Speaking of Science

Kimball, Jack
Institute of Languages and Cultures, Kyushu University

https://doi.org/10.15017/6796317

出版情報：言語科学. 29, pp.75-86, 1994-02-28. The Institute of Languages and Cultures, Kyushu University
バージョン：
権利関係：

SPEAKING OF SCIENCE

J. Kimball

Abstract

This paper describes the teaching of speaking within the paradigm of academic-content-based learning, concentrating on science. The paper suggests that when college-level advanced speakers of English engage in talk about science, they are developing communicative and strategic competencies; that is, they are extending their abilities to convey meaning and to employ varieties of language for specific purposes. Forms and conventions of scientific discourse are examined to reveal rhetorical structures useful for both speaking practice and the genesis of speaking strategies.

Introduction

When we reflect on the purpose of oral language practice -- or of any language practice for that matter -- we are mid-debate between opposing schemata for envisioning what we are doing, schemata that derive from two revered epistemological and psychological traditions. On the one hand we can view speaking as rule-governed creativity that reflects what Chomsky calls competence. The speaker's competence is itself unobservable but "psychologically real," a mental grammar best researched at the de-contextualized level of the intrapersonal utterance, usually the sentence. This is the so-called rationalist

『言語科学』 第29号 (1994) P. 75～86

schema associated with Chomsky (1965). On the other hand, an alternative, empiricist schema looks at speaking as a set of descriptive, and thus observable, habits conditioned by social and functional rules or contexts. Appropriate interpretation and conveyance of interpersonal messages in particular context constitute a communicative competence (Hymes 1972).

The rationalist schema yields a research and teaching agenda pertaining to structure and knowledge about language -- metalanguage; the empiricist schema focuses on situation, function and interaction. In this regard Widdowson (1978) draws the key distinction between rationalist-based linguistic usage and empiricist-based communicative use. The Chomskian tradition, when adapted for language teaching, stresses acceptable usage by way of analysis of grammatical structure and form. Ironically, while of course upholding the relevance of the de-contextualized approach for linguistic research, Chomsky takes a dim view of its application in the language classroom: "I am, frankly, rather skeptical about the significance, for the teaching of languages, of such insights and understanding as have been attained in linguistics and psychology" (1966:37). For classroom practice in a communication-driven skill such as speaking, the *use* of language in specific contexts comes to the fore.

The question is, What uses work best? One approach is the notional syllabus in which language content is manifested as specific functions together with associated ideas -- formulated as contextualized scripts for

introducing oneself to new acquaintances, for example, or inviting, accepting, complaining, requesting and so forth. Here language is isolated into situational units, a process that parallels the emphasis on grammatical units in rationalist syllabi. Widdowson suggests, "the focus of the notional syllabus is still on the accumulation of language items rather than on the development of strategies for dealing with language use" (1979:249).

Indeed, a subset of communicative competence would be an emanating strategic competence, that is, a means for manipulating various registers to achieve communication goals and for repairing breakdowns in communication due to mistakes, misunderstandings, distractions, etc. (Canale and Swain 1980, Savignon 1983, Bachman 1987). A further differentiation within this subset is the variations of strategy required for commonplace versus specialized domains of discourse. Cummins (1981) distinguishes between the context-embedded "basic interpersonal communicative skills" (BICS) and context-reduced "cognitive/academic language proficiency" (CALP). Notional-functional scripts situated in concrete social contexts, such as making a request to borrow a newspaper, would typify BICS. Relevant to college language teaching, however, and particularly with respect to advanced language learners speaking on topics of science, of all these schemata and subsets it is strategic competence in the domain of CALP that we can inspect most profitably.

Scientific Discourse: Forms, Contents, Conventions

Turning to issues related to college language learners talking about science, we first need to emend the too-simple dichotomy between concrete commonplace discourse and abstract cognitive/academic discourse. While it is certainly accurate to characterize notional-functional scripts as referring to a recognizable social reality -- the "reality," for instance, of two acquaintances conversing, one pointing to and requesting to borrow the other's newspaper -- the authenticity of such a concrete reference is highly questionable *within the more immediate social reality of the college classroom.* And the relevance of this reference is all the more uncertain for advanced language learners. In other words, although this is a recommended practice at beginning levels of language acquisition, attempting to replicate interpersonal realities like inviting, accepting, complaining and requesting is an artificial classroom procedure -- concrete in form, but abstract in its distance from immediate, academic-based contexts.

Conversely, speeches, dialogues and other sorts of discourse on academic topics such as science constitute authentic, concrete processes for the college classroom, concrete in the sense that they comprise real experiences underpinning students' general education. The discourse *forms* of academic language surely entail conceptual abstractions, as we shall see, but the *contents* of such discourse have a direct bearing on learners' cognitive development and scholastic achievement.

The abstract forms of scientific discourse, moreover, are frequently addressed to real phenomena and attendant questions of causality. The abstractions of other academic fields, such liberal arts as literary criticism, ethical theory or social analysis, for example, typically refer to mental constructs like "tone," "justice" and "motivation." While these fields offer rich content for language learning as well, one advantage of scientific discourse is that its abstractions commonly refer to verifiable sense data and to what Kuhn (1970) describes as "useful problems." Whereas the discourse focus of fields in the liberal arts utilize emotional, ethical, logical and stylistic appeals, the focus of scientific discourse is almost exclusively logical, relevant to physical reality, and explicative in goal. Explanation is key as Chomsky asserts:

> It is hardly open to question that natural sciences are concerned precisely with the problems of explaining phenomena, and have little use for accurate description that is unrelated to problems of explanation. (1965:589; cited in Kinneavy 1980:84)

Further, scientific explanation follows a highly conventional and transparent pattern of rhetorical development, militating toward a superordinate classification of causality by means of exemplification. Rhetorician James Kinneavy writes:

> Sometimes causal explanation comes to be stated in terms of a general principle of which the event to be explained is an example... This is sometimes called deductive explanation. It actually establishes the thing to be explained...as a member of a class... In actuality, this is explanation by classification... (85)

Another facet of the conventionality and transparency of scientific discourse is its concern for the literal and its reliance on evidence. Science, as Aristotle observes, is primarily concerned with "things"; the things it addresses are "an already articulated body of problems, data, and theory...to which the scientific community is committed" (Kuhn:136). The style of scientific discourse in English is also conventionalized, weighted toward brevity and a bee-line simplicity whose origins go back to the Renaissance and the establishment of stylistic objectives by the Royal Society. Sprat, Society historian, notes that these objectives were "to reject all amplification, digressions...to return back to the primitive purity and shortness when...so many *things* [were expressed] in an equal number of words." He characterizes the "purity" of the discourse as "a clear, naked, natural way of speaking...bringing all things as near the mathematical plainness as they can" (cited by Kinneavy:170).

Maxims, Metaphors and Discourse Processes as Strategies

The Royal Society "plain style" and the Aristotelian preoccupation with evidence permeate academic and even general discourse in English. For example, semanticist H. P. Grice (1975) has specified "maxims" associated with his Co-operative Principle. These maxims re-formulate the conventions outlined above into normative strategies for an efficient exchange of factual information, strategies which are applicable, as Grice sees it, in all communication.

Grice's maxims for quality stipulate: Do not say what you believe is false or that for which you lack evidence. The maxim for relation: Be relevant. Maxims for manner: Avoid obscurity, be brief and orderly (adapted from Kempson 1977:69). Whether and how these maxims apply to general communication are moot points. More important, these maxims are the bedrock for fluent discourse in a variety of scientific fields. In a guide to composition in biology, for instance, Pechenik (1987) urges us to write "to illuminate, not to confuse," to make a statement "and back it up" and to "distinguish fact from possibility" (4-5).

Science privileges facts but it advances by way of speculation. Thus the role of scientific metaphor in model-building qualifies Grice's maxims concerning truth and evidence. Metaphor is a special case of not telling the "truth." As Kinneavy suggests,

> science usually prefers the literal to the nonliteral term -- that is, figures of speech are often out of place [but] models and analogies are nonliteral terms and are necessary in science... (177)

Citing the Watson-Crick "double helix" model of DNA in which a genetic "message" "transmits" "information," Halloran and Bradford (1984) illustrate the priority given figures of speech in synthesizing and presenting novel ideas. They conclude,

> No synthesis could ever be achieved, no models postulated, no paradigms established if science relied wholly upon "careful observation" for its theories. Model-building requires an inductive leap; carefully recorded examples must be synthesized into a logical premise, and then be further verified and expanded by traditional scientific method. For this, science must exploit the power of metaphor... (183)

Model-building and practice in making analogies and metaphors afford a powerful strategic technology for discovering and interconnecting scientific concepts. Trimble (1985) categorizes metaphor and analogy as a kind of applied comparison/contrast which in turn is one of various "rhetorical techniques" available to science. Other techniques are examples, illustrations, cause/effect, order of importance, and time/space order. Trimble explains that these processes operate as "cohesive ties"; they "bind together the items of information" within larger linguistic frameworks which he labels "rhetorical functions" (52). The three most common functions -- description, definition, classification -- are fundamental to organizing scientific information, each "capable of being isolated and studied separately" (69). This last insight is central to our final point of discussion, translating discourse features into classroom procedures.

Teaching Procedures

Trimble's techniques and functions are, in classical rhetorical terms, modes of invention, that is, processes for finding and communicating ideas. Within the domain of teaching scientific discourse Trimble has re-worked these modes of invention, restoring them to their original heuristic value, so that student involvement in rhetorical analysis transforms itself into a system of discovery. While Trimble concentrates on written discourse for his examples, following is an adaptation of his five-step procedure for language learners that could be used as a

guidepost by language instructors in establishing objectives and developing materials for speaking practice.

> Step 1. Determine the core generalization and structure of the discourse.
> Step 2. Determine the rhetorical techniques -- focus on the relationships between items of information.
> Step 3. Determine rhetorical functions for presenting major items of information.
> Step 4. Determine the grammatical elements that govern the functions.
> Step 5. Determine often-confused vocabulary. (69-70)

To take one function, classification, as a case in point, language learners might practice speaking about both formal and informal classes of phenomena. As Trimble suggests, students could operate two ways with their classifying, that is, start with two or more member-phenomena and find the class, or start with the class and find its members. To introduce such activity Trimble recommends that instructors "have students orally make several levels of classification about familiar things easy to classify -- cars, sports, stereo systems, etc." (85).

In formulating the interactive use of metaphor and rhetorical modes of invention as discussion items, the instructor needs to consolidate components of genuine communication tasks. These include a purpose for the communication, a focus on message (rather than grammar), negotiation by learners to supply some missing information (an "information gap" in current parlance), and most important, a choice of linguistic resources determined by learners (see Ellis 1982, Nobuyoshi and Ellis 1993). Nunan (1991) lists the following steps, among others, for the instructor to follow in developing classroom activities:

1) identify target task -- for example, classifying chemical compounds; 2) provide students with language models; 3) concentrate on the "enabling skill" -- in our case, perhaps, reading and oral practice in two-way classifying.

A string of interrelated tasks can be devised for the speaking class as "project work," including "gathering of information through reading, listening, interviewing etc., discussion...problem solving" and so forth (Hedge 1993). Project work of this sort offers a disciplined means for sustaining genuine communication, but it requires that the language teacher redistribute the weight of traditional classroom authority. While the individual instructor maintains responsibility for setting a coherent curriculum for the language class, for instance, it might be helpful to collaborate with science faculty by arranging subject-area content to complement students' other coursework. The instructor's role with students, rather than that of lecturer, would be better viewed as coordinator and partner in research, discovery and assessment. Developmentalist Jerome Bruner describes this as teaching in the "hypothetical mode" in which

> the teacher and the student are in a more cooperative position with respect to what in linguistics would be called "speaker's decisions." The student is not a bench-bound listener, but is taking a part in the formulation and at times may play the principal role in it. He will be aware of alternatives and may even have an "as if" attitude toward these, and he may evaluate information as it comes... I think it largely the hypothetical mode which characterizes the teaching that encourages discovery. (1979:83)

The hypothetical mode requires reciprocal teaching in which students and instructor take turns asking questions, summarizing, clarifying, etc. The instructor provides models, as suggested above, but also by way of hints and reminders the teacher coaches students into fuller practice in scientific discourse and independent reflection with respect to discourse strategies for becoming more fluent -- strategies like making analogies, defining terms, and the like. These communication tasks, project work and reciprocal teaching suggest only a partial solution to the puzzle of teaching speaking about science. But the direction is plain. The value of such a teaching enterprise is its relevance to students' present and future needs. Language instruction that foregrounds students' needs points to meaningful practice and meaning-making skills for learners to assume responsibility for their own discovery and fulfillment.

References

Bachman, L. 1987. *Fundamental considerations in language testing*. Reading, MA: Addison-Wesley.

Bruner, J. 1979. *On knowing*. Cambridge, MA: Belknap.

Canale, M. and M. Swain. 1980. Theoretical bases of communicative approaches to second language teaching and testing. *Applied Linguistics* 1:1-47.

Chomsky, N. 1965. *Aspects of the theory of syntax*. Cambridge: MIT Press.

Chomsky, N. 1966. Linguistic theory. In R. Mead (Ed.) *Reports of the working committee*. NY: Northeast Conference on the Teaching of Foreign Languages.

Cummins, J. 1981. *The role of primary language development in promoting educational success for language minority students*. Sacramento, CA: California State

Department of Education, Office of Bilingual Bicultural Education.

Ellis, R. 1982. Informal and formal approaches to communicative language teaching. *ELT Journal* 36 1:73-81.

Grice, H. P. 1975. Logic and conversation. In P. Cole and J. Morgan (Eds.) *Syntax and Semantics* 3: *Speech Acts* 41-58.

Halloran, S. M. and A. N. Bradford. 1984. Figures of speech in the rhetoric of science and technology. In R. Connors et al. (Eds.) *Essays on classical rhetoric and modern discourse*. Carbondale, IL: Southern Illinois University Press.

Hedge, T. 1993. Project work. *ELT Journal* 47 3:276-277.

Hymes, D. 1972. On communicative competence. In J. Pride and J. Holmes (Eds.) *Sociolinguistics*. Harmondsworth, UK: Penguin.

Kempson, R. M. 1977. *Semantic theory*. Cambridge: Cambridge University Press.

Kinneavy, J. L. 1980. *A theory of discourse*. NY: W. W. Norton.

Kuhn, T. S. 1970. *The structure of scientific revolutions*. Chicago: University of Chicago Press.

Nobuyoshi, J. and R. Ellis. 1993. Focused communication tasks and second language acquisition. *ELT Journal* 47 3:203-210.

Nunan, D. 1991. Communicative tasks and the language curriculum. *TESOL Journal* 25 2:279-295.

Pechenik, J. A. 1987. *Writing about biology*. Boston: Little, Brown.

Savignon, S. 1983. *Communicative competence: Theory and classroom practice*. Reading, MA: Addison-Wesley.

Trimble, L. 1985. *English for science and technology*. Cambridge: Cambridge University Press.

Widdowson, H. G. 1978. *Teaching language as communication*. Oxford: Oxford University Press.

Widdowson, H. G. 1979. *Explorations in applied linguistics*. Oxford: Oxford University Press.