THE INFLUENCE OF LANGUAGE ON THOUGHT

CURTIS HARDIN AND MAHZARIN R. BANAJI
Yale University

The mystery of language was revealed to me . . . Everything had a name, and each name gave birth to a new thought.

Helen Keller, 1903

We see and hear and otherwise experience very largely as we do because the language habits of our community predispose certain choices of interpretation.

Edward Sapir, 1921

Experimental psychologists regard the hypothesis that language influences thought to be disconfirmed. In this paper, we examine (a) traditional interpretations of the hypothesis, (b) the basis on which the disconfirmation rests, and (c) experimental evidence supporting effects of language on memory, perception, problem-solving, and judgment. The purpose of this analysis is to question the prevalent view that the language-thought hypothesis is disconfirmed as well as to motivate renewed experimental interest, especially in the study of social cognition, where the social nature of thought is a primary assumption.

Many who have considered the relationship between language and thought assume that language influences the way people think and behave. Experiences like Helen Keller's provide compelling anecdotal evidence that language functions as a critical tool for thought. Some philosophers have concluded that not only does language importantly constrain thought, it may largely define it (Dewey, 1929; Marx & Engels, 1846; Quine, 1960; Wittgenstein, 1953, 1980). In recent years,

others have argued that language can justify action (e.g., Lakoff, 1991), and that language change is imperative for social change (see Cameron, 1990; Frank & Treichler, 1989; Miller & Swift, 1976; Spender, 1980; Thorne, Kramarae, & Henley, 1983).

For psychology, the question is an empirical one, and because language is inherently social, the language-thought relationship would appear to be an ideal domain for social psychologists to examine how human cognition emerges in social practice (e.g., McGuire & McGuire, 1982; Piaget, 1955; Vygotsky, 1962, 1978). Yet on the status of language in social psychology, Higgins (1981) has observed:

It is . . . surprising that the area of psychology most directly concerned with interpersonal relations, social psychology, has paid so little attention to the nature and consequences of language. (p. 343)

This state of affairs is especially surprising when considering that the role of language in thought is regarded as among the earliest and most important observations in social psychology (Cooley, 1902; James, 1890; Mead, 1934; Watson, 1924). For example, Gordon Allport devoted an entire chapter in his influential *The Nature of Prejudice* (1954) to linguistic factors in stereotyping, suggesting that words "cut slices" of social reality, "activate categories," and may interfere with the perception of "concrete reality." He concluded that "without words we should scarcely be able to form categories at all" (p.172). Sherif and Cantril (1947) made clear their assumption that language is essential for conceptual thought, quoting Huxley (1927) that "words are tools which automatically carve concepts out of experience." George Herbert Mead (1956) may have stated the assumption most strongly:

Language does not simply symbolize a situation or object which is already there in advance; it makes possible the existence or appearance of that situation or object, for it is a part of the mechanism whereby that situation or object is created. (p.165)

Psychologists have not just assumed the importance of language in thought, they provided the first experimental tests of the language-thought relationship (Brown and Lenneberg, 1954). However, the failure of early tests to provide unequivocal support for the hypothesis that language influences thought led Brown (1976) to conclude:

the fascinating irony of this research is that it began in a spirit of strong relativism and linguistic determinism and has now come to a position of cultural universalism and linguistic insignificance. (p. 152).

Influenced by such interpretations of the early experimental research, generations of students in psychology courses have learned that an interesting hypothesis about the influence of language on thought unfortunately failed to obtain experimental confirmation (cf. Anderson, 1985; Bernstein, Roy, Srull, & Wickens, 1991; Darley, Glucksberg, & Kinchla, 1988; Matlin, 1992; Seamon & Kenrick, 1992; Zimbardo, 1985). In fact, in most circles of experimental psychology it is impossible to mention Whorf's thesis without quick acknowledgment of its empirical disconfirmation.

In this paper, we question the wisdom of this conclusion, for social psychology in particular. We begin by discussing interpretations of the language-thought relationship proposed by Whorf (1956) because his linguistic *principle of relativity* has framed the theoretical and empirical debate in psychology. We perform this historical ritual for the lessons about scientific practice it may contain, despite our belief that advances in psychology will eventually require relocating the language-thought question independently of Whorf's original formulation. We proceed with a brief examination of the research that led to the rejection of the hypothesis in experimental psychology. Although we do not dispute the findings of the early experiments, in retrospect they appear to be insufficient to dismiss the thesis that language influences thought. In contrast, we believe that experimental evidence does provide support for the hypothesis, and present a selected review of experiments that demonstrate linguistic effects on perception, memory, problem-solving, judgment and inference. We conclude that renewed interest in the influence of language on cognition is warranted in psychology, especially in experimental social psychology. For concomitant with the emergence of social cognition as one of social psychology's primary paradigms is the availability of technologies that may finally allow one of the oldest social psychological assumptions to be subjected to a full empirical investigation. Further, the driving assumption of social cognition, i.e., that cognition and social practice exist in synergy, implies that the study of the relationship between language and thought should occupy a prominent place in the study of social cognition.

THE SAPIR-WHORF HYPOTHESIS

Experimental research on the language-thought relationship began in response to the claims of Benjamin Lee Whorf, who argued that the grammar of a language creates unique perceptions of reality for its users. Influenced by the ideas of his mentor, Edward Sapir, Whorf amassed an impressive array of anecdotes and observations, as well as

anthropological and linguistic data, consistent with that claim. In several influential papers (collected in Whorf, 1956), he introduced anthropologists, linguists, and psychologists to the controversial principle of relativity:

all observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar or can in some way be calibrated. (1956, p. 214)

Lenneberg (1953) is credited with the observation of two primary theses in Whorf's writing, *linguistic relativity* and *linguistic determinism* (Au, 1992; Brown, 1976, 1986; Cole & Scribner, 1974; Foss & Hakes, 1978; Gerrig & Banaji, in press; Kay & Kempton, 1984; Kay & McDaniel, 1978; Rosch, 1988). The hypothesis of *linguistic relativity* is that "structural differences between language systems will, in general, be paralleled by nonlinguistic cognitive differences" (Brown, 1976, p. 128). For example, Whorf observed that the Aztec language has just a single base term that includes what are termed in English 'cold,' 'snow,' and 'ice.' The absence of such lexical distinctions correlates with the relative insignificance of frigid weather in Aztec life of tropical southern Mexico (Whorf, 1956, p. 216). The hypothesis of *linguistic determinism* is Whorf's controversial statement of a causal relationship between language and thought, specifically, that language *causes* the cognitive differences observed across linguistic communities. For example, because the English lexicon distinguishes between ice and snow, English speakers are led by their language to habitually assume and perceive a greater differentiation than Aztec speakers, whose lexicon does not offer this distinction. To emphasize the distinction between the two theses, notice that the observation of covariation between language and thought (linguistic relativity) does not imply causal direction, much less the direction advanced by linguistic determinism. Although both hypotheses are provocative, we focus on the causality implicated in linguistic determinism. This thesis has been the primary impetus for experimental research, and support for linguistic determinism, in practice, has subsumed support for linguistic relativity (cf. Brown, 1976; Foss & Hakes, 1978; Langacker, 1976).

EXPERIMENTAL PSYCHOLOGY'S TREATMENT OF LINGUISTIC DETERMINISM

An extreme version of linguistic determinism has motivated experimental research on the Sapir-Whorf hypothesis (Kay & Kempton, 1984; Santa & Baker, 1975). For example, Brown's (1976) statement of linguistic determinism is that "the structure of anyone's native language strongly influences or *fully determines* the world-view he will acquire as he learns the language" (p. 128, emphasis added). Brown's use of "strongly influences" is open to interpretation as qualitative statements of functional relationships inevitably are, but the thesis that language "fully determines" thought is more difficult to defend. It may be interpreted to mean that thought is not posssible without language, a thesis easily dismissed by the weight of evidence for non-linguistic representations such as images (Kosslyn, 1980; Shepard & Metzler, 1971), cognitive maps (Tolman, 1932), tones (Deutsch, 1975), and prelinguistic thought (Piaget, 1955). Similarly, an influential formulation proposed by Foss and Hakes (1978) suggested a distinction between "strong" and "weak" versions of linguistic determinism. For them, the strong form of the hypothesis is that language *determines* thought; the weak form is that language *strongly influences* thought.

Further, Foss and Hakes correctly pointed out that an evaluation of linguistic determinism hinges upon what constitutes a "cognitive difference." They argued that if linguistic changes do not produce "differences in conscious awareness of aspects of the environment," i.e., that if language changes are only hypothesized to change underlying cognitive operations, then the hypothesis of linguistic determinism can only be a truism. On this point we agree. An interesting form of the hypothesis requires that experience of reality—measured independently of language—changes as a function of linguistic variation. (Of course, this is not to say that the existence of linguistic effects or their mechanisms must be consciously accessible to subjects [e.g., Nisbett & Wilson, 1977]). However, this line of reasoning led Foss and Hakes to suggest that something less than a "strong influence" of language on thought is uninteresting. They concluded that:

a strong version of the Whorfian hypothesis cannot be true. Our cognitive systems are not *completely pliable* and sensitive to whatever distinctions a language happens to make. (p. 393, our emphasis).

Although this continues to be the prevalent way in which linguistic determinism is treated, we find such statements of determinism curious because they are oddities in experimental psychology. Whorf himself did not think linguistic determinism was absolute, and his statement of the principle of relativity contains appropriate qualifications (see 1956, pp. 213-214). For example, discussing the emergence of science, he wrote: "Science of course was not caused by this grammar; it was simply coloured by it" (1956, p. 221). More importantly,

however, psychologists rarely, if ever, find it productive to state that all variance attached to a dependent variable can be accounted for by a single independent variable, whether, for example, it be the effects of time, interference, serial position, or expectancy on learning, memory, categorization, or evaluation. Accordingly, with what value may we formulate the hypothesis that language "fully determines" thought? Such a hypothesis would require but a single disconfirmation. Indeed, when such caricatures of linguistic determinism are removed, more useful questions remain concerning the extent to and conditions in which language may constrain thought.

Non-trivial hypotheses of linguistic determinism deserve experimental attention. Like Foss and Hakes (1978), we believe that this influence must demonstrate that perceptions of the environment are affected by linguistic variation. However, such effects may or may not be large, and their magnitude may vary as a function of domain and procedure. But these are empirical questions, not the sort to be defined a priori as interesting or not. Linguistic influences might be detected in the form of linguistic constraints on a variety of accepted measures of cognition, including verbal protocols, reaction time, explicit and implicit memory, categorization, judgments, etc. In sum, it is the causal direction of the language-thought relationship that is critical in tests of linguistic determinism, not whether it is absolute.

THE TRADITIONAL TEST: RECOGNITION OF COLOR AS A FUNCTION OF COLOR TERMS

Because traditional tests of the Sapir-Whorf hypothesis were motivated and evaluated by an extreme and untenable form of the hypothesis, not surprisingly it took only a few studies conducted within a single experimental paradigm to disconfirm it. Much of this research has been thoroughly reviewed elsewhere (e.g., Brown, 1976, 1986; Lucy, 1992; Rosch, 1988). We therefore present only a brief overview of the history of its empirical investigation so that the disconfirmation may be reconsidered accordingly. We describe more fully the most recent research in the paradigm, which has not been included in existing major reviews of the literature.

Early Tests. Memory for color was considered an ideal domain to test the Sapir-Whorf hypothesis, and the color paradigm dominated early tests. The color spectrum was thought to provide a continuous gradation of stimuli to which color labels may be arbitrarily assigned. Because color labels were known to vary across cultures, linguistic relativity could be supported if corresponding differences in color recognition could be identified across linguistic communities.

The first color studies found support for linguistic relativity by identifying cross-cultural correlations between episodic memory for colors and the number of basic color terms in the language. Such results were consistent with the hypothesis that the differentiation of color in the lexicon makes colors more distinct, and hence more memorable. However, the effects obtained were considered small and the hypothesis of linguistic determinism was not directly tested (Brown & Lenneberg, 1954; Burnham & Clark, 1955; Carroll & Casagrande, 1958; Lantz & Stefflre, 1964; Lenneberg & Roberts, 1956; Stefflre, Vales, & Morley, 1966; Takano, 1989). Thus, when two investigations reported results inconsistent with linguistic relativity they had serious consequence.

Berlin and Kay (1969) identified a total of eleven colors from which all languages take their basic color terms and found further that color terms emerged across linguistic communities according to a five-level hierarchy: (1) black, white, (2) red, (3) yellow, green, blue, (4) brown, and (5) purple, pink, orange, gray. That is, if a particular language had just two basic color terms, the terms would correspond to "black" and "white." If a language included a third term, it would correspond to "red." A fourth term would be taken from the level composed of "yellow," "green," and "blue." These findings were interpreted as disconfirmation of linguistic relativity because, despite variability across languages within levels 3 and 5 of the hierarchy, it appeared that the physical properties of color determined the development of linguistic terms and placed limits on interlinguistic variation in color perception.

The most serious blow to the experimental analysis of the Sapir-Whorf hypothesis, however, was provided by Heider (1972; Heider & Olivier, 1972; Rosch, 1974). She showed that the Dani of New Guinea, who have only two basic color terms, were nevertheless better able to recognize previously presented focal than nonfocal color chips, similar to the whites of North America. From this evidence, Heider argued that perceptual salience, not language, caused differences in memory, thereby compromising even the hypothesis of linguistic relativity.

Recent Tests. In contrast to these disconfirmations, support for the Sapir-Whorf hypothesis emerged with Lucy and Shweder's (1981) critical response to Heider and Olivier (1972). Not disputing the relationship between focality and color recognition, they argued that (a) focal colors in the arrays used by Heider and Olivier were easier to locate than nonfocal colors, which may have accounted for the better recognition of focal colors, and (b) Heider and Olivier did not test for a relationship between color terms and color recognition independent of focality. Lucy and Shweder replicated Heider and Olivier's experiment

using a color array designed to be unbiased with regard to focality. They replicated the superior recognition of focal than nonfocal colors, but also found an independent relationship between color recognition and codability, thereby supporting linguistic relativity (for replications see Garro, 1986; Lucy & Shweder, 1988). In addition, Kay and Kempton (1984) found support for linguistic determinism using a procedure not dependent on the controversial color arrays. They found that English speakers' subjective perception of the difference between blue and green was exaggerated relative to Tarahumara speakers, who do not distinguish blue and green lexically.

It appears that the continued rejection of the hypothesis that language influences thought is unwarranted, even within the color paradigm, which is the primary basis of the disconfirmation (Lenneberg, 1967). Although only a small number of cross-cultural studies were actually inconsistent with the hypothesis (Berlin & Kay, 1969; Heider, 1972; Heider & Olivier, 1972), conclusions based on them arrested research on the hypothesis for nearly a decade. Further, color perception is now known to be highly constrained by the physiology of the color system (for reviews, see Glucksberg, 1988; Gregory, 1981; Marr, 1982). This fact raises questions about whether the traditional color research could disconfirm linguistic determinism because it compromises the assumption that color labels are arbitrarily assigned to the color spectrum (for a full discussion of the importance of this assumption see Brown, 1976; Rosch, 1988). Finally, despite the physiological constraints on color perception, the most recent research within the color tradition has found linguistic correlates with color perception and with memory (Garro, 1986; Kay & Kempton, 1984; Lucy & Shweder, 1981, 1988). In light of these discoveries, it appears that the logic of the early color studies as tests of linguistic relativity is compromised, and not the hypothesis.

EXPERIMENTAL EVIDENCE FOR THE INFLUENCE OF LANGUAGE ON THOUGHT

The rejection of the hypothesis of linguistic determinism has been based almost exclusively on tests using a single paradigm, in which color terms were operationalized as "language" and color recognition as "thought." The discovery of limits of linguistic influence on color perception is important, but it leaves open the question of whether language influences cognition under other conditions. Alternative procedures might have been pursued under any circumstance, particu-

larly because Whorf himself emphasized the multiplicity of operations of language and thought (Bloom, 1981; Langacker, 1976; Lucy, 1992; Lucy & Wertsch, 1987).

Before reviewing experimental evidence consistent with linguistic determinism, it is useful to make explicit the often tacit assumptions that have guided investigations of the influence of language on thought, and our position regarding these assumptions. First, unlike linguistic relativity, the hypothesis of linguistic determinism requires evidence of causality—namely, that language variation *causes* cognitive consequences. Although observations of cross-language correlations with thought are consistent with linguistic determinism and important in their own right, they do not provide direct evidence of the influence of language on thought (Au, 1992; Rosch, 1973; Santa & Baker, 1975; Takano, 1989). We agree with this distinction, and we will focus primarily on those studies that illustrate the causal role of language in cognition. Of course, this focus excludes many excellent cross-language studies, which recently have been reviewed elsewhere (Gerrig & Banaji, in press; Hunt & Agnoli, 1991; Lucy, 1992). Instead, most studies we review employ within-language manipulations of linguistic use, a paradigm that allows inferences about causal relationships to be made with greater confidence.

A second assumption we make is that language-thought relationships may be demonstrated by variation in the semantics and pragmatics of language use, in addition to variations in syntax. Thus, a demonstration that the availability of particular words in one language but not in another "predisposes certain choices of interpretation" for the speakers of those languages is no weaker as evidence than a demonstration of the influence of varying grammatical structure on thought. This assumption is shared by many investigators, including Whorf (see Lakoff, 1987; Langacker, 1976; Mühlhäusler & Harré, 1990). For example, in the original cross-cultural color studies, the availability of a greater number of color terms was hypothesized to produce superior perception and memory for color (e.g., Brown & Lenneberg, 1954; Heider & Olivier, 1972). In this review, we will examine largely effects of language on thought that implicate such semantic and pragmatic components of language. This assumption is indirectly related to the previous one. By focusing on studies that demonstrate causal relationships between language and thought (rather than correlational evidence) we will concentrate on within-language experiments that show how meaning and use of linguistic labels influences thought. Because grammatical structure is less amenable to experimental manipulations and because cross-linguistic correlational studies do

not necessarily imply causality, we discuss many fewer studies illustrating the effects of grammatical structure on thought.[1]

A third assumption we make is that "language" and "thought" must be operationalized independently (Brown, 1976; Foss & Hakes, 1978). Indeed, Whorf's sometimes circular use of language differences as *evidence* of thought differences was part of the need for the first experimental tests of linguistic determinism (Brown & Lenneberg, 1954). In these studies, the "language" variable (color terms) was independent of the "thought" variable (recognition performance) (Rosch, 1988).

In the remainder of the paper we present experimental evidence of linguistic influences on thought. The review is organized according to traditional divisions in psychology, reporting effects on perception, memory, reasoning and problem-solving, and judgment and inference. The review is not exhaustive; rather, we have selected experiments that illustrate various effects of language on cognition but adhere to the criteria discussed in this section.

LANGUAGE INFLUENCES PERCEPTION

Although most articulations of linguistic determinism have emphasized the role of language in structuring what Whorf (1956) called the "kaleidoscopic flux" of incoming perceptual information, most experiments have actually measured memory. For example, although the earliest experimental investigations of linguistic determinism assumed that color labels should influence color perception, recognition memory was the measure of choice (Brown, 1976; Rosch, 1988).

However, a few studies using verbal color labels have directly assessed perception. For example, Kay and Kempton (1984) argued that the idiosyncratic arrangements of colors in all the color studies that used color arrays confounded theory-relevant explanations for recognition differences. To impose better control over stimulus presentation, they developed a new procedure in which subjects judged the perceptual distance between eight hues along a continuum of greenish-blue to bluish-green. The task was to view triads of color hues and indicate which one of three hues differed most from the other two. They found that English speakers, who have a blue-green lexical category boundary, exaggerated subjective distances of hues close to the boundary as compared to Tarahumara speakers, who do not lexically code the

1. In addition, it has been suggested that "grammar" may be no more than a formal description of conventional language use (Whorf, 1956; Wittgenstein, 1953, 1980).

blue-green distinction. On the other hand, Tarahumara speakers judged shades of blue-green hues to be closer than English speakers. Thus, linguistic relativity was demonstrated in a procedure that eliminated the problematic color arrays.

Kay and Kempton's (1984) second experiment is a landmark in the color-recognition tests of the Sapir-Whorf hypothesis because it represents the first explicit test of linguistic determinism. Specifically, they hypothesized that if the exaggeration in perceptual distance between blue and green in English was *caused* by the lexical distinction, then eliminating the relevance of the names to the experimental task should attenuate the perceived distance. In this experiment, the color triads were housed in a container with a sliding top such that subjects could only see alternative pairs of colors, and never all three at once. Shown one pair from the triad, a chip was called *greener* than the other, but when shown the another pair from the triad, the same chip was called *bluer* than the other. This procedure effectively made the names of the colors irrelevant. The chip of interest could not be called blue or green because in the comparison task it had been called *both* blue and green. Kay and Kempton found that when color names were experimentally controlled, judged distances for English speakers were equivalent to judged distances for Tarahumara speakers.

An effect of color labels on perception was also identified in a study that was not expressly motivated by an interest in the Sapir-Whorf hypothesis. In a learning experiment, Thomas, Caronite, LaMonica, and Hoving (1968) trained subjects to respond to a light of 490mu, but the label attached to the color of the light produced differences in stimulus generalization. If the light was labeled green, subjects generalized to longer wavelength, "greener" stimuli. If the light was labeled blue, subjects generalized to shorter wavelength, "bluer" stimuli.

These studies of lexically mediated color perception illustrate two ways in which language can influence cognition. The study by Kay and Kempton (1984) demonstrates that the implicit availability of lexical terms can influence perception, unless the terms are made temporarily irrelevant. On the other hand, the study by Thomas et al. (1968) demonstrates that temporary, within-language differences in label use can influence color perception.

A large literature has emerged implicating language in the perception of speech-related sound. Although infants exhibit a similar pattern of phonetic perception regardless of their language environment, by adulthood language background is strongly associated with phonetic perception (reviewed in Werker, 1991). In particular, linguistic experience appears to reduce the ability to perceive differences between speech sounds that do not differentiate words in one's native language.

For example, it is difficult for native Japanese speakers to distinguish between the English phonetic segments /l/ and /r/, which belong to the same category in Japanese. On the other hand, it is difficult for native English speakers to distinguish between the Vietnamese phonetic segments /d/, /t/, and /th/, all of which sound like "d" to the English speaker.

Several cross-language studies suggest that language influences acoustic perception (for reviews see Best, in press; Pisoni, Logan, & Lively, in press; Werker, 1991). For example, Gandour and Harshman (1978) compared tone discrimination judgments of adult Thai, Yoruba, and English speakers. Unlike English, Thai and Yoruba are tone-languages—that is, the lexical meaning of words is determined in part by phonological *direction* (increasing or decreasing pitch) and *slope* (the shape of pitch change). In Thai, for example, the same consonant-vowel sequence means either "face" (/naâ/) or "thick" (/naǎ/), depending on its prosodic shape. Gandour and Harshman found that in difference judgments of non-word tone pairs, Thai and Yoruba speakers made greater use of tone direction and slope than English speakers, consistent with the distinctions required by their respective languages. Tone characteristics unrelated to meaningful linguistic distinctions in the three languages (e.g., average pitch, length) were used equivalently in judgment by all three language groups. Similar cross-linguistic differences in tone perception have been identified between Japanese and English speakers (Miyawaki et al., 1975), Japanese and Cantonese speakers (Henley & Sheldon, 1986), Zulu and English speaking adults and infants (Best, McRoberts, & Sithole, 1988), and in Swedish and English infants as early as six months of age (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992). Hence, the role of language in structuring the perception of phonetic relations and distinctions is being seen as an increasingly important aspect of models of language acquisition (Nusbaum & Goodman, 1993).

In sum, language has been identified as a causal influence of the perception of color and sound, consistent with the hypothesis that the language one speaks can organize incoming experience. In addition, experiments demonstrate that not only is perception influenced by temporary manipulations of label or language use, but that perceptual differences are also associated with chronic distinctions imposed by native language.

LANGUAGE INFLUENCES MEMORY

The longest research tradition on the influence of language on cognition has examined the effects of temporary lexical use on episodic

memory. As compared to cross-language comparisons of memory, it has been suggested that within-language manipulations of label use provide more direct evidence of the causal role of language in cognition (Santa & Baker, 1975).

In a well-known early experiment, Carmichael, Hogan, and Walter (1932) demonstrated that differential label use influenced memory for visual forms. Given identical figures to memorize, but with one of two labels randomly assigned to each figure (e.g., dumbbells or glasses), subjects later produced drawings that were consistent with the labels they had received (cf. Bartlett, 1932). Daniel (1972) demonstrated a similar effect on recognition. Ambiguous figures taken from midpoints of several continua of progressively distorted figures (e.g., duck, dog) were presented to subjects who were later asked to recognize targets from the complete continua. Subjects given labels after they had studied the stimulus set tended to recognize figures toward the undistorted poles of the continua, away from the stimulus targets, but responses of subjects not given labels were distributed normally about the stimulus targets.

Many studies since have demonstrated that verbal labels can influence memory for visual forms, both by facilitating and inhibiting memory performance (cf. Ranken, 1963; Saltz & Newman, 1960; Santa & Ranken, 1968; Spiker, 1956). In a classic study, Bahrick and Boucher (1968) presented subjects with drawings of common objects and later tested verbal recall and visual recognition. At presentation, half the subjects verbally labeled the objects and half did not. Results showed that verbalization interfered with visual recognition, but improved verbal recall.

Label training also has been shown to improve short-term recognition for nonsense shapes under conditions in which the stimulus set is complicated (Ellis & Muller, 1964) and when there are a large number of shapes to be maintained (Santa & Ranken, 1972). In addition, some experiments have found effects of labeling after long retention intervals (e.g., Daniel & Ellis, 1972; Ellis & Daniel, 1971). Ellis (1968; 1972) has found evidence that labeling effects on recognition are especially pronounced when labels can in some way represent features of the stimuli.

However, Santa and colleagues have shown that even labels with an arbitrary relation to shapes can influence retrieval processes (Santa & Baker, 1975; Santa & Ranken, 1972). For example, Santa and Baker (1975) presented subjects with nonsense shapes paired with verbal labels which were either names of categorized objects or nonwords. Experimental stimuli were composed of (a) sixteen shapes designed to not resemble category name exemplars, (b) sixteen words belonging to

four categories (fruits, animals, musical instruments, and furniture), and (c) sixteen two-syllable nonwords chosen for their pronounceability and dissimilarity to real words. Subjects were trained on three blocks of 16 shape-label pairs in a paired-associate learning task. In one block, the 16 shapes were paired randomly with the 16 categorizable words. In a second block, the same shapes were paired with the same words in different random combinations. In a third block, the 16 shapes were paired randomly with the 16 paralogs (control condition). Recall was assessed both immediately and after a one week delay by having subjects draw the shapes they remembered. Results indicated that recall was superior when the shapes had been paired with the meaningful words than nonsense labels.

More important, however, were the labeling effects on recall organization. Category clustering scores were computed on the basis of sequential recall of shapes from the same category—that is, consecutive recall of shapes that had been paired with words from the same category. Although no reliable clustering patterns were obtained for shapes paired with the nonsense labels, recall of shapes paired with word labels were clustered according to the word categories. These results provide evidence that lexical organization influences the recall of randomly associated nonsense shapes, suggesting that language can indeed function to dissect nature.

Labeling effects on memory have been shown to obtain under more ecological conditions. In a study particularly reminiscent of the early color tests, Loftus (1977) exposed subjects to a film of an automobile accident involving a green car. After viewing the film, subjects were misleadingly asked about a blue car, or about a car for which no color was mentioned. Loftus found that recognition for the color of the car varied as a function of the label. Subjects in the "blue" condition recognized the color of the car as more blue than subjects in the "no-color" condition, whose responses were normally distributed about the true color of the car.

In more recent experiments, Schooler and Engstler-Schooler (1990) found that verbalization interfered with the retrieval of visual information. In one experiment, subjects viewed a videotape of a bank robbery, after which half were instructed to verbally describe the thief's face and half worked on an unrelated task. Subjects who verbally described the face later recognized the face less well than subjects who did not. In another experiment, recognition impairment was demonstrated for subjects who verbally described the face as compared to those who visualized the face. In yet another experiment, the finding was replicated using color chips as stimuli. After exposure to the color stimuli, subjects either verbally described the stimuli or were given

visualization instructions. As before, verbal descriptions of the colors impaired recognition as compared to conditions of visualization only.

In addition to the effects of verbal labels on perception and memory, Loftus and Palmer (1974) reported that labels also influence related judgments, assessed on a memory measure. In this well-known experiment, subjects saw a film of two cars colliding, and were subsequently questioned about the speed of the cars when they either smashed or hit one another. In the "smashed" condition, subjects remembered the speed of the cars to be higher than those in the "hit" condition, and were more likely to report that they saw broken glass.

Labels influence not only memory for color, but as Allport (1954) suggested, may create biases in person memory. For example, Snyder and Uranowitz (1978) found that a verbal label introduced after an initial representation of a person is formed influences memory for the person. Subjects first read a case history about Betty K. and learned afterward that she was either currently living a lesbian or heterosexual lifestyle. Multiple choice tests revealed that although the total amount of information retrieved in the two conditions did not differ, the manipulation of lifestyle labels produced memory differences consistent with the label. Further, errors in memory also tended to be consistent with lifestyle label (e.g., falsely remembering that Betty K. had never dated men if given the lesbian lifestyle label), suggesting that inferences (as assessed by memory) were also affected by the label manipulation. Bellezza and Bower (1981) questioned the particular memory mechanism proposed by Snyder and Uranowitz, but replicated the main finding, attributing it to differences in subjects' decision criteria (but see Clark & Woll, 1981).

In a similar study, Cohen (1981) presented a film of a woman and a man at dinner and then informed subjects that the woman was either a waitress or a librarian. Subsequent memory for details of the film was superior for material congruent with the label than for incongruent material, as were intrusions in memory. Such data demonstrate the potency of social labels to restrict or facilitate impressions and judgments of the social world.

Measuring memory to examine comprehension, Bransford and Johnson (1972) also demonstrated how influential mere labeling can be in the organization of experience. They found that subjects remembered more than twice as much information about an ambiguous passage if they were first provided with a title than if no title was provided, consistent with the hypothesis that language functions to package and organize incoming information.

It is worth pointing out that the logic of most of the studies in this section is similar to the original experimental investigations of the

Sapir-Whorf hypothesis. That is, can differential access to (color) labels influence memory? Taken together, experiments in this section support the hypothesis that labels may function to package information and influence what information is subsequently accessible on explicit memory tasks.

LANGUAGE INFLUENCES REASONING AND PROBLEM-SOLVING

Although the investigation of the language-thought relationship has been dominated by tests of memory, linguistic effects have been identified on problem-solving performance as well. Bloom (1981) criticized the uniform reliance on color memory and color terms and initiated a new examination of the language-thought relationship by examining problem-solving as a function of differences in the Chinese and English coding of counterfactuals. Bloom found that linguistic counterfactual terms in English were associated with superior counterfactual problem-solving by English speakers as compared to Chinese speakers.

However, the finding has been difficult to replicate and criticized on methodological grounds (Au, 1983, 1984, 1992; Brown, 1986; Bloom, 1984; Cheng, 1985; Liu, 1985). Au (1983) suggested that the stimulus material Bloom used was less idiomatic in the Chinese translation than it was in the English translation. Using a more idiomatic translation, Au found that Chinese and English speakers solved the counterfactual problems equally well. However, the Chinese speakers in her studies were Chinese-English bilinguals, allowing the possibility that subjects made use of their knowledge of English to solve the problems (cf. Bloom, 1984; Liu, 1985).

Of course, both English and Chinese speakers can reason counterfactually. As Au (1992) has argued, hypothetical thinking is required for a wide diversity of human functions known to be universal. For example, hope, regret, and frustration not only permeate everyday life, but require an ability to reason about things that do not immediately exist. At the same time, it is still not safe to assume that differential availability of linguistic counterfactual terms exerts no influence on reasoning. So far, this literature has relied solely on error rate measures, which do not reflect linguistic influences that might emerge on other measures such as reaction time (Cheng, 1985; Gerrig & Banaji, in press; Hunt & Agnoli, 1991; Hunt & Banaji, 1987).

The hypothesis that language may influence the facility with which

processing occurs does find support in a literature inspired by Baddeley, Thomson, and Buchanan (1975), who demonstrated that the span of immediate memory (in words) is inversely related to the time it takes to pronounce the words. Ellis and Hennelly (1980) identified a correlation between the time it takes to pronounce numbers across languages and math performance. They attributed superior math performance in children who spoke English rather than Welsh to the longer terms for Welsh digits, which require more time to pronounce than English digits. The story came full circle when Hoosain (1986) demonstrated that not only are numbers more quickly pronounced in Chinese than English, but in populations of equivalent math education, Chinese speakers performed better than their English-speaking counterparts. This correlation has since been identified in comparisons across several languages, supporting linguistic relativity (Hoosain, 1986, 1987; Hoosain & Salili, 1987; Naveh-Benjamin & Ayres, 1986). Although these studies demonstrate an inverse relationship between math performance and the time it takes to pronounce numbers across languages, none provides a direct test of linguistic determinism (Takano, 1989).

However, several well-known studies of problem-solving do provide direct evidence for linguistic influences. For example, Ranken (1963) demonstrated that although verbal descriptions improved recognition of ambiguous shapes, the labels interfered with their use in a problem-solving task. Subjects using the shapes in a jigsaw puzzle made more errors when the shapes had been labeled than when they were not labeled.

Schooler, Ohlsson, and Brooks (1993) demonstrated that performance on problem-solving tasks requiring "insight"—long assumed to be independent of linguistic processing (e.g., Bruner, 1966, Ericsson & Simon, 1980, 1984; Wertheimer, 1959)—can be influenced by verbalization. In two experiments, subjects in the verbalization conditions were interrupted while they attempted to solve each of several common puzzles and asked to describe the strategies they had been using. In other conditions, subjects were either allowed to complete each puzzle uninterrupted, or were interrupted but not asked to verbalize their strategies. Subjects who verbalized their strategies solved fewer of the puzzles than those who did not verbalize their strategies, and the differences could not be attributed to simple interruption. Subsequent experiments suggested that verbalization does not always interfere with problem-solving, but only in tasks in which solutions involve processes difficult to verbally describe. This finding is consistent with the hypothesis that although cognition may not be impossible without

language, the availability of an appropriate language of processing may greatly facilitate problem-solving (Gerrig & Banaji, in press; Hunt & Banaji, 1987; Hunt & Agnoli, 1991; Wittgenstein, 1976).

Consistent with the hypothesis that labels "cut slices" of reality and facilitate the categorization of perceptual experience, Glucksberg and Weisberg (1966) manipulated the presence or absence of labels in the classic box and candle task and found superior problem-solving performance when labels were provided (see also Duncker, 1945). Higgins and Chaires (1980) used the same task to demonstrate that differences in the accessibility of different linguistic constructions can strongly influence problem-solving. They found that subjects exhibited far superior performance in attempts to solve the problem if in a previous unrelated task subjects were incidentally exposed to 'and' constructions (e.g., "carton and milk") rather than 'of' constructions (e.g., "carton of milk"). This study is particularly important because it provides direct evidence that a habitual use of language may induce habitual modes of thought. Although the linguistic "habit" was temporarily induced, its influence on problem-solving was dramatic.

In sum, linguistic influences on memory are demonstrated on a variety of measures from a variety of procedures. Most studies show that even temporary manipulations of language use influence reasoning and problem-solving. In addition, the evidence reviewed here suggests that lexical differences are associated with the speed with which information can be processed.

LANGUAGE INFLUENCES JUDGMENT AND INFERENCE

Research in social cognition often demonstrates that basic findings in perception, memory, and problem-solving have implications for social behavior and understanding. Similarly, effects of language on basic cognitive processes have been shown to affect processes of social judgment and inference. In particular, research has demonstrated that the language used to describe the social world can influence subsequent thought about the social world.

For example, Higgins and Rholes (1978) found evidence that "saying is believing" by demonstrating that messages modified for the benefit of listeners influenced communicator's subsequent memory for the original message, as well as related judgments (cf. Bartlett, 1932; Neisser, 1967; Whorf, 1956). Subjects first read a person description containing positive, negative, and evaluatively ambiguous information. They were led to believe that they would summarize the information to another person who either liked or disliked the stimulus

target. Half the subjects actually wrote the summary while the other half did not. Higgins and Rholes found that not only did subjects tailor their summaries to be congruent with the listener's attitude (cf. Manis, Cornell, & Moore, 1974), but subsequent memory and judgment of the stimulus target were biased in the direction of the distorted summary for subjects who actually wrote their summaries. In addition, they found that biases in memory and judgment tended to become more exaggerated over time. It is important to note that these effects did not obtain for subjects who did not write down their summary. Preparing a summary only influenced subsequent cognition if it was put into words (cf. Ranken, 1963; Schooler & Engstler-Schooler, 1991; Schooler et al., 1993). Similar results have been demonstrated in several other studies as well (Higgins & McCann, 1984; Higgins, McCann, & Fondacaro, 1982; McCann, Higgins, & Fondacaro, 1991; Sedikides, 1990).

If temporary differences in language use can affect cognition, differences should also obtain between language communities, though it is usually assumed that cross-language comparisons preclude direct tests of an influence of language on thought (Au, 1992; Takano, 1989). However, Hoffman, Lau, and Johnson (1986) provided just such a demonstration between linguistic communities, capitalizing on the observation that particular personality types are described more economically in some languages than others. Two personality descriptions were created, one consistent with a one-word label in English (but not Chinese) and the other consistent with a one-word label in Chinese (but not English). Chinese-English bilinguals, randomly assigned to language condition, read character descriptions based on the two personality types. When the language of processing allowed a one-word label for the personality-type, they found that impressions of targets were more congruent with personality-type, and that subjects made more extreme judgments on attributes congruent with the personality-type. This study is especially compelling because not only did subjects begin with equivalent person information, but because bilinguals were randomly assigned to language condition, the usual confounds associated with cross-cultural comparisons were eliminated.

GENDERED LANGUAGE AND SOCIAL INFERENCE

Whorf (1956) observed that gender in English is an obligatory grammatical form, but an examination of the specific role of gender in language to create, perpetuate, and justify the social status of women

and men has become prominent only recently, with the emergence of feminist critiques in the past two decades (e.g., Bodine, 1975; Cameron, 1990; Lakoff, 1975; Spender, 1980).

Experimental research on the topic began with a study of the effects of generic masculine pronoun use in introductory sociology textbooks. Schneider and Hacker (1973) asked students to suggest photographs and cartoons for potential use as illustrations for chapter topics. Students were more likely to choose all-male illustrations for chapter headings like "Industrial Man" than for headings like the more gender-neutral "Industrial Life." Harrison (1975) replicated this finding with junior high-school students who were asked to draw pictures illustrating human activities described in terms of "early man" versus "early people," suggesting that spontaneous imagery is affected by use of the generic masculine.

The effect of the generic masculine also has been examined by exposing subjects to longer texts identical in all respects except for pronoun type. For example, Martyna (1980) found that subjects who read person descriptions employing generic masculine pronouns completed sentence fragments and chose representative pictures that included more male than female referents compared to subjects who read neutral gender pronoun person descriptions (cf. Cole, Hill, & Dayley, 1983; Moulton, Robinson, & Elias, 1978). In a conceptual replication, Khosroshahi (1989) gave subjects a sex-indefinite paragraph to read which involved either the use of the generic he, he or she, or they. Drawings evoked by the paragraph were analyzed for the gender of figures included. Paragraphs using he were least likely to evoke female referents; paragraphs using he or she were most likely to evoke female referents. Paragraphs using they yielded an intermediate number of female referents. Although this pattern held for all subjects, the effect of the pronoun manipulation was more pronounced for female subjects than male subjects. MacKay (1980) found that the effect of differential pronoun use extends to memory. Fifty percent of subjects exposed to descriptions employing generic masculine pronouns mistakenly remembered the target to be male and not female, while just 13% of subjects exposed to gender-neutral neologisms (E, e, tey) made the error.

Not only does generic masculine pronoun use influence whether male or female referents will be imagined, but it has also been shown to influence subjects' interest in occupations. For example, Bem and Bem (1973) found that women express more interest in professions described using gender neutral terms than masculine generic terms. Although Gottfredson (1976) did not replicate the effect, it has been more recently replicated by Stricker (1981) as well as Briere and Lanktree (1983).

Prentice and Miller (1992) have extended the general finding by

manipulating language practice of subjects over the course of a semester, differentially correcting the use of masculine generics in their regular laboratory write-ups. Half the subjects were corrected each time they used a masculine generic term, while half were not. At the end of the semester, females who were corrected generated more female free association completions than females who used the generic masculine terms without correction. However, male subjects were not affected by the manipulation.

Cognitive consequences of more chronically imposed linguistic habits also have been identified. For example, in a study of native speakers of Serbo-Croation (in which gender is coded explicitly in grammar as it is in Spanish) conducted by Gurjanov, Lukatela, Lukatela, Savic, and Turvey (1985), lexical decisions were faster when noun targets were the same gender as possessive-pronoun primes. That is, subjects were quicker to process target words when they formed grammatical than ungrammatical relations to the primes.

Unlike Spanish or Latin or Serbo-Croate, in which gender is an explicit grammatical category, gender in English forms what Whorf called an implicit grammatical category. Although in English gender is not marked by attaching a "masculine" or "feminine" inflection, the gender of a pronoun must agree (grammatically) with the gender of its referent. For example, Suzy says that she is a doctor, but Billy says that he is a doctor. Whorf observed that gender is coded not only in names, but in many social category nouns (e.g., husband, mother, uncle, woman), and suggested further that the "invariable precision" with which such nouns are linked with their pronoun referents leads to a "habitual consciousness of two sex classes as a standing classificatory fact in our thought world" (1956, p. 90). Consistent with this thesis, we have shown that gender classification functions automatically in cognition (Banaji & Hardin, 1993). For example, in one experiment using a standard semantic priming task (e.g., Neely, 1977), we found that after exposure to words like fireman, man, and father, subjects were faster to identify he than she, but after exposure to words like waitress, woman, and mother, subjects were faster to identify she than he. In other experiments, similar effects were obtained on the speed with which subjects judged female and male names.

The role of gendered language in cognition illustrates the importance of the language-thought question to social cognition research. Not only are these studies consistent with the hypothesis that language influences thought, but the finding that particular linguistic constructions may produce differing cognitive consequences for members of distinct social groups (e.g., Khosroshahi, 1989; Prentice & Miller, 1992) is a question deserving empirical attention. The priming studies, whose

results are consistent with the hypothesis that grammatical rules have cognitive consequences, illustrate how recent methodological innovations may be used to examine the language-thought relationship. In sum, language may not only serve to reify and organize information, but research on the language-cognition interface may suggest new ways in which representation and information-processing are related to social status and social experience.

THE IMPORTANCE OF LANGUAGE EFFECTS ON THOUGHT

Although we have presented many studies as demonstrating that linguistic manipulations have cognitive consequences, it may be argued that they do not implicate language in thought at all. Instead, it may be argued that different language conditions activate or otherwise make salient different information structures which are directly responsible for the observed effects on cognition.

Such a criticism is not without merit. In particular, it forces experimental examinations to identify the full array of mechanisms that underlie language-thought effects. However, we find such an argument unpersuasive if its implication is to place greater creedance on unobservable mental constructs (such as 'schemas') over observable and manipulable linguistic factors. Most importantly, pointing to knowledge structures activated by language as causes of cognitive change appears to be less of an alternative explanation than a plausible mechanism for the manner in which language influences thought (Higgins & Chaires, 1980). It is worth pointing out that similar mechanisms were hypothesized in the earliest statements of the language-thought relationship (Bartlett, 1932; Sapir, 1921; Vygotsky, 1962; Whorf, 1956). In fact, Hunt and colleagues have argued that several models of cognition actually implicitly subscribe to the hypothesis of linguistic determinism (Hunt & Agnoli, 1991; Hunt & Banaji, 1987), and provided arguments for studying the role of language in the activation of knowledge structures.

A second related question is whether some of the effects on cognition we have reviewed are unique to language. That is, can the function performed by language be equally accomplished by non-linguistic means. To our knowledge, such tests have simply not been conducted. However, whether or not such a demonstration emerges, the importance of the role of language in social cognition is assured because of its ubiquity, essential role in human functioning, and status as an objectifiable feature of social discourse (Mead, 1956; Vygotsky, 1962).

ADDITIONAL ISSUES CONCERNING LANGUAGE, COGNITION, AND SOCIAL COGNITION

We believe that the influence of language on thought should be of central concern for research on social cognition. Although many studies reviewed were not expressly motivated by an interest in linguistic determinism, they suggest that an expanded arena of possible operationalizations of "language" and "thought" may serve as the future testing ground for the hypothesis. For example, variables may include false alarm rates as well as other measures of error in memory (e.g., Snyder & Uranowitz, 1978; Daniel, 1972), as well as the use of heuristics in judgment. Investigators might also look for effects of language on measures such as the speed of computation, based on the assumption that language may be an important currency of computation even when it does not affect explicit memory, categorization, or evaluation (Hoosain, 1986; Hunt & Agnoli, 1991; Hunt & Banaji, 1987). In addition, many have emphasized the influence of grammatical compunctions, as opposed to lexical influences, of language on thought (Langacker, 1976; Lucy & Wertsch, 1987; Whorf, 1956; Wittgenstein, 1953).

Although the influence of grammar on cognition is difficult to test directly, in part because grammar is not easily manipulated, evidence is emerging from research on language acquisition. For example, Landau and colleagues have found that in the presence of a novel noun (i.e., "this is a *dax*"), subjects exhibit a bias to group objects by shape—a bias that is not prominent in non-lexical classification tasks (Landau, Smith, & Jones, 1988; Landau & Stecker, 1990). Similarly, the noun/adjective distinction appears to influence children's performance on categorization tasks (for reviews see Markman, 1991; Waxman, 1991).

Studies employing priming procedures suggest that recent methodological advances may be exploited to examine the language-thought relationship (e.g., Banaji & Hardin, 1993; Gurjanov et al., 1985; Higgins & Chaires, 1980). Further, given that the goal of research on social cognition is to describe the relationship between individual information-processing and social context, language, as the primary form of social interaction, is poised to take center stage. New questions of interest are: How can language provide "prefabricated thoughts" that may be used to build data structures for comprehension? How does language establish relations between objects? How does language provide entry-points that activate larger data structures than otherwise available? What is the role of language practice in cognitive representation? How does language reify and perpetuate existing social status

and relations? Does language differentially faciliate modes of expression, judgment, and perception? Such questions are interesting to contemporary psychologists, but often without explicit awareness of their similarity to the "old" Whorfian idea.

In this paper we have focused on experimental evidence concerning the influence of language on cognition because of the common assumption among experimental psychologists that the causal relationship has been disconfirmed. However, outside this particular concern, language has re-emerged as a prominent interest in social psychology, and particularly in social cognition (for reviews see Giles & Robinson, 1990; Semin & Fiedler, 1992a). Studies of communication and verb use are two such literatures.

As issues of pragmatics are incorporated into psycholinguistic theory (Grice, 1971), studies of the role of communication in social cognition are becoming increasingly important in understanding the language-thought relationship (for reviews see McCann & Higgins, 1992; Strack & Schwarz, 1992). For example, Higgins, McCann, and Fondacaro (1982) demonstrated effects of communication role on impression formation. Speakers and listeners were exposed to the identical stimulus information and then recorded their impressions of the person described. Although listeners' impressions were more differentiated and less unified if additional information was expected, rather than unexpected, speakers were unaffected by the expectation manipulation. The coherence required by the active communication of a message may constrain the cognitive representation of the message, even in the face of contextual variation (cf. Bartlett, 1932).

Another recent literature has examined the causal information implicit in verbs (reviewed in Semin & Fiedler, 1992b). For example, in simple subject-verb-object sentences, action verbs (e.g., kiss, hit) imply that the subject caused the action, but state verbs (e.g., love, hate) imply that the object caused the action. If "Tom hits Jerry," subjects attribute the cause of the action to Tom, but if "Jill loves Kate," subjects attribute the cause of the action to Kate. Differences in verb-type use have been identified in conventional descriptions of ingroups and outgroups, and appear to contribute to the perpetuation of stereotypes (Fiedler & Semin, 1992; Fiedler, Semin, & Bolton, 1989). And in a different line of study involving information contained in verbs, McGuire et al. (1986) have found that verb-type use differs as a function of social context, and may be associated with differences in social and self-complexity.

In sum, the verb studies and communication studies represent ways in which the synergistic relation between language and thought can be fruitfully studied outside strict demonstrations of language as a causal influence on thought.

CONCLUSION

In this paper we have questioned the current position among experimental psychologists that the hypothesis of linguistic determinism is disconfirmed. We have done so by examining interpretations of the hypothesis itself, research in the traditional color paradigm, and selected examples of confirmatory evidence for the influence of language on perception, memory, problem-solving, judgment and inference.

In our examination of the interpretation of the hypothesis, we found an unusual state of affairs. Tests of linguistic determinism were motivated by statements so extreme that, in retrospect, disconfirmation was inevitable. The hypothesis that language *fully determines* thought may have actually discouraged further research on the topic. Moreover, this treatment of the hypothesis of linguistic determinism may have obscured more important issues of the magnitude and mechanisms of linguistic influences on cognition.

Our survey of traditional tests of the Sapir-Whorf hypothesis yielded three observations. First, although interest in the relationship between language and thought was stated in terms of linguistic determinism, early studies primarily tested linguistic relativity. Second, although the bulk of early findings supported linguistic relativity, only a few cross-cultural comparisons disconfirmed linguistic relativity. This too, we concluded, represents an oddity in the standard scientific ritual of hypothesis testing. Third, although the most recent color experiments do support the hypothesis of linguistic relativity, they appear to have left scientific sentiment unchanged. Finally, using criteria congruent with conventions developed in the empirical investigation of the Sapir-Whorf hypothesis, we reviewed evidence suggesting that linguistic manipulations can influence memory, perception, and judgment.

Whorf's writing provides a rich representation of the variety of language-thought relationships that can occur, but his ideas have been more easily accepted in disciplines other than experimental psychology. We believe that experimental tests of the language-thought hypothesis will ultimately be the most persuasive to those who operate within this tradition. The purpose of this paper is to encourage discussion about the language-thought relationship—independent of the acceptability of Whorf's original statements—and to motivate renewed experimental interest in the question, especially among those who are interested in the relationship between language and social cognition.

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