The Recognition of Antonymy by a Language-Enriched Right Hemisphere

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Abstract

A commissurotomy patient with limited language in the right hemisphere was tested for ability to recognize direct and indirect antonyms. Normal subjects performing this task recognize direct antonyms faster than indirect. The patient's left hemisphere responded normally, but his right showed no difference in response to direct and indirect antonyms. It is concluded that the patient's right hemisphere had not learned that particular pairs of adjectives (the direct antonyms) can be used to represent the attribute whose contrasting values they express. Such learning normally occurs in the course of reasoning about attributes of things and events, but presumably failed to occur in this patient's right hemisphere because its powers of reasoning are severely limited.

Introduction

Studies of diminished cognitive systems brought about through brain lesions or surgery have underlined the complexity of the relations between language and other cognitive systems. In cases of hemisphere disconnection, the isolated right hemisphere has been assessed in dozens of cases, but in only a few has evidence developed that the non-dominant right hemisphere can possess some language capacity. The majority of cases show little or no evidence for language capacity of any kind.

For those patients who do show language in the isolated right hemisphere, it has been of great interest to characterize the linguistic and cognitive capacity of this system, and to look for correlations among various mental structures. In work carried out to date, the kind and extent of language present in these mental systems has varied widely (Gazzaniga, 1983). Some patients are capable of comprehending written and spoken material; of those, a few can also access speech from their right hemisphere. The distinction between cases that both comprehend and speak and those that merely comprehend language is reflected in other measures of language capacity. One such difference is found in the N400 brain wave associated with semantic incongruity: Patients who both speak and comprehend out of the right hemisphere show an N400 response from their right hemisphere, whereas those who only comprehend language do not (Kutas, Hillyard, & Gazzaniga, 1988). Another difference is that patients who speak also show semantic priming in their right hemisphere, whereas the others do not.

When the extent of the lexicon is assessed using standardized tests, the two hemispheres prove to be remarkably similar in capacity in these special cases of right hemisphere language. The right hemispheres tested to date, however, are extremely impoverished on tests of syntax: active-passive judgments, use of the functor to disambiguate meaning, and other similar assessments reveal little or no ability to use grammatical information to comprehend sentences. At the same time, these right hemispheres are able to make grammaticality judgments (Baynes & Gazzaniga, 1987). Apparently a language system can be organized in such a way as to allow for the recognition of grammaticality in the absence of the productive use of grammar. Consistent with this dissociation is the finding that these same right hemispheres are poor at making causal inferences, carrying out simple mathematics, or solving simple problems of spatial reasoning (Gazzaniga & Smylie, 1984). In short, although the extent of the right hemisphere's lexicon can be impressive, its capacity for active thought (to reason or solve problems) seems quite limited.

In the present study, the right hemisphere of a well-studied patient, J.W., was examined in an effort to deter-

Table 1

RESPONSE DISTRIBUTIONS			
Stimulus	**"Yes"**	**"No"**	**Sum**
Left Hemisphere-Right Visual Field			
Direct antonyms	77	3	80
Indirect antonyms	76	4	80
Controls	21	138	159
Sum	174	145	319
Right Hemisphere-Left Visual Field			
Direct antonyms	55	25	80
Indirect antonyms	56	24	80
Controls	41	118	159
Sum	152	167	***

synonymy. Predicative adjectives are thought of as organized into clusters of synonymous words, and pairs of contrasting clusters are held together conceptually by bipolar attributes whose opposite ends are labeled by direct antonyms that provide focii for the contrasting clusters. Thus, for example, "public" and "private" are direct antonyms, with "open, overt, common, popular," and "communal" clustered around "public," and "confidential, covert, secret, personal," and "secluded" clustered around "private." Pairs such as public/secluded or overt/private are indirect antonyms—they express the same conceptual opposition as the direct antonyms, but speakers of English do not associate them as immediately and directly as they associate direct antonyms.

2.4. Indirect antonymy is a conceptual or semantic relation between contrasting concepts.

Because Gross et al. assume that direct and indirect antonyms should be characterized in terms of semantic relations (antonymy and synonymy), their hypothesis concerning the organization of adjectives in the mental lexicon can be called relational. As a test of the relational hypothesis, Gross et al. showed that direct antonyms are recognized significantly faster than are indirect antonyms. They concluded that more cognitive processing is required in order to understand indirect antonyms, and that this additional processing involves an appreciation of synonymy. For example, in order to process the indirect antonyms public/secret, it is necessary to understand both the direct antonymic relation of public/private and the synonymy of private/secret.

However, their experimental results are not incompatible with a simpler hypothesis, namely, that in ordinary discourse direct antonyms occur together—are used in the same phrases and sentences—more often than they occur with other adjectives (Charles & Miller, 1989; Deese, 1965). According to a co-occurrence hypothesis, no appreciation of synonymous relations between adjectives is required in order to recognize indirect antonyms. Longer latencies are obtained because the cognitive skill is less well practiced. In short, some antonymous pairs are more familiar than others.

The present paper reports an attempt to decide between the relational hypothesis, according to which indirect antonymy involves the appreciation of two different semantic relations, and the co-occurrence hypothesis, according to which indirect antonyms are simply rare and unfamiliar.

The following reasoning led to the present experiments. Evidence favoring one or the other of these two hypotheses might be obtained from a person who appreciated antonymy but not synonymy. According to a relational hypothesis, the normal diffculty with indirect antonyms should be greatly exaggerated in such a person. According to a co-occurrence hypothesis, however, synonymy is irrelevant: such a person should give the same results as anyone else. Since J.W.'s right hemisphere is weaker in recognizing synonyms than antonyms, it approximates the kind of person who could provide such evidence.

On that basis the following experiments were designed and conducted.

Table 2

RESPONSE DISTRIBUTIONS			
Stimulus	**"N"**	**Mean RT**	**St. dev.**
Left Hemisphere-Right Visual Field			
Direct antonyms	77	1175	310
Indirect antonyms	76	1476	485
Controls	21	1823	420
Right Hemisphere-Left Visual Field			
Direct antonyms	55	1498	490
Indirect antonyms	56	1448	450
Controls	118	1943	585

have been identical. Differences in frequency of exposure alone (granting that they exist, as hypothesized) cannot explain the facilitation of direct antonymy by J.W.'s left hemisphere and its total absence in his right.

Co-occurrence may be useful, however, once a learner is ready to learn direct antonyms. Frequent co-occurrence should enable the learner to infer what pairs of adjectives are conventionally used as direct antonyms.

Learning Direct Antonyms

If frequency of exposure is rejected, the major unanswered question behind this discussion is why a difference between direct and indirect antonyms develops. Why do children bother to learn direct antonyms? Why isn't the undifferentiated state of J.W.'s right hemisphere good enough for everyone?

In the absence of evidence, a speculation may be admissible: Perhaps the right hemisphere's innocence of direct antonyms is related to its demonstrated deficiencies in reasoning and communication.

Consider the possibility that direct antonyms are learned in the course of thinking and talking about attributes of things and events. Such thinking must occur rather frequently. For example, whether a proposition is true, or an action feasible, often depends on the values of certain attributes: depends whether it's hot or cold, we say, or equivalently, depends on the temperature. Note that in thinking or talking about attributes, a pair of opposing adjectives can sometimes provide a convenient substitute for an attribute name. Hot and cold come to serve not only as predicative adjectives, but also, taken together, as an alternative name for the temperature dimension. Such pairs would be particularly useful when thinking or talking about attributes that do not have familiar names.

Linguists have noted that one member of the pair of direct antonyms, called the unmarked member, is often chosen to represent the attribute. Thus, for example:

Unmarked	Marked	Attribute
high	low	height
thick	thin	thickness
happy	sad	happiness
grateful	ungrateful	gratitude
legal	illegal	legality
major	minor	?
official	unofficial	?

There is an association between the unmarked member of a pair and the name of its attribute. Indeed, a case might be made that pairs of direct antonyms are more important than attribute names, since the attributes underlying many pairs have no other name.

To make this speculation more definite, it can be stated as an additional premise.

3. Pairs of direct antonyms can serve in reasoning and communication as names for the attributes whose values they express.

Table 3

PAIRS OF ANTONYMOUS ADJECTIVES

Direct Antonyms

able	unable	full	empty
active	passive	hard	soft
afraid	unafraid	heavy	light
alive	dead	hot	cold
back	front	kind	unkind
bald	hairy	long	short
big	little	lost	found
busy	idle	major	minor
clean	dirty	new	old
clever	stupid	coarse	fine
common	uncommon	outer	inner
deep	shallow	proud	humble
dull	lively	pure	impure
early	late	sane	insane
even	uneven	senior	junior
exact	inexact	simple	complex
fast	slow	sweet	sour
fat	lean	tame	wild
first	last	tidy	untidy
fit	unfit	tough	tender

Indirect Antonyms

afraid	brave	unafraid	scared
alive	extinct	dead	living
back	face	front	rear
bald	shaggy	airy	bare
big	small	little	large
busy	resting	idle	active
clever	dumb	stupid	bright
coarse	smooth	fine	grainy
common	rare	uncommon	usual
even	irregular	uneven	constant
fat	slim	lean	flabby
fit	sick	unfit	healthy
full	vacant	empty	stuffed
hot	frigid	cold	warm
kind	mean	unkind	caring
old	fresh	new	stale
outer	internal	inner	external
sane	crazy	insane	lucid
senior	younger	junior	elder
tidy	messy	untidy	neat

One point in favor of (3) is that it would help to explain why J.W.'s right hemisphere is ignorant of direct antonyms. Inasmuch as J.W.'s right hemisphere does not use its lexical knowledge—it does not think or talk about attributes of things—there would be no need or occasion for such learning to occur.

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