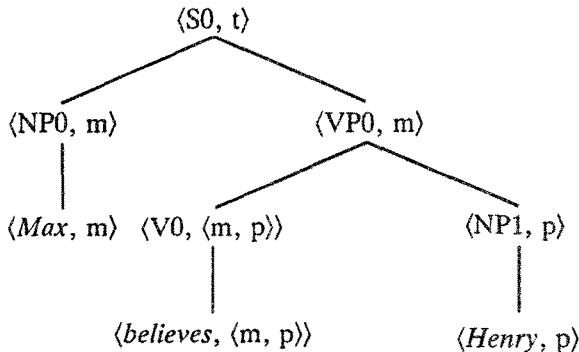
The T-sentences resulting from this theory correctly predict inference paradigms like (52a,b) that are sometimes thought to raise problems for accounts that don't yield a hierarchy of senses stronger than that available here. The observation is that singly embedded attitude contexts like (52a) permit substitution of a proper name for a clausal complement when the former refers to the sense (here the ILF) of the latter; however, the same substitution is not licit in doubly embedded contexts like (52b). This result appears to suggest a distinction between

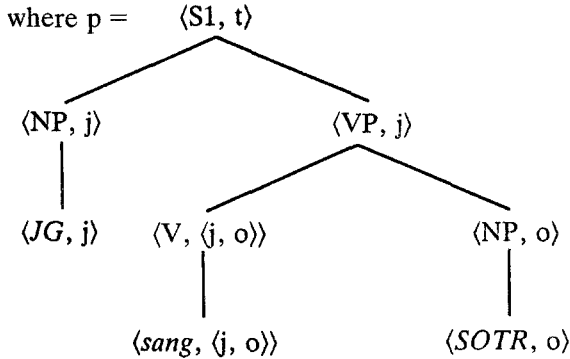
senses in singly vs. multiply embedded contexts; i.e., a distinction between senses, senses of senses, and so on.

- (52) Suppose $\text{Val}(x, \text{Henry}, \sigma)$ iff $x = [] \text{Judy Garland sang SOTR} []$
- a. Max believes Judy Garland sang SOTR
Max believes Henry
 - b. Bill thinks Max believes Judy Garland sang SOTR
##Bill thinks Max believes Henry

As it turns out, the ILF theory predicts these paradigms directly without appeal to a sense hierarchy. Assuming that *Judy Garland sang SOTR* and *Henry* are associated semantically with the very same ILF (the former by the lexical axiom in (52), the latter by the definition in (16)), it follows that *Max believes Judy Garland sang SOTR* is true only if *Max believes Henry* is true.²⁵ On the other hand, the inference in (52b) will be excluded in the by now familiar way: Bill simply believes different ILFs in the two cases. If the first sentence is true, he believes the ILF given earlier in (51); if the second sentence is true, he believes the ILF given in (53). The inference is thus correctly blocked:

- (53) $\text{Val}(t, \text{Bill thinks Max believes Henry}, \sigma)$ iff Bill thinks





6. RELATION TO OTHER THEORIES

The ILF theory shares features with other analyses of propositional attitude constructions that have been advanced in the literature. Like quotational accounts, it takes the objects of the attitudes to contain linguistic forms. Hence it shares with them the prediction that the truth-conditions of propositional attitude reports may be at least as finely individuated as the linguistic means that express them. This prediction appears correct given cases like (2a,b), where reference is constant, but its linguistic expression is not. On the other hand, unlike quotational theories, the ILF analysis also takes the objects of the attitudes to contain nonlinguistic items – things. Hence it makes the further prediction, unavailable under strictly quotational views, that the truth-conditions of propositional attitude reports may be at least as fine-grained as the things referred to in those reports. This further prediction is confirmed by cases like (37a,b), where linguistic expression is constant, but reference is not.²⁶

The ILF theory also shares features with the account of propositional attitude contexts advanced in Frege (1892). As is well known, failures of substitutivity like those in (2–4) led Frege to introduce the notion of senses, which he took to have the following central properties:

- (i) Senses are expressed by phrases.
- (ii) Senses are compositionally derived (that is, the sense expressed by a phrase is a function of the senses expressed by its parts).

- (iii) Senses determine the referent of their associated phrase.
- (iv) Senses constitute a mode of presentation of their associated referent.

Frege proposed that in embedded contexts, expressions take on different semantic values and refer to their (customary) senses, rather than their usual referents. The logical nonequivalence of pairs like (2)–(4) is then explained by saying that substitution yields different semantic values for the substituted parts. In (2a), *Judy Garland* contributes its sense, which is a mode of presentation of the individual Judy Garland. By contrast, in (2b), *Frances Gumm* contributes its sense, which is presumably a distinct mode of presentation of the same individual Judy Garland. ILFs resemble Fregean senses in some respects, and explain failures of equivalence with attitude reports in a roughly analogous way. ILFs can be seen as being expressed by their associated phrases in the sense of being built out of them (together with their values); and under the formal theory presented above ILFs are also fully compositional, being defined in terms of the ILFs of their subconstituents. Furthermore, ILFs can be seen as giving a mode of presentation of a referent insofar as they pair that referent with a particular expression that linguistically ‘presents it’. This latter feature entails that the different names *Frances Gumm* and *Judy Garland* will make different semantic contributions to the complement clauses in (2a,b), and hence yield nonequivalent attitude reports.²⁷

Finally, the ILF theory is also related to the account of propositional attitude contexts proposed by Russell (1956), and its more modern versions elaborated in Barwise and Perry (1983), Salmon (1986a), Soames (1987), and Richard (1990).²⁸ Russell took verbs like *believe*, *think*, *say*, etc., to express relations between agents and propositions, where the latter are abstract objects containing predicable and non-predicable individuals. On this view, the sentential complements in (3a) and (3b) (repeated below) would be associated with the propositions in (54a) and (54b), respectively, where $\mathcal{R}_{\text{xerox}}$ is the relation (i.e., the particular universal) of xeroxing and $\mathcal{R}_{\text{photocopy}}$ is the relation of photocopying:

- (3)a. Max believes Mary xeroxed *War and Peace*.
- b. Max believes Mary photocopied *War and Peace*.

- (54)a. $\langle \text{Mary}, \mathcal{R}_{\text{xerox}}, \text{War and Peace} \rangle$.
 b. $\langle \text{Mary}, \mathcal{R}_{\text{photocopy}}, \text{War and Peace} \rangle$.

Since $\mathcal{R}_{\text{xerox}}$ and $\mathcal{R}_{\text{photocopy}}$ are different relations, the respective propositions containing them are different as well. This permits failures of substitutivity like those in (3) and (4) to be explained by saying that the two attitude reports express relations to different propositions. Standing in the believe-relation to one thus does not entail standing in the believe-relation to the other. ILFs resemble Russellian propositions in containing extralinguistic objects as constituents. And like propositions, ILFs are distinguished in virtue of containing distinct objects. This yields an account of (certain) substitution failures in attitude reports similar to that in the Russellian theory.

The most important difference between Russellian propositions and ILFs is that the former contain nonpredicable individuals and particular universals, whereas the latter contain nonpredicable individuals and linguistic forms.²⁹ Two points appear noteworthy in this regard. First, the ILF theory does not appear to suffer in virtue of its more restrictive ontology. The responsibilities borne by properties and relations in the richer ontology of Russellian propositions seem to be discharged equally well by appeal to more homey entities such as words. The ILF theory successfully separates the truth-conditions of (3a,b) by reference to the different predicates *xerox* and *photocopy* that appear in each. No further entities such as $\mathcal{R}_{\text{xerox}}$ and $\mathcal{R}_{\text{photocopy}}$ need be invoked.³⁰

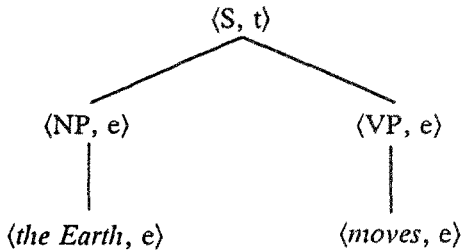
Second, the more restrictive ontology of the ILF theory is not an arbitrary feature of the account but rather reflects the important conceptual dependence of its treatment of intensional contexts on its treatment of extensional contexts. The recursive algorithm in (16) has the effect of ensuring that the nonlinguistic objects appearing in ILFs, and hence the ontology of nonlinguistic objects appealed to in the analysis of (hyper)intensional contexts, can be no richer than that required for the portion of the grammar that excludes them. Under these proposals, then, the analysis of propositional attitudes cannot introduce anything new into the ontology; it must be semantically 'innocent' in the sense of Davidson (1984b). To justify introducing primitive properties and relations into ILFs would require first justifying their introduction in the account of the simple parts of language falling outside the attitudes. At present, the grounds for such a move do not appear secure to us.

7. EQUIVALENCE AND CONTENT

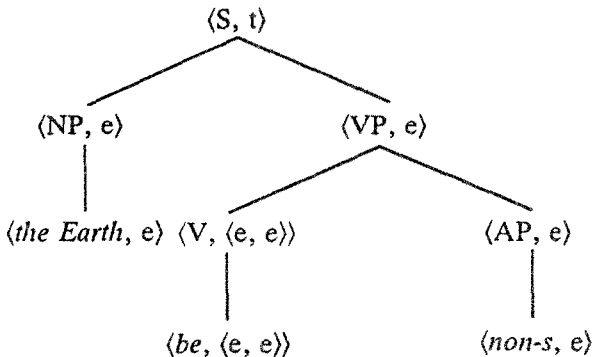
As a result of its fine-grained individuation criteria for ILFs, the ILF theory entails the logical nonequivalence of many attitude reports. Attitude reports from a given language whose logical forms contain different expressions in the complement clause (55a,b) will always differ in truth-conditions, since these will involve distinct ILFs (cf. (56a) and (56b)).³¹

- (55)a. Galileo believed the Earth moves.
- b. Galileo believed the Earth is nonstationary.

- (56)a. $\text{Val}(t, \text{Galileo believed the Earth moves}, \sigma)$ iff Galileo believed

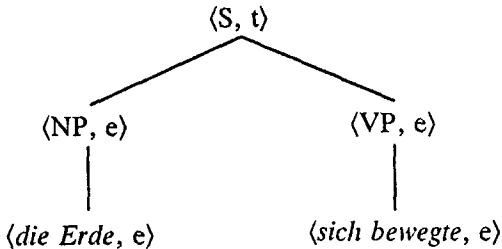


- b. $\text{Val}(t, \text{Galileo believed the Earth is nonstationary}, \sigma)$ iff Galileo believed



Similarly, attitude reports from different languages (57a,b) will always be logically nonequivalent, since, once again, their truth-conditions will involve relations to distinct ILFs (cf. (56a) and (58)):

- (57)a. Galileo believed the Earth moves.
 b. Galileo glaubte daß die Erde sich bewegte.
- (58) Val(t , *Galileo glaubte daß die Erde sich bewegte*, σ) iff Galileo believed



These results raise an important general question for the ILF theory. It is arguable that one of the main charges of any semantic theory is to give (or at least contribute to) an account of the content of a given utterance: semantic theories should characterize what is said in uttering a given sentence S , and what is grasped in understanding it. In a truth-conditional theory, such as the ILF theory, content is ostensibly captured through the truth-conditions that are assigned; hence the fact that pairs like (55) and (57) receive different truth-conditions entails that they are ascribed different content by this account. Nonetheless, in many communicative contexts, and for many communicative purposes, speakers of English would very clearly regard these pairs as reporting the same beliefs – more generally, as ‘saying the same thing’. For example, if one wished to report what someone had said in uttering (55a), then (55b) would be a natural choice for most purposes. Similarly, if one wished to report in English what a speaker of German said in uttering (57b), then in most cases it would be very natural to employ (57a). Evidently, logical equivalence of attitude reports, as defined by the ILF theory, does not mirror the notion of ‘same-saying’ or ‘same communicative content’ that figures in everyday attitude ascriptions. The simple question arises, then, as to how we may square the two.

Broadly speaking, we see two ways of doing this: on the one hand, we may adjust the truth-conditions delivered by the ILF theory so as to bring its relation of logical equivalence into closer agreement with the informal relation of same-saying or same-content. Alternatively, we may leave the truth-conditions of the ILF theory intact and propose an auxiliary theory specifying when two sentences, despite different

truth-conditions and hence different content, might nonetheless be used to report the same propositional attitudes.

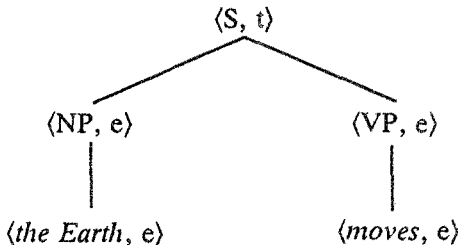
7.1. *Similarity/Same-saying*

One way to adjust the ILF theory so as to reflect sameness of content is to import this notion directly into the truth-conditions that it assigns. Broadly speaking, this is the approach advocated by Davidson (1984b), LePore and Loewer (1989), and Higginbotham (1986), who propose introducing a relation of *same-saying* or *similarity* that would serve to relate either events of saying/believing/thinking, etc., or ILFs.³² Thus suppose our lexical axioms in (15) are replaced with the ones in (15'):³³

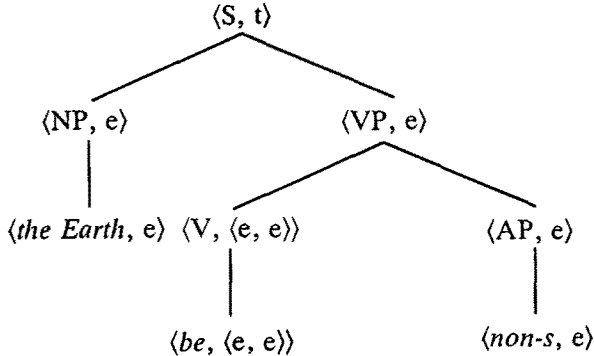
- (15')a. $\text{Val}(\langle x, y \rangle, [\text{v believes}], \sigma)$ iff x believes some ILF similar to y .
- b. $\text{Val}(\langle x, y \rangle, [\text{v thinks}], \sigma)$ iff x thinks some ILF similar to y .
- c. $\text{Val}(\langle x, y \rangle, [\text{v claims}], \sigma)$ iff x claims some ILF similar to y .

This revision ‘loosens’ the truth-conditions for attitude reports insofar as an agent is no longer required to stand in relation to an ILF defined through the complement clause, but only to one similar to it. This in turn allows reports containing formally distinct complement clauses to nonetheless come out logically equivalent. For example, under the revised VP axiom, sentences (55a,b) receive the T-sentences in (59a,b) (respectively):

- (59)a. $\text{Val}(t, \text{Galileo believed the Earth moves}, \sigma)$ iff Galileo believed some ILF similar to



- b. $\text{Val}(t, \text{Galileo believed the Earth is nonstationary}, \sigma)$ iff Galileo believed some ILF similar to



Supposing that the ILFs given here are indeed similar (with respect to some set of features F), the two sentences will come out equivalent despite the formal differences in their complement clauses. An analogous result holds for (57a,b). Assuming similarity (wrt some features F) between the relevant ILFs containing English and German words, the English and the German sentences will be truth-conditionally equivalent under the ILF theory.³⁴

Introduction of the similarity relation relaxes the conditions on equivalence of attitude reports; where we previously required strict identity of ILFs we now require only similarity. Nonetheless it is important to observe that appeal to similarity does not lose the fine-grained distinctions among attitude reports available through ILFs: these distinctions still delimit the *potential* individuation of attitude reports. Recall that the predicate *similar* is a three-place relation of the general form $R(x, y, F)$: one object x is similar to another y with respect to some features F . It follows that in the similarity theory, equivalence of attitude reports will turn crucially on the features F by which ILFs are compared. For example, if the feature is objectual content, then the ILFs for (2a,b) will be grouped as similar, but those for (37a,b) will not. By contrast, if the feature is linguistic content, then the ILFs for (37a,b) will be grouped as similar, but those (2a,b) will not.³⁵ Finally, if the features are objectual and linguistic content taken together, then neither of the pairs in (2) and (37) will count as having similar ILFs, and the attitude reports will all be truth-conditionally distinct. The upshot is that while the similarity relation allows us to assimilate the

content of ILFs in certain circumstances, the underlying distinctions among ILFs remain, and their full individuating power can be exploited through choice of the features F .³⁶

An ILF theory, relativized by means of the similarity (or same-saying) relation, is attractive in certain respects. It retains the virtues of the original ILF theory, while also permitting an approach to the issue of content. Furthermore, through the context-dependence of *similar* it captures the fact that equivalence of attitude reports often varies pragmatically according to the goals and assumptions of the agent, attitude reporter, and/or attitude reportee. Nonetheless, as discussed by Segal (1989), the theory also has an important drawback. Segal observes that in a T-sentence like (59a) or (59b), the *believe* occurring in the metalanguage on the right-hand side of the biconditional cannot be the English word *believe*. To see why this is so, the following example may be helpful.

Imagine a language English* that is like English except that the English* word *kick* in an English* sentence like *Max kicked Smith* has a meaning that we would express in English as 'x kicked something that resembles y'. So, for example, if Smith resembles Jones, and someone kicks Jones but not Smith, one may truly assert the English* sentence *Someone kicked Smith*. Now suppose that a semanticist who is a monolingual speaker of English* offers the following axiom for the English* word *kicks*:

(60) $\text{Val}(\langle x, y \rangle, \textit{kicks}, \sigma)$ iff x kicks something that resembles y.

In fact, this will not be a legitimate axiom for the English* semanticist. The problem is that it relies on a word that is not part of English*, namely, the English word *kicks* on the right-hand side of the biconditional.³⁷ Such an axiom therefore does not give the semantic value of the object language expression in the language that the semanticist understands.

What should the English* semanticist do? Segal observes that one of two options is open. Either the semanticist must provide some explication of the new, nonEnglish* word *kick* appearing on the right-hand side of the biconditional in (60) or, alternatively, he or she should simply replace (60) with an axiom like the following:

(61) $\text{Val}(\langle x, y \rangle, \textit{kicks}, \sigma)$ iff x kicks y.

Here the English* semanticist would be relying on the meaning of the

English* word *kicks* to give the semantic value of the object language expression.

Segal argues that English propositional attitude verbs like *believe*, *think*, *claim*, etc., are analogous to the hypothetical English* word *kick* in that whenever we stand in an attitude relation to a given ILF we stand in the same relation to ILFs similar to it. It follows, then, that when analyzing these predicates we are in essentially the same position as the English* semanticist, and when we appeal to axioms like (15'a–c), we encounter the same problem encountered with the English* axiom (60). (15'a–c) do not use the English expressions *believe*, *think*, and *claim* on the right-hand side of the axiom, but rather expressions of a language that we do not understand. The same two options are then open to us. We must provide some explication of the new, non-English words appearing in our axioms. Alternatively, we must simply replace (15'a–c) with our original (15a–c), relying on the English expressions *believe*, *think*, *claim*, etc., to give the semantic values of the corresponding object language expressions.

Appeal to (61) is clearly the simplest course of action for our English* semanticist with regard to English* *kick*. Nonetheless, it is perhaps plausible that he or she might come up with the technical notion 'kick⁺' required for the right-hand side of (60). This notion 'kicks⁺' would in fact just be the familiar notion of 'kick' in English, hence (59) would be reconstructed as (61):

- (62) $\text{Val}(\langle x, y \rangle, \textit{kicks}, \sigma)$ iff x kicks⁺ something that resembles y where x kicks⁺ y iff . . .

However, in the case of *believe* and the English semanticist, Segal argues that the prospects for the latter move are dim. Evidently, we would have to replace (15'a), for example, with an axiom like (63), where the new, technical notion 'believes⁺' is given some explicit definition in English:

- (63) $\text{Val}(\langle x, y \rangle, \textit{believes}, \sigma)$ iff x believes⁺ some ILF similar to y where x believes⁺ y iff . . .

Segal points out that the content of this definition is anything but clear. Segal concludes that, like the English* semanticist, we are better off adopting the simplest course. We should dispense with the foreign verb *believes⁺* and the similarity predicate, relying on the use of the English verb *believes* in the metalanguage to give the semantic value of the

corresponding object language expression. In short, we are best off relying on the original axioms (15a–c).

7.2. *ILFs and Belief Ascription*

If, as Segal (1989) argues, the ILF theory should retain the simple truth-conditions given by axioms (15a–c), then our view must be that although speakers use sentence pairs like (55) and (57) to report the same propositional attitudes in certain cases, these sentences nonetheless always express different content. Accordingly, the ILF theorist is committed to the view that similarity or same-saying in such cases is fundamentally a matter of *usage* and not content, and that the correct account of these phenomena falls outside the domain of semantics proper and into pragmatics.

Although we believe that the responsibility for explaining when two propositional attitude sentences can be used to report the same attitude is a pragmatic matter, we believe that the general shape of such a pragmatic account is fairly clear. Our picture of this account rests on the view that the ability to use language to ascribe beliefs is a complex ability relying on a rich system of tacit knowledge. The precise nature of this system of tacit knowledge is a matter of empirical enquiry, and much work needs to be done to illuminate it. Nonetheless, we believe that a full account of this system will involve at least the following three components:

- I. The theory of belief tacitly held by speakers.
- II. The theory of the goals of belief ascription tacitly held by speakers.
- III. The theory of belief ascription ‘logistics’ tacitly held by speakers.

To illustrate, consider speaker S, who wishes to ascribe a propositional attitude to agent A for the benefit of hearer H. In order for S to succeed, S and H must share a theory of what beliefs are, for it is the shared ontology of beliefs that will guide the way in which beliefs are ascribed. S must also have tacit knowledge of the goals of belief ascription. That is, S must have a theory that allows him or her to determine what features of A’s belief will assist H in the relevant way. Finally, S must have a tacit theory that allows him or her to deliver the kind of ascription that will be helpful to H.

Component I will state the properties that speakers tacitly ascribe to beliefs, including their relations to other components of thought and to action. For example, in ascribing beliefs, speakers and hearers would standardly assume that beliefs are formed on the basis of knowledge and experience, that they interact together, that they are relatively stable over time, that they can be shared or mistaken, and that they can and often do correspond to the world. Philosophers have often discussed this theory under the heading of 'folk psychology', which they take to be the theory of psychology used by individuals to explain the actions of other agents. Philosophical explications of folk psychology have been helpful, but full elaboration of the common-sense theory of belief will doubtless require systematic study on the model of work investigating common-sense physics (see Hobbs and Moore 1985) and common-sense biology (Carey 1988). Fortunately, much work is currently being done in this area, particularly in regards to the child's theory of mind (see Astington, Harris, and Olson (1988) and Frye and Moore (1991) for surveys).

Component II will state the theory a speaker deploys in determining a hearer's interest. With propositional attitude ascriptions, the goal of a speaker S is typically to cause a hearer H to form a certain theory about the belief structure of an agent A. Unless S has duplicitous motives, S will be attempting to assist H in forming a theory of A's psychology. What H finds helpful will of course depend on H's interests. Sometimes H will want a theory that allows him or her to predict the behavior of A. Other times H will want a theory of what A knows, so that H may modify his or her behavior accordingly. For example, H may need to know whether to inform A of something, ask A something, or otherwise act in the knowledge that A has the proper information. A theory of this ability is a species of a more general family of cognitive abilities studied under the guise of 'planning' and the theory of action (see, for example, Georgeff and Lansky (1986)).

Finally, component III will state which expressions may be used in a given context to achieve specific belief ascription goals. This theory interacts with ILFs directly on our view, and will incorporate the knowledge required for determining which ILF should be used in reporting a given attitude. For example, depending on H's interests, it is sometimes the referential component of an ILF and sometimes the syntactic component that will be important to the goals of ascription. We can identify several rules of thumb in characterizing which component of

an ILF will be relevant in a given belief report. For example, if H is interested in information that A has about the world (for example, the distance to the Venus), then the objectual component of the ILF will be of primary importance to the goals of belief ascription. H will therefore be indifferent to the choice of *The Morning Star* vs. *The Evening Star* in an attitude ascription concerning Venus. By contrast, if H is interested in explaining or predicting A's behavior, for example, whether A will assent to an utterance of *The Morning Star is The Evening Star*, or whether A will act in a way compatible with the knowledge that the Morning Star is the Evening Star, then H may well be interested in the syntactic expressions that S uses to characterize A's belief.

In cases of the latter kind, where prediction or explanation of behavior is the goal, we envision the speaker's choice of syntactic constituents in an ILF to involve a two-stage process vis-à-vis the hearer H. First, S determines the way in which H models A's belief structure. Then S 'negotiates' with H the expressions to be used in speaking of the components of that model. Both steps involve complex subprocesses. For example, in inferring H's model of A's belief structure, S would appear to draw at least on all of the following:

- S's knowledge of H's interests;
- General principles of common-sense psychology that S supposes that H believes;
- Knowledge that S knows H to have about A.

Suppose that S knows H to be interested in the behavior of A – for example, in whether A will train his or her telescope on a particular region of the dawn sky. Then by general principles of common-sense psychology, which S supposes H to share, S may infer that H will deploy a fine-grained model of A's psychology – one that distinguishes Morning Star-beliefs from Evening Star-beliefs. S may also rely on information supplied directly by H or some other source. For example, S may learn that H knows that A is unaware that the Morning Star is the Evening Star.

In the second stage of selecting an ILF, S and H must agree on expressions used to speak of the components of H's model of A's belief structure. We speculate that expressions used in attitude ascriptions will be tacitly 'negotiated' by participants in the discourse, following quite general principles holding of discourses of all kinds. The general

process by which discourse participants negotiate a way to speak of objects (sometimes called 'entrainment' by psychologists) is currently the subject of research in psycholinguistics (e.g., by Brennan and Clarke 1992). Ultimately, we believe this work must be extended to the study of the way states of mind come to be described, and why subtle differences in expression will have great consequences for the truth of the attitude ascription.

If our perspective differs from most other theories of attitude ascription it is in our emphasis on the relation between the ascription and the hearer, rather than on the relation between the ascription and the agent to whom the attitude is ascribed. In our view, it is studying the former relationship that will yield the biggest dividends in the understanding of belief ascription.

APPENDIX: FRAGMENTS FOR THE LANGUAGES L_0 AND L_1

1. *The Language L_0 (Names, Predicates, Connectives, and Quantifiers)*

Terminal Nodes:

- (1)a. Val(x , *Judy Garland*, σ) iff x = Judy Garland.
 Val(x , *Frances Gumm*, σ) iff x = Frances Gumm.
 Val(x , *Somewhere Over the Rainbow*, σ) iff x = "Somewhere Over the Rainbow".
 Val(x , *Max*, σ) iff x = Max.
 Val(x , t_i , σ) iff x = $\sigma(i)$ for $i \geq 1$.
- b. Val(x , *starlet*, σ) iff x is a starlet.
 Val(x , *girl*, σ) iff x is a girl.
- c. Val(x , *agrees*, σ) iff x agrees.
 Val(x , *walks*, σ) iff x walks.
- d. Val($\langle x, y \rangle$, *sang*, σ) iff x sang y .
 Val($\langle x, y \rangle$, *admires*, σ) iff x admires y .

Nonterminal Nodes:

- (2)a. Val(t , [$_S$ NP VP], σ) iff for some x , Val(x , NP, σ) and Val(x , VP, σ).
- b. Val(x , [$_{VP}$ V NP], σ) iff for some y , Val($\langle x, y \rangle$, V, σ) and Val(y , NP, σ).

- c. $\text{Val}(x, [\alpha \beta], \sigma)$ iff $\text{Val}(x, \beta, \sigma)$ (where α ranges over categories, and β ranges over categories and lexical items).
- (3)a. $\text{Val}(t, [s \text{ S1 and S2}], \sigma)$ iff it is both the case that $\text{Val}(t, \text{S1}, \sigma)$ and $\text{Val}(t, \text{S2}, \sigma)$.
- b. $\text{Val}(t, [s \text{ S1 or S2}], \sigma)$ iff either $\text{Val}(t, \text{S1}, \sigma)$ or $\text{Val}(t, \text{S2}, \sigma)$.
- c. $\text{Val}(t, [s \text{ it is not the case that S1}], \sigma)$ iff it is not true that $\text{Val}(t, \text{S1}, \sigma)$.
- (4)a. $\text{Val}(t, [s [\text{NP}_i \text{ every N}] \text{S1}], \sigma)$ iff for every $\sigma' \approx_i \sigma$ such that $\text{Val}(\sigma'(i), \text{N}, \sigma), \text{Val}(t, \text{S1}, \sigma')$.
- b. $\text{Val}(t, [s [\text{NP}_i \text{ some N}] \text{S1}], \sigma)$ iff for some $\sigma' \approx_i \sigma$ such that $\text{Val}(\sigma'(i), \text{N}, \sigma), \text{Val}(t, \text{S1}, \sigma')$.
- c. $\text{Val}(t, [s \text{NP}_i \text{S1}], \sigma)$ iff for $\sigma' \approx_i \sigma$ such that $\text{Val}(\sigma'(i), \text{NP}, \sigma), \text{Val}(t, \text{S1}, \sigma')$.

DEFINITIONS:

- (i) For any sequence σ , $\sigma(i)$ is the *i*th element of σ .
- (ii) For any sequences $\sigma, \sigma', \sigma' \approx_i \sigma$ iff σ' differs from σ at most on $\sigma'(i)$.
- (iii) $\text{Val}(t, \text{S})$ iff $\text{Val}(t, \text{S}, \sigma)$ for all sequences σ .

2. The Language L_1 ($L_0 + \text{Intensional Contexts}$)

Terminal Nodes (Lexical Items):

- (1) $\text{Val}(\langle x, y \rangle, \text{believes}, \sigma)$ iff x believes y.
 $\text{Val}(\langle x, y \rangle, \text{thinks}, \sigma)$ iff x thinks y.
 $\text{Val}(\langle x, y \rangle, \text{claims}, \sigma)$ iff x claims y.

Nonterminal Nodes:

- (2) $\text{Val}(x, [\text{VP V S}], \sigma)$ iff for some y, $\text{Val}(\langle x, y \rangle, \text{V}, \sigma)$ and $y = [\text{S}]$ wrt σ .

DEFINITION: Let α be a phrase-marker with root S, let σ be a sequence, and let β be a sub-phrase-marker of α .

- (i) If there is an x such that $\text{Val}(x, \beta, \sigma)$ is provable from $\text{Val}(t, \alpha, \sigma)$ under the axioms of L_0 , and for all y, $\text{Val}(y, \beta, \sigma)$ is

provable from $\text{Val}(t, \alpha, \sigma)$ iff $y = x$, and:

- (a) β is a terminal node, then $[]\beta[] = \langle \beta, x \rangle$.
 (b) β is $[]_{\gamma} \delta_1 \delta_2 \dots \delta_n []$ for $n \geq 1$, then $[]\beta[] = []_{\langle \gamma, x \rangle} [] \delta_1 [] [] \delta_2 [] \dots [] \delta_n [] []$.
- (ii) If there is no x as defined in clause (i), and:
 (a) β is a terminal node, then $[]\beta[] = \langle \beta \rangle$.
 (b) β is $[]_{\gamma} \delta_1 \delta_2 \dots \delta_n []$ for $n \geq 1$, then $[]\beta[] = []_{\langle \gamma \rangle} [] \delta_1 [] [] \delta_2 [] \dots [] \delta_n [] []$.

We call $[]\alpha[]$ wrt σ the *ILF of α with respect to σ* .

NOTES

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¹ Accounts of propositional attitudes similar to the ILF theory have been developed by Burdick (1982) and Richard (1990). Each stresses the importance of including lexical material in the objects of propositional attitudes.

² For an extended defense of this observation see Burge (1978).

³ The T-sentences in (7) and (8) pair a sentence of the object language containing a verb and a sentential complement with a sentence of the metalanguage containing a verb and a noun phrase complement (here, a description of an ILF). The theory is thus nonhomophonic, but note that this involves no violation of the grammar of the metalanguage. As is well known, propositional attitude verbs routinely accept nominal complements in uses like those in (i):

- (i) Max believed/said/wanted $\left\{ \begin{array}{l} \text{that} \\ \text{the very same thing} \end{array} \right.$

⁴ This discussion simplifies considerably for the purposes of exposition. In modern versions of the EST theory, sentences are in fact associated with a quadruple of syntactic representations including a D-structure, an S-structure, a Phonetic Form, and a Logical Form. D-structure is a pure representation of grammatical and thematic relations, and Phonetic Form is the input to phonological interpretation. We ignore these additional representations here, since they are irrelevant to semantic interpretation. For fuller discussion see Chomsky (1986), and the helpful summary in Sells (1985).

⁵ The axioms collected in our fragments all satisfy a general compositionality principle that can be stated as follows:

COMPOSITIONALITY: If α is an expression, $\beta_1, \beta_2, \dots, \beta_n$ are immediate constituents of α , and for some x, y_1, y_2, \dots, y_n , $\text{Val}(x, \alpha)$, $\text{Val}(y_1, \beta_1)$,

$Val(y_2, \beta_2), \dots, Val(y_n, \beta_n)$, then for some function f , $x = f(y_1, y_2, \dots, y_n)$.

A number of objections to compositionality have been advanced in Hintikka (1983) and Hintikka and Sandu (1989). See Larson and Segal (forthcoming) for a discussion of these objections and a general defense of compositionality.

⁶ We are grateful to Stuart Shieber for pointing out an important problem with an earlier version of this definition and to Irene Heim for helpful comments.

⁷ Lexical information also specifies syntactic category, and subcategorization and selectional features. The content of lexical items assumed in current syntactic theory is discussed in Radford (1988) and Haegeman (1991). For recent theoretical discussion see Baker (1988) and DiSciullo and Williams (1987).

⁸ Phrases containing *only* are standardly analyzed as quantifiers, hence the LFs for (31a,b) involve a trace in subject position. This analysis of the ambiguity in (30) in terms of binding by *John* or the full quantifier phrase *only John* is first proposed (to our knowledge) in Evans (1977), using a slightly different notational system. Evans employs (ia,b) in place of our (31a,b) (respectively):

- (i)a. [Only [John]] loves his mother.
- └──────────┘
- b. [Only [John]] loves his mother.
- └──────────┘

For interesting extensions of this analysis to a number of other constructions, see Higginbotham (1980, 1991).

⁹ This account follows the general line of Higginbotham (1991) in response to similar issues raised by Salmon (1986b) and Soames (1989–90). Soames observes that (i) may be understood as reporting two quite different thoughts on the part of Mary. On the one hand, she may believe John to be an ‘own-mother-lover’; on the other hand, she may believe him to be a ‘John’s-mother-lover’. Higginbotham (1991) observes that this observation can be accommodated within an ILF type theory if the complements are distinguished syntactically as shown in (ii):

- (i) Mary thinks John loves his mother.
- (ii)a. Mary thinks John loves his mother.
- └──────────┘
- b. Mary thinks John loves his mother.

Higginbotham here adopts the ‘chain’ notation of Evans (1977, 1980) to indicate antecedence in place of numerical indices.

¹⁰ See Richard (1990, pp. 181–82) for discussion.

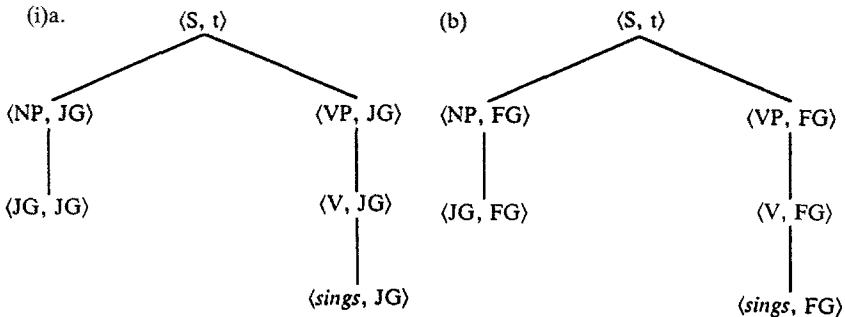
¹¹ Norbert Hornstein and Robert May have drawn our attention to the following variants of the paradigm in (15):

- (i)a. Judy Garland was cute. Max believes she sang ‘‘Somewhere Over the Rainbow’’.
- (she refers to JG/FG)

- (i)b. Frances Gumm was cute. Max believes she sang "Somewhere Over the Rainbow".
(*she* refers to JG/FG)

They observe that the second sentences in (ia) and (ib) may actually differ in truth-value despite the fact that the pronouns refer to the same individual, namely, to Judy Garland/Frances Gumm. The question arises as to how the ILF theory can distinguish these cases given that both the form and the values in the associated ILFs appear to be the same.

We suggest that the pronoun in these cases is behaving as a "pronoun of laziness" (Geach 1962) going proxy for its antecedent expression *Judy Garland* and *Frances Gumm*, respectively. On our view, the LFs for these sentences will actually contain the names in place of the pronouns, and hence their ILFs will be those given earlier in (7) and (8). Similar issues arise with the paradigm in (37) when *Hans* and *Franz* are fictional names.¹² We should note that although ILFs containing distinct expressions of the object language will be distinct ILFs, ILFs that are described using distinct expressions of the metalanguage will *not* be distinct. That is, on our view (ia,b) constitute the same ILF, where 'JG' and 'FG' are expressions of the metalanguage both referring to Judy Garland:



This position reflects the standard assumption that scientific laws and results are not sensitive to the way in which they are expressed in the metalanguage of investigation. Thus, in stating the results of astronomical inquiry, it is irrelevant whether we chose the metalanguage expression *Luna* or *the Moon* to refer to Earth's only satellite:

- (ii)a. Luna is approximately 248,000 miles distant from the Earth.
b. The Moon is approximately 248,000 miles distant from the Earth.

Similarly, in stating the results of semantic inquiry it is irrelevant whether we chose the metalanguage expression *Frances Gumm* or *Judy Garland* to refer to the individual Judy Garland.

¹³ We understand that this example is due originally to David Kaplan.

¹⁴ For simplicity, we ignore the internal syntactic structure of demonstratives here.

¹⁵ We are grateful to Barry Schein for bringing this work to our attention.

¹⁶ Other parameters in Burge's T-sentence such as *p* (the speaker) and *t* (the time of utterance) need not be regarded as parameters in the semantic value of the demonstrative

itself, although see Enc (1983) and Larson (1983) for arguments that noun phrases are in fact generally relativized to times and spatial locations.

¹⁷ It is an interesting consequence of Burge's account that a sentence like (ia) will differ in informativeness from a sentence like (ib) even when it involves two demonstrations of the same object (where N ranges over common nouns):

- (i)a. That N is that N. (e.g., *That man is that man*)
- b. That N is self-identical. (e.g., *That man is self-identical*)

Whereas statements like *That man is self-identical* will be necessarily true and uninformative, statements like *That man is that man* will be necessarily true and informative. This is because distinct occurrences of a demonstrative will involve distinct demonstrations and hence distinct semantic values $\langle x, e \rangle$.

These remarks appear to leave open certain important questions about the logical equivalence of attitude reports containing demonstratives. Suppose that Max and John are both at Edwards Air Force Base observing the landing of the Space Shuttle. At the moment it appears in the sky, both individuals utter (iia) while making distinct gestures accompanying their distinct utterances of the demonstrative *that*. I report this situation with (iib):

- (ii)a. That is the space shuttle.
- b. John said what Max said.

There is a clear intuition that I have spoken truly with (iib). Nonetheless, on the version of Burge's account urged here, John stands in the say-relation to a different ILF than Max – one distinguished by its different event of demonstration. We believe that a correct understanding of (iib) turns crucially on a correct account of similarity of actions and events generally; we take up this point in Section 7.

¹⁸ It is of course a familiar view of *de re* attitude reports that successful substitution of coextensive expressions X and Y involves assigning the latter scope broader than their embedding attitude verbs (see, e.g., Buridan (1966, pp. 126–27), Harman (1972)). The representations in (44), and analogous ones for quantified examples such as *John believes everyone in the neighborhood is a spy*, have been asserted to be ruled out on syntactic grounds by Hornstein (1987). Hornstein suggests that such representations would violate the so-called Empty Category Principle (ECP) of Chomsky (1986), and concludes that *de dicto/de re* ambiguities are not a matter of scope at LF. Hornstein's syntactic claim is highly dubious, however. Other movements that are similar to QR, but syntactically overt, show configurations of the kind Hornstein asserts to be excluded. For example, consider Topicalization, as illustrated in (ia). According to Lasnik and Saito (1984), this operation involves syntactic movement of a referential phrase with adjunction to S (ib). This is analogous to QR as described earlier, except that it involves overt movement at Surface Form instead of covert movement at Logical Form (iia,b):

- (i)a. Judy Garland, Max admires. Surface Form
- b. $[_{S} [_{NP} \text{Judy Garland}]_i] [_{S} \text{Max admires } t_i]$. Logical Form
- (ii)a. Max admires every starlet. Surface Form
- b. $[_{S} [_{NP} \text{every starlet}]_i] [_{S} \text{Max admires } t_i]$. Logical Form

Notice now that covert movements of the kind postulated for QR in (44) are *overtly* available with Topicalization (iii_a,b):

- (iii)a. Judy Garland, Max believes sang "Somewhere Over the Rainbow".
- b. "Somewhere Over the Rainbow", Max believes Judy Garland sang.

We conclude that such movements will be available with QR as well.

Topicalization and QR do show a difference with respect to the paradigm in (iv) that might be thought significant in this context. Observe that whereas overt Topicalization of an embedded subject is impossible when the complementizer *that* appears (iv_a), scopal movement of the subject at LF must be possible if (iv_b,c) are to have equivalent truth-conditions under one reading:

- (iv)a. *Judy Garland, Max believes that sang "Somewhere Over the Rainbow".
- b. Max believes that Judy Garland sang "Somewhere Over the Rainbow".
- c. Max believes that Frances Gumm sang "Somewhere Over the Rainbow".

In fact this difference is a superficial one. Lasnik and Saito (1984) argue that (iv_a) is excluded by a syntactic constraint holding at Surface Form and that at LF semantically empty elements like *that* are deleted from syntactic representation. It follows that at the level of LF, (iv_b,c) are not analogous to (iv_a), where *that* appears, but rather to (iii_a), where *that* has been omitted. Hence movement of the names is possible with (iv_b,c) for the same reason it is possible with (iii_a). For further discussion of LF movement out of tensed complements, see Ludlow and Neale (1991).

¹⁹ In modern versions of the Extended Standard Theory (Chomsky 1989), representations like (46_a,b) are excluded by the Empty Category Principle (ECP).

²⁰ In the terms of Davies (1981), individuals are *truth-conditionally salient* under this theory. For further discussion, see McDowell (1980), Davies (1981), and Evans (1982).

²¹ We are indebted to Stuart Shieber for criticism and technical advice on this section.

²² We believe that a more adequate analysis of natural language quantification would ultimately involve binary or generalized quantifiers (Barwise and Cooper 1981; Higginbotham and May 1981; Sher 1991). Under a binary quantifier analysis, determiners like *every*, *no*, etc., are categorematic and express relations between sets; thus in *every starlet smiled*, *every* denotes the subset relation between the set of individuals given by the quantifier restriction (the set of starlets) and the set of individuals given by the predicate (the set of smilers). We adopt a classical quantification theory here mainly for expository convenience. For further discussion of binary quantifiers in the current framework, see Davies (1981) and Larson and Segal (forthcoming).

²³ There is in fact a current comic book whose main character, named *Cerebus*, is a (rather ill-tempered) talking aardvark. The spelling of the name apparently represents an error on the part of the comic's authors, who had intended the same name as the mythological canine guardian of Hades (see Sim 1981). But for this error, English would in fact have contained the two empty names described in the text.

²⁴ The ILF analysis appears to embody a 'one-level' theory of sense, in the terminology of Parsons (1981). Burge (1979) has argued that multi-level sense theories are in fact necessary to account for the properties of intensional contexts, however, our account appears to fall outside the scope of Burge's argument in adopting what he would view as a nonextensional analysis of the [_{VP} V S] configuration. Recall that under our axioms,

the extension of the latter is not a function of the extensions V and S; specifically, it is a not a function of the extension of S, but rather its ILF.

²⁵ The inference in (25a) thus follows under the same reasoning that yields (i):

- (i) Suppose $\text{Val}(x, \text{Tully}, \sigma)$ iff $x = \text{Cicero}$, then $\frac{\text{John saw Tully}}{\text{John saw Cicero}}$

²⁶ This limitation on quotational theories is also discussed in Partee (1979). See also Cresswell (1980).

²⁷ The most important difference between ILFs and Fregean senses is that the former contain extralinguistic objects, whereas the latter do not.

²⁸ The ILF theory is also similar in this regard to the theory of Cresswell (1984), which derives from suggestions by Carnap (1956) and Lewis (1972). On Cresswell's account, the object of a propositional attitude verb is a "structured meaning": a graph that is partially to fully isomorphic to the syntactic structure of the complement clause, and with intensions (understood as functions from possible worlds to values) as its terminal and nonterminal nodes. As in most Russellian theories, but unlike ILF theories, Cresswell assumes that no lexical material appears in the 'structured meaning', but only semantic values.

Cresswell (1984) is one of a large number of analyses of propositional attitude constructions involving central appeal to possible worlds. For lack of space, we will not attempt to address these analyses here; for representative literature the reader is referred to Hintikka (1962, 1969), Lewis (1972), Cresswell (1973), Montague (1974), and Stalnaker (1987).

²⁹ One neo-Russellian theory bears a number of similarities to the ILF theory – Richard's (1990) theory in which Russellian Annotated Matrices (RAMs) are introduced as the objects of the attitudes. RAMs, like ILFs, include lexical formatives and at least some linguistic structure. Nevertheless, there are significant differences between the proposals. First, the linguistic forms introduced into ILFs are much richer than those found in RAMs. ILFs, as noted earlier, include complete syntactic phrase-markers, including diacritics (e.g., variables and indices). A more important and more fundamental difference between these proposals, however, is that RAMs include properties among their constituents, whereas ILFs contain only objects and linguistic forms.

³⁰ An account of (3a,b) involving primitive relations \mathcal{R}_{xerox} and $\mathcal{R}_{photocopy}$ appears objectionable on at least two grounds. First, such an analysis appears to require very different accounts of nonequivalence for semantically similar elements in propositional attitude contexts. Note that while an analysis assuming distinct reference for *xerox* and *photocopy* is possible for (3), this view is not possible for (i), in which *Judy Garland* and *Frances Gumm* refer to the same individual. A 'primitive relations' account therefore cuts across the uniform status of the relevant items in (3) and (i) as rigid designators (Kripke 1972; Putnam 1975), and is forced to treat the two cases quite differently:

- (i)a. Max believes Judy Garland is a starlet.
 b. Max believes Frances Gumm is a starlet.

Furthermore, the very possibility of an account of (3) involving distinct reference appears to trade on a familiar 'weakness' in our understanding of properties vs. other individuals, namely, on the fact that whereas our grasp on the identity of persons and dinner plates

goes beyond our linguistic resources, our grasp on the identity of properties appears no stronger than the words we use to express them. It is precisely because we lack language-independent criteria for identifying properties that we feel free to postulate distinct properties in (3), given the presence of distinct words. And it is precisely because we possess such language-independent criteria for persons that we cannot make such a proposal for (i), despite the presence of different words. These general points are of course familiar from Quine (1961a, 1961b).

³¹ Axioms yielding the result in (56b) would include the following:

- Val($\langle x, y \rangle$, *be*, σ) iff $x = y$.
 Val(x , *nonstationary*, σ) iff x is nonstationary.
 Val(x , [ν_P V AP], σ) iff for some y , Val($\langle x, y \rangle$, V, σ) and Val(y , AP, σ).

³² Davidson (1984b) analyzes only constructions involving the English verb *say*; LePore and Loewer (1989) extend Davidson's analysis to the general class of propositional attitude verbs. Higginbotham (1986) introduces similarity in relation to ILFs.

³³ An alternative, and more efficient way to introduce similarity into the truth-conditions of the ILF theory, would be to alter, not the lexical items in (15), but rather the general composition axiom in (14):

- (14') Val(x , [ν_P V S], σ) iff for some y such that y is similar to [ν_P] wrt σ ,
 Val($\langle x, y \rangle$, V, σ).

This avoids the redundancy in the lexical specifications of (15'), allowing us to locate similarity in a single axiom. We appeal to the the revision in (15') in virtue of the points made below in connection with Segal (1989). Note that Segal's criticisms of the similarity theory go through equally with the axiom in (14').

³⁴ The same general account could be offered for sentences purporting to attribute propositional attitudes to humans at a prelinguistic stage, or to nonhuman species that do not display extensive linguistic capacities:

- (i)a. Vicky thinks it's time to eat. (said of a baby)
 b. Jubilation thinks it's time for a walk. (said of a dog)

Presumably, to the extent that such reports are not metaphor or anthropomorphizing, they implicitly ascribe to the infant or dog some representational system – however rudimentary – in which the beliefs are given – a 'language of thought' as it were. What is then required by the ILF theory is that the ILF for *It's time to eat* or *It's time for his walk* be similar (in relevant features) to one definable with respect to the representational system of the child or animal. Again, it is not necessary that they stand in relation to an ILF containing English words.

It is perhaps useful here to point out a pseudoproblem that also appears to be addressed by the similarity theory. We noted earlier that the ILF account represents attitude reports like those in (55) and (57) as *object-dependent*, since their truth requires the existence of ILFs that in turn demand the existence of certain individuals. Equally, however, this theory represents such reports as *language-dependent*, since their truth requires the existence of ILFs that in turn demand the existence of certain English expressions. It is tempting to see this latter result as raising a problem that is eased by the similarity theory. One might worry that although Galileo's belief reported in (55) is dependent on the

existence of the planet Earth, it is implausible to take it to be dependent on the existence of English. Surely, Galileo could have had the attitudes he did even if, causally, he were entirely isolated from English. Introduction of similarity would appear to ease this problem by not requiring Galileo to stand in relation to an ILF containing English expressions but only one similar to it, and so on.

It is important to recognize that the apparent problem sketched above and the apparent solution just considered rest on a confusion between two quite different assertions:

- (ii)a. If English failed to exist, the English sentence *Galileo believed that the Earth moved* could not be assigned truth-conditions.
- b. If English failed to exist, Galileo could not have had the beliefs he did (specifically, he could not have believed that the Earth moved).

The first assertion is trivially true. One cannot give truth-conditions for nonexistent languages. The second assertion is surely false, and does not follow under the ILF theory. The latter (as a semantic theory) addresses only the truth-conditions of sentences involving *believe*, *think*, *assert*, etc., it does not address the beliefs, thoughts, and assertions of persons. The 'problem' referred to above rests on a confusion, and does not require the introduction of similarity to solve it. (We are grateful to Gabriel Segal for discussion on this point.)

³⁵ The pair in (i) gives a natural case in which we might want to talk about people having the same attitudes in virtue of being related to linguistically similar ILFs:

- (i)a. John believes his favorite actress will receive an Oscar.
- b. Max believes his favorite actress will receive an Oscar.

Supposing that John and Max have different favorite actresses, and supposing that each pronoun refers back to its respective subject, the ILFs for the complements of (ia,b) will contain different individuals. Nonetheless, for certain purposes it is clear that we might still want to report the two men as having the same belief.

³⁶ This result has an interesting consequence for pairs like (2a,b) (repeated). Note that under the similarity theory, such pairs can be truth-conditionally equivalent in either of two very different ways:

- (2)a. Max believes Judy Garland sang "Somewhere Over the Rainbow".
- b. Max believes Frances Gumm sang "Somewhere Over the Rainbow".

On the one hand, the proper names may remain with scope within the complement clause, with equivalence obtained by appropriate choice of similarity features, despite different ILFs (e.g. as discussed in the text, the two can be equivalent if F is the feature 'objectual content'). Alternatively, the proper names may be assigned scope outside the complement clauses (as discussed in (44) above) yielding identical ILFs. Equivalence will then obtain independently of similarity feature choice. This result shows that *de re* equivalence (equivalence in virtue of broad scope) can be distinguished even in a theory employing similarity. *De re* equivalence of attitude reports is the case where equivalence obtains without regard to choice of similarity features.

³⁷ Notice that if (60) does utilize the the English* word *kicks* on the right-hand side, then it will assign the wrong truth-conditions; for then *Someone kicked Smith* will mean that someone kicked something that resembles something that resembles Smith.

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