Definite Descriptions and Semantic Memory*

ANDREW ORTONY AND RICHARD C. ANDERSON

University of Illinois at Urbana-Champaign

Subjects were exposed to sentences containing "direct" and "indirect" uses of names and definite descriptions. On a subsequent recognition test incorrect rejections tended to be of sentences involving indirect uses, and false alarms to sentences involving direct uses. This finding is contrary to the predictions of models that suggest indiscriminate substitution of names for descriptions, as do those of Anderson and Bower, and Rumelhart and Norman. The implication is that models of semantic memory must incorporate distinct intensional and extensional representations to avoid semantic distortion.

A definite description is a phrase which purports to uniquely identify or refer to an entity, as does, for example, *The first president of the United States*. A complete psychological theory of semantic memory must face the problem of how propositions involving definite descriptions are to be represented. Such expressions have been discussed by Anderson and Bower (1973), who stated:

> One of the more interesting features of our simulation program is the way in which it treats definite descriptions. Suppose that the parser encountered an input sentence such as "The first President of the United States was a good husband." It would take the definite description "X was the first President of the United States," match that to memory, determine that X is George Washington, and then encode in memory that "George Washington was a good husband." Thus, no record would be left in HAM's memory to the effect that the assertion had been made using a definite description rather than a proper name. (p. 248)

One of the reasons why Anderson and Bower think the matter of definite descriptions is interesting and important is that they believe this same procedure of substitutions underlies visual recognition as well.

Rumelhart and Norman (1973) distinguish an occurrence of a definite

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description in what they call a "nominal sense" from its use as an "operator." When a definite description like *The capital of the United States* is encountered there is, they say, no problem. This is the case of an operator (in this instance, *The capital of*) applying to an argument (in this case, *the United States*) and, like any other function, it delivers a value (*Washington, D. C.*). The other use they recognize would be the occurrence of *the capital* in a sentence like *Yesterday I visited the capital*. This would be the nominal sense and instead of again evaluating the description, its old value would be sought. A difficulty with this is that when the description is used as an operator one can only assume that the operator is distinguished from the argument on purely syntactic grounds. However, without a careful analysis of the preceding context this could lead to problems, for the operator might not be *The capital of ( )*, it might be *The ( ) of the United States*, with a whole range of possible arguments like capital, size, population, president, and so on. Usually contextual information is required to determine the operator. The way in which Rumelhart and Norman handle the nominal sense differs from the "operator" method only insofar as the value is looked up rather than recomputed. The mistake that they make, as do Anderson and Bower, is to imagine that it really is always necessary or appropriate to access the value.[1]

The purpose of this paper is to develop and empirically test an account of names and descriptions which is adequate for psychological theory. A satisfactory account will require semantic memory models to maintain separate intensional and extensional representations, and to invoke pragmatic rules for determining to which kind of representation a predicate is to be attached in particular cases. The claim is that this decision ought to be based, in part, on a distinction between direct and indirect uses of referring expressions, both at the logical level, as the arguments are intended to show, and at the psychological level, as the experiment is designed to show.

Although there is a long philosophical tradition of speculation and argument concerning definite descriptions, proper names, and their relationships both to one another and to the entities to which they refer or purport to refer (see, e.g., Frege, 1891, 1892; Kripke, 1972; Linsky, 1971; Russell, 1905; Strawson, 1950), for the purposes of this paper we can start with the analysis offered by Donnellan (1966). Donnellan argues that there are two uses of definite descriptions, those that he calls "referential" and those that he calls "attributive." A referential use of a definite description is one in which the description serves to pick out or identify the intended referent. Contrasted with this is the attributive use of a definite description to characterize any individual who satisfies the description. In the first use, Donnellan notes, the definite description may succeed in picking out the individual even if (by chance) there is no one who

[1]It should be mentioned that Norman (personal communication) has indicated that they are changing the way in which the model handles definite descriptions to accommodate our objections. Bower (personal communication) has also accepted our objections.

satisfies it, as when, for example, a man at a party is successfully identified using the description "the man drinking a martini" even though he actually has only water in his glass. This accidental success, however, would be impossible in an attributive use since the description, far from being merely a device to uniquely identify some individual, is all-important. So, if one asserts that the inventor of dynamite had a profound influence on the nature of warfare, it becomes very important that "the inventor of dynamite" is an attributive description, indeed, is *the* description which fits, for the meaning and the truth of the assertion depend not on whether some individual who happens to be identifiable by means of the description had a profound influence on the nature of warfare, but rather on the fact that *any* individual who satisfies the description would have had such an influence.

From a philosophical viewpoint, Donnellan's distinction can be criticized. One difficulty is that there probably is no sharp distinction between the two uses, but rather a continuum of uses with these two representing the extremes. From a psychological perspective, however, it is possible to determine empirically if there is a psychological correlate of the distinction, and if there is, we can dismiss objections about lack of a sharp distinction as easily as we can dismiss the denial of a perceptual difference between adjacent colors on the visible spectrum (e.g., red and orange) based on the observation that there is no point at which the one ends and the other begins. We can still distinguish two colors most of the time.

A general account of how models of semantic memory ought to treat names, definite descriptions, and propositions involving them can be developed on the basis of the following extension of Donnellan's analysis. If the principle that descriptions can be used both referentially and attributively is accepted, it is reasonable to suppose that names also can be employed to perform these two functions.[2] Consider first referntial uses. A description used referentially serves the same function typically performed by a name. That is, it picks out or uniquely indentifies an individual. But if a name is available, using a description is an *indirect* way of identifying that individual. The direct way would be to use the name. Put in ordinary terms, people generally use names to talk about entities when they can, and when they cannot they refer to them in indirect or roundabout ways.

Consider next the attributive use of descriptions and names. The attributive use of a definite description is the *direct* use, and one reason for calling it "direct" is that its transformational history includes a direct derivation of it from a predicate, without necessary reference to the name of the individual associated with that predicate. So, if we wish to speak about the inventor of dynamite, regardless of who he was, the definite description "The inventor of dynamite" can be directly produced from the predicate "invented dynamite" independently of, and without reference to, the name corresponding to the entity of which it is

[2]Kripke (1972) suggests this possibility in a lengthy footnote.

predicated. Our claim is that sometimes names are used indirectly, particularly in cases where it can be assumed that the hearer knows that a predicate is true of the individual whose name it is. For example, most of the things one might want to say about the first President of the United States could be unambiguously expressed using the name *George Washington*, because the description is in some sense a preferred or privileged one.

To summarize, referential uses of names and attributive uses of descriptions are *direct*. Attributive uses of names and referential uses of descriptions are *indirect*. These distinctions should have empirically testable consequences, since they imply that direct uses will require less knowledge and fewer inferences than indirect ones. For illustration, consider first a direct use of a name, as in *Alfred Nobel wore a fine beard*. A full understanding of this sentence in no way requires that the hearer know that Nobel invented dynamite. At most it requires the knowledge, implicit in the name, that Alfred Nobel was a man. Next, consider the indirect use of the name in *Alfred Nobel had a profound influence on the nature of warfare*. Here a full understanding *does* require that the hearer use the knowledge that Nobel invented dynamite, as evidenced by the fact that an answer to "how?" would most appropriately be along the lines that he was the inventor of dynamite. Contrast this with the direct use of the definite description, as in *The inventor of dynamite had a profound influence on the nature of warfare*. Here a full understanding in no way requires knowledge of *who* he/she was, but only that one know the sense or meaning of "The inventor of dynamite"; the name of the individual is irrelevant. Finally, an indirect use of the definite description, as in *The inventor of dynamite wore a fine beard*, requires that the definite description be analyzed for its reference—individuals wear beards in a more direct way than do inventors of dynamite. The various conditions and knowledge requirements for direct and indirect uses in the general case are laid out in Table 1.

TABLE 1
Knowledge Requirements for Direct and Indirect Uses

	Type of use	
Type of expression	Direct	Indirect
Name	Referential: Knowledge that the description fits the referent is irrelevant	Attributive: Knowledge that the description fits the referent is relevant
Description	Attributive: Knowledge of name of referent is irrelevant	Referential: Knowledge of name of referent is relevant

A preliminary experiment tested whether people judge the relevance of information in the manner summarized in Table 1. Subjects were presented with items comprised of two noun phrases and a predicate, in the following arrangement:

Christopher Columbus

was He changed the course of history.

the man who discovered America.

There were counterbalanced permutations of each item such that for half the subjects the name was on the top and for half the description was on top; for half the name was directly related to the predicate, while for the remainder it was the description that bore the direct relationship; and finally, for one group the item was in the first of two blocks of items presented, while for the other group it was in the second block. Subjects were asked to decide for each item whether the predicate was more relevant when considered as information about the named or the described individual. Overall subjects selected direct uses twice as often as indirect ones, $t(35) = 2.50$, $p < .01$. The bulk of the difference was due to subjects' strong preference for direct uses of names. The results suggest that people do accept and apply criteria of direct use like those we have outlined.

It must be acknowledged that in some cases the distinctions between direct and indirect uses will be less obvious and possibly even inoperative. From the point of view of representation in memory, some cases should be left so that the predicate attaches to whatever expression was used. For instance, there are logical reasons why substitutions cannot be made into referentially opaque contexts, as has long been argued by phiosophers (see, for example, Quine, 1963). Such contexts are characterized by propositions embedded in clauses whose main verbs express attitudes toward these propositions, namely, verbs of propositional attitude, such as *hope, know, believe, say, claim, want,* and so on. In other cases the predicate should perhaps be attached to both the extensional representation (Alfred Nobel) and the intensional one (the inventor of dynamite). An example might be *Alfred Nobel singed his beard*. It is not obvious at first glance how relevant inventing dynamite could be to such a disaster.

As indicated earlier, psychological models currently substitute names for descriptions. In contrast, what we are suggesting is that substitutions can occur in either direction, depending on the comprehender's interpretation of the use being made of the expression. Substitutions will tend to eliminate indirect uses. Thus, indirect uses of names will tend to be replaced by direct uses of descriptions, and indirect uses of descriptions by direct uses of names. Another way of putting this is to say that if the use is taken to be attributive (direct description, or indirect name) then the predicate will be associated with an intensional representation; if the use is taken to be referential (direct name, or indirect description) then the predicate will be associated with an extensional representation. The experiment attempted to test this supposition and the distinctions on which it is based.

If the distinction between direct and indirect uses of names and definite descriptions has psychological reality, then one would expect a particular pattern of confusions in a recognition task. Given the indirect use of the definite description in

The first president of the United States sometimes annoyed his father.

one would expect subjects to false alarm more frequently on seeing later the direct use of the name with the same predicate

George Washington sometimes annoyed his father.

than if they had seen the direct use of the definite description

The first president of the United States signed a treaty with France.

and were subsequently exposed to the indirect use of the name

George Washington signed a treaty with France.

Similarly, more incorrect rejections would be expected given old indirect than old direct uses.

Subjects were exposed to complementary pairs of sentences selected from sets of four. The sets contained a direct and indirect use of a description and of a name. One example of a set was:

The first man on the moon became a national hero.	(DD)
Neil Armstrong has several children.	(DN)
The first man on the moon has several children.	(ID)
Neil Armstrong became a national hero.	(IN)

The codes in parentheses refer to direct use of a description (DD), direct use of a name (DN), indirect use of a description (ID), and indirect use of a name (IN). Complementary pairs were (DN) with (DD), and (IN) with (ID). Each subject saw the same number of (D) pairs as he did (I) pairs. The study task was to write a continuation for each sentence beginning with the word "but." This encouraged semantic processing of the sentence. Later, a previously unannounced recognition test was given. Each subject was shown all the sentences, half he had already seen and half he had not. He was asked to judge if the sentences were old or new and he gave a confidence rating.

METHOD

Sixteen quadruples of sentences were constructed. Two different predicates appeared within each quadruple. Following the rule for directness explained earlier (see Table 1), the predicates were such that the description was used directly when coupled with one and used indirectly when paired with the other. The complementary pairings of the two predicates with the name gave rise to the corresponding direct and indirect occurrences of the name. Below is another example of a sentence set.

The most distant planet circles the sun once every 248 years.	(DD)
Pluto is 4,000 miles in diameter.	(DN)
The most distant planet is 4,000 miles in diameter.	(ID)
Pluto circles the sun once every 248 years.	(IN)

Two lists of 32 sentences were formed. Each list contained the (DD) and (DN) sentences from eight sentence sets and the (ID) and (IN) sentences from the other eight sets. Consequently each list involved exactly one appearance of each name, each description, and each predicate.

The lists were further divided into two blocks on a random basis, subject to the constraints that just one sentence from each set appeared in a block and that each block contained the same number of each sentence type (DD, DN, ID, IN). Block order was counterbalanced and there were four distinct random orders of items within blocks.

The experiment was run on a group basis with 56 undergraduates enrolled in an introductory educational psychology course. They received one exposure of one of the lists. The sentences were presented one per page in a mimeographed booklet. The assignment to lists, and block and item orders was accomplished simply by distributing the booklets from a randomly ordered stack.

The instructions asked the subject to write continuations of the sentences, starting with the word "but." In this way we sought to guarantee that subjects would meaningfully encode the sentences (cf. Anderson & Kulhavy, 1972).

As each subject completed the first task, the nature of the second part of the experiment was introduced for the first time. A recognition test involving all 64 sentences was given. On each page of a booklet one of the sentences was mimeographed. Below it were the words "old" and "new" and a four-point scale upon which to rate confidence. The instructions stressed that the subject was to determine whether he had seen exactly this sentence before, to indicate his judgment by encircling the appropriate word, and to rate his confidence. The subjects were told that they had seen half of the sentences and that half were new.

The test was also organized in blocks. Parallel blocks from the two lists were merged to form test blocks. The first block of items seen during the first task was included within the first block of items tested. Since blocks were counterbalanced during list presentation, they were also counterbalanced in the same way during testing. There were four distinct random orders of items within test blocks. The purpose of the blocking procedure was twofold. One was to minimize recall from short-term, nonsemantic memory. The second was to space encounters with sentences from within sets so as to increase the likelihood that an independent judgment would be made in each case. The test was subject paced.

RESULTS

Analyses of variance were computed, in which the fixed factors were directness and type of expression and the random factors were, respectively, subject and sentence set. Then minimum quasi F ratios were calculated (Clark, 1973). The

dependent variable was false alarms minus incorrect rejections. That is, the measure was the number of instances in which a new sentence was called "old" minus the number of instances in which an old sentence was called "new."

The only significant effect was the predicted one for directness, min F' (1,25) = 13.70, $p < .01$. There was not a suggestion of either a main effect or interaction involving type of expression. Table 2 summarizes proportions of errors. Of the 16 sentence quadruples, directness had the expected net effect in 12 cases, whereas the data ran marginally against the hypothesis in 3 cases and 1 case was equal. Of the 56 subjects, the directness hypothesis was confirmed by 46 and disconfirmed by 4. There was no difference for the remaining 7.

TABLE 2
Proportions of Total Errors[a]

Type of expression in test sentence	False alarms	Incorrect rejections
Direct	.339	.184
Indirect	.202	.275

[a] *Note:* Of 3,584 observations there were 788 errors.

DISCUSSION

The present experiment shows that whether a name or a definite description is used directly strongly influences recognition memory. One conclusion follows immediately: Anderson and Bower, and Rumelhart and Norman are wrong to lean so heavily on the unidirectional substitution of names for descriptions. For, if there were not a memorial distinction between the two kinds of expression, it would be difficult to understand the systematic pattern of errors observed in this experiment.

It must be possible for names and descriptions, although intimately related, to be separately maintained in memory. The hypothesis is that people tend to encode expressions in the semantically most direct fashion. We say "tend to encode" because unless semantic constraints are seriously violated, people may represent sentences, or parts of them, in the form presented. So, for example, subjects might well encode *George Washington signed a treaty with France* as it stands, even though, by our analysis, the indirect use of the name is semantically less appropriate than the direct use of the definite description. Our view is that when the encoded proposition does vary from the input sentence, the change will be one of increasing the semantic directness of the memorial representation, rather than one of eliminating descriptions.

There is an alternate and less interesting version of the directness hypothesis. It could be claimed that when subjects forgot a sentence they guessed, and that

their guessing preferences were dictated by directness. In other words, when a subject had no record of a sentence in memory he might have called the sentence "old" if it contained a direct use of the expression but "new" if the one it contained was indirect. Those cases were examined in which a subject indicated low confidence in his judgment and, therefore, in which he was presumably guessing. The criterion of low confidence was marking either a "1" or a "2" on the four-point confidence scale, a criterion met in 361 cases (i.e., in about 10% of the cases). Among these cases the proportion of direct expressions called "old" and indirect expressions called "new" was .507, which does not differ significantly from the chance level of .5, $t(47) = .17$. Eight subjects were confident of all their judgments. So, while response bias is always difficult to discount, it would appear that the guessing hypothesis gives a poor explanation of the data.

We know of two other experiments that have investigated the encoding of definite descriptions. Anderson and Bower (1973, pp. 248–251) found that subjects false alarmed about 20% of the time when names were substituted for descriptions. But they also found the same false alarm rate when descriptions were substituted for names, which is hardly consistent with their theory (see p. 248) that descriptions will be encoded as names when the identity of the individual named and the individual described is known.

Anderson and Hastie (1974) drilled subjects on the equivalence of a list of "common Anglo Saxon names" randomly paired with definite descriptions of the form "the lawyer," "the doctor," and so on. Various facts were predicated either of the names or of the definite descriptions. Finally, a sentence verification task was presented. Some of the sentences involved an inference; that is, it was necessary to affirm a fact in connection with a name which had originally been predicated of a description, or vice versa. In other test sentences the referential expression and the predicate were paired as they had been originally, so no inference was required. As Anderson and Hastie had predicted, an important factor was whether the subjects were taught the referential identity of the proper name and definite description before or after they learned the other facts. When the identity was established beforehand, there was no difference in verification time between inference and no inference test sentences, which Anderson and Hastie took to mean that all of the facts predicated of either the name or description were linked to the same memory node. When the referential identity of the name and description was learned after the other facts, it then took longer to verify inferential sentences than noninferential sentences. Anderson and Hastie argued that this must mean that the facts predicated of the name and the facts predicated of the definite description were linked to distinct memory nodes.

We dispute, however, that the only relevant variable could be the order in which information arrives. If this were the case people would constantly be in epistomological quicksand, considering that *any* predicate can be made into a

definite description. Much more likely is the view that logical, semantic, and pragmatic constraints are factors in determining whether predicates will be attached to an intensional or extensional representation of a concept.

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