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CONTENTS

Mental Logic and Human Sentence Comprehension

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INTRODUCTION

One can describe theories/models of speech perception (i.e., speech comprehension) as specifications of the overt and covert psychological processes utilized in developing a mental representation of the meanings conveyed by a particular series of acoustic (or orthographic) signals. In this paper, we address a small aspect of this enterprise, namely, the problem of inference-drawing in sentence comprehension, and the degree to which this requires the use of some sort of substantive "mental logic" in deducing or calculating inferences.

A theory of sentence comprehension must, we think, satisfy two conditions. First, it must correctly predict how a given sentence will be interpreted in a particular speech context. For instance, it must account for the fact that a person who hears some speaker say (1) will very probable draw inference (2) [1].

(1) John can lift 250 pounds.
(2) John has lifted 250 pounds at least once.

Let us call this condition one of observational adequacy. The second condition, which we shall call theoretical adequacy, is that accounts of sentence comprehension must assume only experimentally warranted cognitive-cum-linguistic human skills.

We will assume that the condition of observational adequacy is relatively uncontroversial and shall address here only the condition of theoretical adequacy. Suppose we have some observationally adequate account of the fact that (1) implies (2) but that it assumes the existence of some computational subroutine which can be proved to be beyond the capacity of language speakers (because, say, it has too many self-embedded loops). We would argue that this account is theoretically (because it is computationally) inadequate. Secondly, an observationally adequate account of inference (2) might be theoretically inadequate because it presumes the existence of unlearnable linguistic knowledge. Suppose, for example, that our observationally adequate account of (2) were to presume the existence of some set of totally unlearnable syntactic or semantic rules (even given a nativisitic assist). We would say that such an account is theoretically (because acquisitionally) inadequate.

Given what has been said, an observationally adequate theory of sentence comprehension could be theoretically

inadequate in at least two ways: computationally and acquisitionally. In this paper we examine two theories of natural language inferencing which almost certainly could lay claim to (or at least provide promise of) observational adequacy and examine them with respect to the condition of theoretical adequacy: the standard Truth-Conditional (TC) approach and a Lexico-Grammatical (LG) approach [2]. We shall argue that LG is theoretically superior to TC in regard to what each assumes about human linguistic computational skills and language acquisition.

Theories of language inferencing normally make a sharp distinction between semantics and pragmatics. The purpose of semantics in many such theories is to describe the truth conditions of sentences and, in the process, account for those propositions that are entailed by any particular sentence (i.e., what inferences can validly be drawn from any sentence). Pragmatic inferences of sentences (which, of course, are not valid) are usually assumed (Gazdar, 1979) to be somehow derivable from the truth-conditional meanings of sentences and such nonsemantic conditions as speech act felicity conditions, rules of conversation and politeness conventions. (See Geis, 1984, for more discussion of this point). A crucial assumption of this approach is, then, that pragmatic inferences are somehow "calculated," (to borrow the term used by Grice, 1975). In a very recent paper, Kempson (1984) has, for instance, presumed that deduction plays a central role in the drawing of some pragmatic inferences [3].

Characteristic of the standard TC theory is that sentences with determinate literal meanings acquire equally determinate pragmatic inferences when uttered in context [4]. Atlas (1979) has argued, however, that the fact that such a theory might be observationally adequate (our term) does not redound to its particular credit. Suppose we were falsely to assume that the earth is flat. We could create a method of navigation which allows us to make various mid-course "corrections" that permit us always to be able to get from any one point to any other point on our globe. In some cases, as in going from Dover to Calais, no corrections are necessary. This is similar to the case in TC semantics in which a sentence means in a particular context what it means literally. In other cases, as in going from Dover to Alexandria, mid-course corrections are required. This is like the case in which a sentence does not mean in context what it means literally, but, rather, has an implied meaning instead. On the TC theory (3) is, taken literally,

(3) Would you mind taking me to work?

a yes-no question, but thanks to mid-course pragmatic corrections (calculations) it is assigned a request-type meaning in context. Though Atlas does not say so, we might profitably view the TC theory this way: adoption of the TC paradigm causes us to

take a "false step" in the analysis of (at least some) indirect speech acts and (recall (1) and (2)) some generalized conversational implicatures (Grice, 1975). Perhaps it would be better to get the analysis of sentences like (1) and (3) right the first time by adopting a theory of inference-drawing in which a wide variety of the pragmatic inferences of banal language--that is (not disparagingly) the ordinary language of ordinary life--are "short-circuited" in the sense of Morgan (1978) and are therefore drawn without the need for mid-course calculations. We believe that such an approach would be superior to a theory of sentence comprehension based on a TC approach both computationally and acquisitionally.

Johnson-Laird (1982, 1983) has argued that logically untutored people do not have available a "mental logic"--that is, a substantive validity-based system of inferencing rules--which they employ in reasoning. Geis (1982, 1984b) has noted that if we do not have such a mental logic as reasoners, then we must not have one as language learners and language users. But if this is true, then the TC approach to sentence meaning and to natural language inferencing cannot be wholly correct--it would appear to be theoretically incorrect both computationally (because--on some accounts, at least--it presumes a validity-based deduction system in order to account for pragmatic inferences) and acquisitionally (because it presumes the existence of a validity detector in children) [5]. In this paper, we present evidence supporting these theses.

Experimental evidence (Johnson-Laird, 1982; Rips, 1983) bearing on peoples's logical capacities in reasoning tasks demonstrates that, to a striking degree, people cannot reliably distinquish valid from invalid inferences--the conceptual linch-pin of the TC approach. In related studies, the literature on the memorial representation of sentences demonstrates very significant effects of pragmatic implicature (cf. Bartlett, 1932; Brewer & Lichtenstein, 1975; Schweller, Brewer, & Dahl, 1976; Johnson, Bransford, & Solomon, 1973; Paris & Lindauer, 1976; Harris & Monaco, 1978). The question arises as to whether or not people can reliably distinguish valid from invalid inferences in connection with ordinary sentences, especially in cases in which invalid, but pragmatically compelling inferences are involved. Some evidence suggests they cannot. For example, Harris (1974) found, using a memory task, that subjects evaluated pragmatically implied sentences as true even after very explicit instructions warning subjects not to make such inferences. In order to test the hypothesis that they cannot make such distinctions in conjunction with on-line comprehension, we constructed an experiment in which a large number of subjects were asked to read a set of sentence pairs and to decide whether the truth of

the first sentence guaranteed the truth of the second sentence. The data were constructed to allow assessment of the relative salience of such pragmatic factors as rules of conversation (Grice, 1975) and speech act felicity conditions (Austin, 1965; Searle, 1975) as well as to allow us to determine if lexico-grammatical phenomena might interfere in such judgments.

METHOD

Subjects. Two hundred seventy-two subjects were recruited from an introductory undergraduate linguistics course on the first day of class (before the topics of semantics, pragmatics, implicature, etc., had been covered). All subjects were native speakers of English with no known cognitive deficits. No attempt was made to pre-screen subjects on the basis of their college background (i.e., whether or not they were completely logically untutored), but the following information was obtained from each subject: proposed major, number and type of language-oriented courses taken, and whether the subject had taken logic, philosophy of language, or computer science courses (a complete list of the questions asked appears in Appendix A). This was done so as to allow us to control for these variables statistically. However, the subjects' responses to the stimuli did not differ significantly in terms of any of these variables--including whether or not subjects had taken logic courses. This being the case, the results presented below represent responses collapsed over all subjects.

Materials. A set of 50 sentence pairs was constructed. The stimulus set consisted of 25 pairs where the second sentence was logically implicated by the first sentence, and 25 pairs where no such logical implicature occurred. The stimuli were thus balanced in terms of expected YES and NO responses.

An attempt was made to include in the sentence pairs a wide range of grammatical and pragmatic variables. In order to establish a response baseline, we took the took the pair of sentences (4a) and (4b) as representing an easy case of entailment [6]. We then compared it to pairs of

(4) a. John managed to leave.
b. John left.

sentences in which the two sentences vary lexico-grammatically to different degrees such as:

(5) a. John isn't here yet.

b. John is still not here.

(6) a. John eats less than Mary.
b. Mary eats more than John.

(7) a. John ate the omelet.
b. The omelet has been eaten.

(8) a. John will leave the park after Bill does.
b. John won't leave the park before Bill does.

(9) a. If John hits Bill again, we will be angry.
b. John has hit Bill before.

We used the sentence pair (10a) and (10b) as representative of an easy case of nonentailment.

(10) a. John opened the door yesterday.
b. The door is open now.

We also included sentence pairs in which the first sentence does not entail the second, but the first pragmatically implies the second. In sentence pair (11), the (11a) form is evidence for and thus invites the inference of the form (11b) (recall Grice's second Maxim of Quality).

(11) a. John ran faster than Bill.
b. Bill isn't as fast as John.

In (12), we have the much discussed and very controversial sentence discussed first by Geis & Zwicky (1971) (but see Boër & Lycan, 1973).

(12) a. I'll give you 5 bucks if you mow the lawn.
b. I won't give you 5 bucks if you don't mow the lawn.

In (13) a felicity condition on garden-variety bets is involved.

(13) a. John bet me $5.00 that Boston would win.
b. John believes that Boston will win.

Finally, a "contraposition"-type pair is involved:

(14) a. I left because I wanted to.
b. If I hadn't wanted to leave, I wouldn't have left.

There were five sentences in which three different candidate second sentences were used. Each of the three second sentences represented inferences of potentially different saliences and were included in the sets of sentence pairs representing nonentailments. This was done in order to more precisely evaluate the "strength" of the pragmatic implicature invited by the first sentence.

We took this step because in most pragmatics programs (e.g., in particular that of Grice, 1975) there is so much imprecision in "calculating" implicatures that we are often in danger of calculating too much. Thus sentence (15) might seem to pragmatically imply any of the three sentences of (16).

(15) John can solve algebra problems.
(16) a. If John is given an algebra problem, he'll be able to solve it.
b. If John is given an algebra problem, he'll probably be able to solve it.
c. If John is given an algebra problem, he should be able to solve it.

Similarly, it might be thought that some of (18a)-(18c) are more likely to be inferred from (17) than others.

(17) ABC filters remove bacteria from your drinking water.
(18) a. ABC filters will get rid of bacteria in your drinking water.
b. ABC filters should get rid of bacteria in your drinking water.
c. If you use ABC filters, your drinking water should be free of bacteria.

Rather than present all three versions of each second sentence to all subjects (which would doubtless have introduced bias relative to the other sentence pairs), the subjects were randomly assigned to one of three different numerically equivalent groups. Each group received the same instructions and were tested under the same conditions. In no case was there a significant difference among these three groups except in the responses to these five sets of sentence pairs.

Procedure. The sentences were presented to subjects in a survey format--that is, sentence pairs appeared on mimeographed response booklets passed out to individual subjects sitting in a classroom. Subjects were told that the test was a study examining dialect differences in word meaning between speakers from different parts of Ohio as well as those from different parts of the United States. We expected this to heighten performance since dialect judgments often provoke careful attention to language. The sentences for each stimulus appeared together on the form so that subjects had no memory load placed upon them during the test. This particular design (as opposed to presenting sentences sequentially on a CRT computer screen, as in Godby, 1984) was used because we wanted to minimize the extent to which processes constructing memorial representations influenced obtained estimates of on-line inferencing ability (cf. Johnson, Bransford, &

Solomon, 1973; Loftus & Palmer, 1974; Harris & Monaco, 1978).

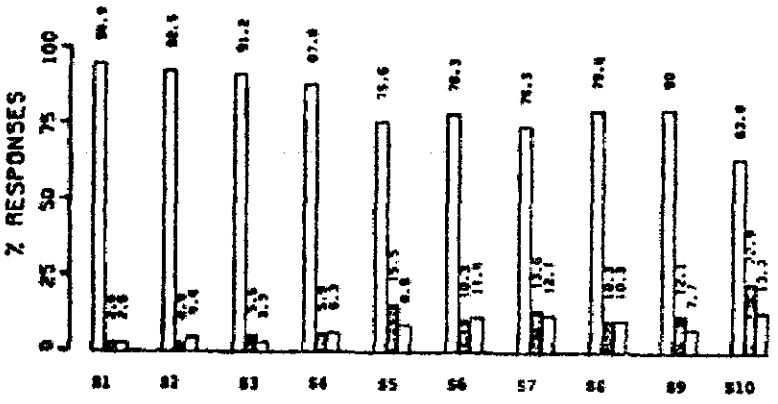
Subjects were required to indicate whether the second sentence of the pair must be true if the first sentence was true--that is, whether or not the truth of the first sentence guaranteed the truth of the second sentence. Subjects were required to circle either YES or NO. In addition, subjects were asked to indicate how confident they were that each separate response was correct. These confidence ratings ranged from very sure ("1") to very unsure ("4") (a copy of these instructions appear in Appendix A). Although these YES/NO answers plus confidence ratings can be converted into 8-point numerical scales (cf. Fox, in press, for converting identification responses), the responses were converted into one of three response categories: confident YES (i.e., YES response with a confidence rating of 1 or 2), confident NO (i.e., NO response with a confidence rating of 1 or 2), or Indeterminant (i.e., YES or NO response with a confidence rating of 3 or 4). Converting the responses into three categories (rather than 8-point scales) represents a more conservative view of the data, but follows the spirit of Harris & Monaco's concern that two-category labeling underdetermines the subjects' performance.

RESULTS

Figure 1 presents the results of judgments from subjects in cases in which the inferences are valid. Shown for each sentence pair are the percentage of confident YES, confident NO, and indeterminate responses. Responses to sentence pairs (S2), (S3), and (S4) do not differ significantly from sentence pair (S1) considered as the baseline valid response [7]. However, sentences pairs (S5)-(S9) all differed significantly from that of (S1). We note that there are significant lexical and/or grammatical differences between these pairs of sentences, which suggests that certain lexico-grammatical differences between pairs can interfere with semantic judgments [8]. We suggest that such facts point to the possibility that on-line sentence processing is a very difficult task under the best of circumstances. In fact, performance on semantic tasks may differ from idealized "competence" so much that the latter notion is of little help in understanding the former. On-line processing difficulties may be why people go for the "gists" (Loosen, 1981) of messages, their actual meanings (except in the simplest cases) often being very difficult to comprehend exactly.

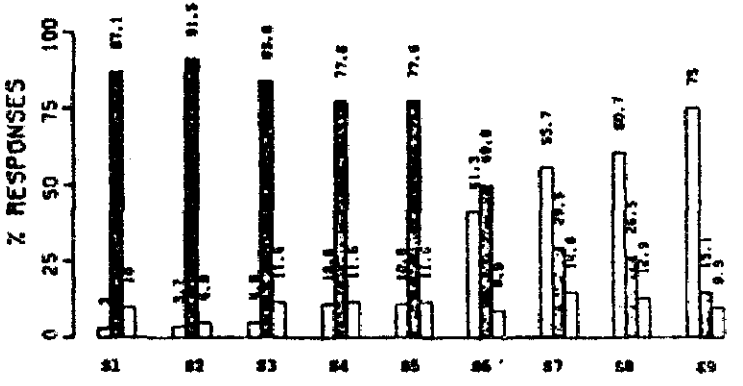
Figure 2 presents judgments concerning cases in which the inferences are invalid. Sentence pair (S1) represents the baseline response for this category. Note that, compared

Figure 1.



S1: John left with Mary./John didn't leave alone.
S2: John managed to leave./John left.
S3: John eats less than Mary./Mary eats more than John.
S4: John isn't here yet./John is still not here.
S5: If John hits Bill again, we'll be angry./John has hit Bill before.
S6: ABC coffee tastes better than most brands./Few brands of coffee taste better than ABC.
S7: John will leave the park after Bill does./John won't leave the park before Bill does.
S8: It isn't hard to please John./John is easy to please.
S9: John ate the omelet./The omelet has been eaten.
S10: John doubts that ABC pain killers are effective./John believes the ABC pain killers aren't effective.

Figure 2.



S1: John opened the door yesterday./The door is open now.
S2: ABC products are preferred by many doctors./ All doctors prefer ABC products.
S3: John comes from Boston./John now lives in Boston.
S4: If John and Mary have left, we'll leave./John has left.
S5: John ran faster than Bill./Bill isn't as fast as John.
S6: John willingly kissed Mary./Mary was willingly kissed by John.
S7: I'll give you 5 bucks if you mow the lawn./I won't give you 5 bucks if you don't mow the lawn.
S8: John bet me $5.00 that Boston would win./John believes that Boston will win.
S9: I left because I wanted to./If I hadn't wanted to, I wouldn't have left.

Figure 3.

John can solve algebra problems.

A. If John is given an algebra problem, he'll be able to solve it.

B. If John is given an algebra problem, he'll probably be able to solve it.

C. If John is given an algebra problem, he should be able to solve it.

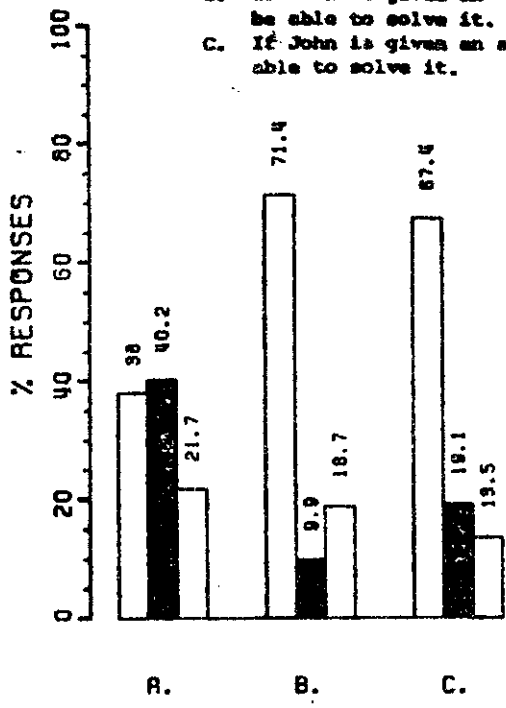


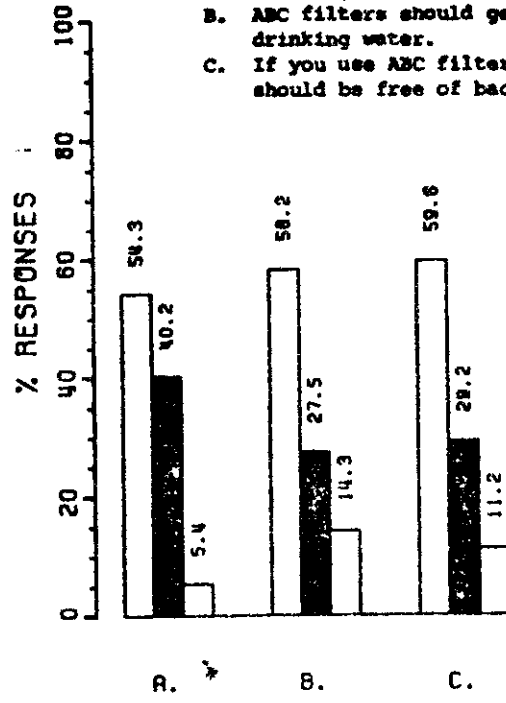
Figure 4.

ABC filters remove bacteria from your drinking water.

A. ABC filters will get rid of bacteria in your drinking water.

B. ABC filters should get rid of bacteria in your drinking water.

C. If you use ABC filters, your drinking water should be free of bacteria.



to the results presented in Figure 1, there are relatively greater shifts from the baseline sentence pair. There are no significant differences between (S1)-(S3) but (S4)-(S9) are all significantly different from (S1). (Some lexico-grammatical interference can expected here too.) These data show that people find certain pragmatic inferences, such as (S5)-(S9), to be quite compelling. Note, for example, that (S9) of Figure 2 is not significantly different from (S9) of Figure 1, even though the latter, but not the former, involve entailment. In some cases, though, the difference in performance between these judgments and earlier ones is significant. We believe that this means that pragmatic inferences are easier to falsify than entailments, not that people notate them differently in their internal linguistic representations.

Figures 3 and 4 present the judgments of subjects on the relative salience of different, though possible, inferences from a single sentence. We note first that generic claims are treated as being very strong even though in no cases are entailments involved (see Geis, 1984b for discussion of some "real world" implications of this fact). The sentences presented in Figure 3 are of special interest. We believe that a Gricean computation is consistent with all three second sentences, but the weaker sentences (B) and (C) are clearly preferred. We submit that people internalize lexico-grammatical postulates sustaining these more salient inferences, which accounts for the fact that (A) is easier to falsify than (B) or (C).

The data of Figure 4 show that a significant percentage of speakers take generic claims as being very strong. Note that the base sentence could be true (on a mindlessly literal, legalistic interpretation) if, say, ABC filters were to remove only a few bacteria from one's drinking water (e.g., five percent). Rather clearly, speakers generally don't see things this way. This fact is of great importance in constructing an adequate theory of what sentences <u>actually</u> mean. To say that speakers are "wrong" is to assume a prescriptivist stance of the sort that linguists have put behind them in other domains.

DISCUSSION

The experiment described is admittedly linguistically somewhat unnatural, though it is the sort of task people evaluating written claims (in advertising, politics, textbooks, scholarly disputes, etc.) might reasonably be said to engage in. Nevertheless, we believe it, like the reasoning studies cited earlier, casts serious doubt on the thesis that people do have a "validity detector," as is assumed (at least covertly) by most work in semantics--especially

semantics of the TC variety. We suggest, therefore, that the sentence comprehension theories based on the TC approach to inferencing may be acquisitionally inadequate because people do not have the cognitive-cum-linguistic capacity to learn them and computationally inadequate because people do not have the deductive skills required (on many accounts) to compute at least some pragmatic inferences.

Though our subjects did not always reliably distinguish valid from invalid inferences, they were reasonably good at identifying valid inferences correctly. Even in a case like (S9) in Figure 1, where there is significant grammatico-semantic interference, 75% of the judgments were correct. Subject's problems lay in the area of detecting invalidities. Humans are clearly expected to maximize their inferencing abilities at the expense of the validity-invalidity distinction in using language. We cannot see how such a distinction could be inferred by people generally and believe, therefore, that our results support a view of inferencing according to which the average (logically untutored) speaker's linguistic knowledge consists not of fully explicit, richly truth-conditional semantic representations but rather of logically relatively impoverished lexico-grammatical postulates that directly provide for both valid and invalid inferences with the difference between them being only marginally salient to average speakers.

We believe, therefore, that the standard theory of the relationship between semantics and pragmatics is also computationally inadequate. We believe, first, that most banal inferences are automatic (Fodor, 1983) and involve minimal computation. Indeed, we feel that most banal indirect speech act inferences (recall the important paper by Morgan, 1978) and generalized conversational implicatures aren't computed at all, but like banal entailments are to be accounted for directly, perhaps by lexico-grammatical postulates [9].

We would propose, for instance, that the lexical representation of <u>can</u> contains a pragmatic postulate (stated quite informally) like (19) in virtue of the knowledge of which people often (although certainly not always) infer a sentence like (2) from a sentence like (1).

(19) <u>can</u>: NP can VP[action] IMPLIES NP has VP'ed

Indeed, when (19) doesn't hold, accurate speakers will normally use <u>could</u> not <u>can</u>. We see no merit in supposing that people "calculate" this inference from Grice's second Maxim of Quality (Evidence), though this maxim may play a role in the acquisition of such a postulate.

(See Cole, 1975, for an interesting diachronic approach to grammaticized implicatures.)

Similarly, we believe the modal would has a lexico-grammatical postulate along the lines of (20) which is employed in interpreting a sentence like (3).

(20) would: would you VP[action] IMPLIES
Speaker requests Hearer to VP

Again, following Morgan (1978), we see no merit in supposing that hearers calculate this sort of speech act inference.

Geis & Zwicky (1971) argued that speakers "perfect" conditionals by construing "P if Q" as "P if and only if Q" and attributed this to a mental disposition. Boër and Lycan (1973) argued against this view in favor of a Gricean approach. We would side with Geis & Zwicky suggesting that perfecting conditionals is a consequence of a disposition of people to assume simple causal explanations of events. A characteristic of much human thinking is the assumption that events have simple, unconditioned causes. We speak, as Bolinger (1979) has noted, of "the cause of cancer" or "the cause of a student's failure," and so on, despite the fact that causes are rarely unconditional. In short, we seem to be guided by the principle that every event has a,that is, one cause. This principle seems to be involved in inference drawing and may account for (12) and, even more obviously, for (14). Thus, we would support the view that people's lexical representations of if and because encode "conditional perfection" over the very elaborate computational explanation of Boër & Lycan (1973).

We are at the initial stage of our research on theoretically adequate (i.e., psychologically plausible) accounts of linguistic inferencing and cannot therefore hope that our minimalist approach is established. However, let it be clearly understood that those who suppose that people have sophisticated logical skills which are employed in the acquisition of language (by two-year old children!) and in computing pragmatic inferences are under the obligation to demonstrate that these capacities exist for all speakers of all languages. We feel that this cannot be done.

AUTHOR NOTES

*This research grows out of theses advanced by Geis (1982, 1984). We shall here, and in subsequent research, adopt the convention of alphabetization of author names without regard to the question of whose contribution might be the greater in any specific case. By and large, Geis is

responsible for language analysis and Fox for experimental design, but even this distinction is blurred.

FOOTNOTES

1. In the study to be described below, 85.4% of the subjects took (2) to be an entailment of (1).
2. We have in mind a theory in which routine pragmatic inferences are coded lexically and are defined over surface syntactic structures. A few examples will be provided in the text to follow.
3. The assumption that people perform deductions in the course of interpreting sentences goes back at least as far as Lakoff (1971), for grammar, and Searle (1975), for pragmatic inferences.
4. Truth-conditional semanticists normally don't take themselves as offering theories of sentence comprehension, and we don't mean to suggest that they do. Such theories, however, seem to presume that children have a "validity detector" in virtue of of which they acquire a semantics-pragmatics distinction and have some means of drawing pragmatic inferences. (See the discussion in Johnson-Laird (1983, pp. 24-40) concerning the difficulties in modeling (and understanding) the acquisition of "mental logic."
5. Since linguists are disposed to hypothesize innate linguistic gifts of all sorts, the assumption that two-year olds have an innate validity detector in virtue of which they internalize a semantics-pragmatics distinction will present few problems. We have a better theory. God gives children a validity detector when they are two, just in time for language acquisition and takes it away when they are sixteen, just before psychologists begin doing experimental studies in testing for this ability. When nativists can distinguish their theory from ours empirically, we will happily abandon our theory.
6. We follow Geis (1982) in not distinguishing conventional implicatures (Grice, 1975) and entailments.
7. All significance testing was done using chi-square, unless otherwise noted. The probability level (alpha) use for determining statistical significance was .01.
8. We believe that these sort of results may impugn theories that employ redundancy rules to relate lexical items for such rules ought to facilitate inference drawing, not hinder it.
9. There are a variety of theoretical approaches one could take in accounting for direct inferencing ability, for instance, one could use the state theory of grammar as proposed by Yngve (in preparation).

REFERENCES

Atlas, J.D. (1979). "How linguistics matters to philosophy: Presupposition, truth, and meaning." In P. Cole & J. Morgan, Syntax and Semantics, Vol. 11, Presuppositions, New York, Academic Press.

Austin, J.L. (1965). How To Do Things with Words. Oxford, Oxford University Press.

Bartlett, F.C. (1932). Remembering. London, Cambridge University Press.

Boër, S.E., & Lycan, W.G. (1973). "Invited inferences and other unwelcome guests." Papers in Linguistics, 6, 483-505.

Bolinger, D. (1979). "Metaphorical agression: Bluenoses and coffin nails." Georgetown University Roundtable on Languages and Linguistics, Washington, D.C., Georgetown University Press.

Brewer, W.F., & Lichtenstein, E.H. (1975). "Recall of logical and pragmatic implications in sentences with dichotomous continuous antonyms." Memory & Cognition, 3, 315-318.

Cole, Peter (1975). "The synchronic and diachronic status of conversational implicature." Syntax and Semantics: Pragmatics, Vol. 9, New York, Academic Press.

Fodor, Jerry A. (1983). Modularity of Mind: An Essay on Faculty Psychology. Cambridge, Mass., MIT Press.

Fox, Robert A. (in press). "The effect of lexical status on phonetic categorization." Journal of Experimental Psychology: Human Perception and Performance.

Gazdar, G. (1979). Pragmatics: Implicature, presuppositon, and logical form.

Geis, M.L. (1982). The Language of Television Advertising. New York, Academic Press.

Geis, M.L. (1984). "On semantic and pragmatic competence." Presented at the Georgetown Roundtable, 17 March 1984.

Geis, M.L. & Zwicky, A.M. (1971). "On invited inferences." Linguistic Inquiry, 2, 561-566.

Godby, C.J. (1984) "The on-line interpretation of quantified sentences." Paper presented to the Department of Linguistics, The Ohio State University, 10 April.

Harris, R.J. (1974). "Memory and comprehension of implications and inferences of complex sentences." Journal of Verbal Learning and Verbal Behavior, 13, 626-637.

Harris, R.J. & Monaco, G.E. (1978). "Psychology of pragmatic implication: Information processing between the lines." Journal of Experimental Psychology: General, 107, 1-22.

Johnson, M.K., Bransford, J.D., & Solomon, S.K. (1973). "Memory for tacit implications of sentences." Journal of Experimental Psychology, 98, 203-205.

Johnson-Laird, P.N. (1982) "Thinking is a skill." Quarterly Journal of Experimental Psychology, 34A, 1-68.

Johnson-Laird, P.N. (1983) Mental Models: Towards a Cognitive Science of Language, Inferencing, and

Consciousness. Cambridge, Mass., Harvard Press.
Kempson, R. (1984). "Pragmatics, anaphora, and logical form." Presented at the Georgetown University Roundtable, Washington DC.
Lakoff, G. (1971). "The role of deduction in grammar." In C.J. Fillmore and D.T. Langendon (eds.), Studies in Linguistic Semantics, New York, Holt, Rinehart, and Winston.
Loosen, F. (1981). "Memory for the gist of sentences." Journal of Psycholinguistics, 10, 17-25.
Loftus, E.F., & Palmer, J.C. (1974). "Reconstruction of automobile destruction: An example of the interaction between language and memory." Journal of Verbal Learning and Verbal Behavior, 13, 585-589.
Morgan, J.L. (1978). "Two types of convention in indirect speech acts." Syntax and Semantics: Pragmatics, Vol. 9, New York, Academic Press.
Paris, S.G., & Lindauer, B.K. "The role of inferences in children's comprehension and memory for sentences." Cognitive Psychology, 8, 217-227.
Rips, L.J. (1983). "Cognitive processes in propositional reasoning." Psychological Review, 90, 38-71.
Schweller, K.G., Brewer, W.F., & Dahl, D. (1976). "Memory for illocutionary forces and perlocutionary effects of utterances." Journal of Verbal Learning and Verbal Behavior, 15, 325-337.
Searle, J.R. (1975). "Indirect speech acts." In P. Cole & J. Morgan, Syntax and Semantics, Vol 3, Speech Acts, New York, Academic Press.
Yngve, V. (in preparation). Human Linguistics: The Scientific Study of How People Communicate. The University of Chicago, Chicago IL.