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I am submitting herewith a dissertation written by Daniel Paul Corts entitled "Figurative Language and Gesture in College Lectures: A Comparison Across Disciplines." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Psychology.

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We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor and
Dean of the Graduate School

SPONTANEOUS PRODUCTION OF FIGURATIVE LANGUAGE AND GESTURE IN COLLEGE LECTURES: A COMPARISON ACROSS DISCIPLINES

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Daniel Paul Corts

December 1999

ACKNOWLEDGEMENTS

I would like to thank the members of my committee for their contributions and support during the writing of this dissertation: Howard R. Pollio, John W. Lounsbury, Richard A. Saudargas, and Jan E. Allen. Each member provided sound advice and encouragement and suggestions for revisions to earlier drafts of this paper. I would especially like to thank Howard Pollio for serving as my advisor, dissertation chair, editor, co-author and counselor; John Lounsbury for his semi-annual pep talks over the past five years; Rich Saudargas for the chance to teach; and Jan Allen for inspiring and mentoring me and GTAs from all over the campus.

This research would not have been possible without the assistance of student collaborators: Elizabeth Guenther, Michele Lamastus, Wayne Robbins, and Tina Wu. Each spent hours of their time collecting, rating, and analyzing data with little tangible recompense (although each came away knowing more about Geology and/or Classics than they ever anticipated).

I am indebted to the support of two families. The first includes my parents, Paul and Diane, my brother Kenneth, and my sister Susan. My wife's family and especially her parents, Fayaz and Shirley Ammar, have forsaken all in-law stereotypes and welcomed me into their home. These individuals and families have been the source of emotional and financial support and believed in me even when I felt that I would never achieve this goal. Most of all, I am grateful to my wife Kimberly, who at times may have found my arguments weak and my methods flawed, yet has accepted me without revision.

ABSTRACT

Previous figurative language research has focused primarily on theories of comprehension and word meaning and has been conducted in highly controlled experimental situations. As a result, little is known about the spontaneous production of figurative language in ongoing discourse, how it functions in various contexts, and how it relates to the production of gestures. Corts and Pollio (1999) addressed these issues by examining of figurative language and gesture production in college lectures. Their results indicated that figurative language was often produced in bursts of novel, coherent figures and concerned the primary topics of the lecture. Figurative language outside of the bursts was more likely to concern the lecture itself and was less likely to be novel. Finally, when gestures overlap figures of speech, they present a representation of the same metaphor. The present research addresses two related goals: (1) to replicate the procedures of Corts and Pollio (1999) including additional lecturers from diverse content areas and (2) to include additional lectures and content areas so that additional patterns and functions of figurative language use may be observed.

Two lectures from each participant (one Geology professor and one Classics professor) provided the text for this study. Data for language and gestures were analyzed independently on the basis of a moving average procedure which identified areas of increased production rates (i.e., bursts). In accordance with Corts and Pollio (1999), figurative language within a burst was predominately novel rather than cliched, was coherent with a root metaphor, and centered around the main topics of the lecture. Also,

figures within bursts included analogies and metaphor, while topical figures outside of bursts often included other types of figures (hyperbole, litote, etc.). These results are interpreted to suggest that figurative language production proceeds at a fairly even rate including a variety of types of figures in all categories (novelty, topicality, coherence, and type of figure). Bursts, however, are characterized as a shift in the lecture to a concept which is understood metaphorically. At this point, the figurative language increases; typically in a burst of novel, topical, and coherent metaphors.

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CHAPTER 1: INTRODUCTION

Consider the following sample of speech taken from an actual college lecture:

> What I want you to understand is that depression-- clinical depression-- is not just feeling sad all the time...As Cyrano de Bergerac described it, it is wearing shoes of marble and gloves made of lead. Everything is heavy and you just lack the physical and emotional energy to move. If you think about it, that's where the term depression comes from-- being pulled or pressed down.

In this passage, the lecturer is describing the experience of depression as a state of being in which the person feels weighed down by heavy objects. If asked, it is likely that he would agree that physical weights, such as marble shoes, are not a necessary condition for clinical diagnosis. So why does he provide such information and what are his students to do with it? Most of us would agree that the lecturer does not mean his words literally and that their figurative meaning is clear enough: Individuals suffering from clinical depression often report feeling as if they are weighted down.

Because few speakers of English would accuse the lecturer of deception, perhaps a better question for psychologists and linguists is whether or not metaphoric comparisons are conceptually useful or merely a decorative way of saying something. We might also wonder if the speaker is doing something different here than he normally does; that is, did the instructor and his students switch to a different cognitive process either to produce or to comprehend this excerpt? Much of the early research on figurative language tended to treat these concerns not as questions but as assumptions about the very nature of

figurative language. In essence, early work characterized figurative language as (1) a special, infrequent manner of speaking, (2) a discrete category of language and meaning derived from, and independent of, literal language, and (3) an ornamental or potentially deceptive way of describing a topic that could be presented in more precise literal terms.

Contrary to traditional beliefs, however, a number of more recent researchers in psychology, linguistics, education, and other fields have developed a different view of metaphor over the past 20 years; namely, that metaphors are not unusual, but pervasive throughout language and that metaphors neither substitute for, nor derive from, literal language. Moreover, figures of speech are not just ornaments or paraphrases of literal language; instead, metaphors and other figures reflect thought and, therefore, must be treated as conceptually useful. If this is the case, it seems reasonable to expect figurative language to play a significant role in education, most especially in the unique pedagogical situation of the college lecture.

At that same time that researchers were challenging traditional views of metaphor, a similar controversy arose concerning the nature and meaning of gestures that accompany speech, figurative or otherwise. Just as traditional research in linguistics has compartmentalized figurative language as distinct from literal language and from thought, so too have researchers in nonverbal communication described gestures as nonverbal and unessential to understanding. Some researchers, such as Armstrong, Stokoe, and Wilcox (1994), have argued that gestures are much more intimately associated with spoken language than previous researchers had allowed. Other researchers, such as McNeill (1992), have even asserted that not only do gestures arise from the same cognitive process

as language but that they also may communicate with or without accompanying spoken language. Careful analysis of gesture therefore should reveal the ways in which humans use metaphor in communication and thought.

Issues in Figurative Language Research

Is figurative language an unusual type of speech? The view that literal language is a primary means for understanding and describing the world suggests that figurative language is an unusual type of linguistic act. It follows that in everyday contexts-- that is, in situations outside of literary writing-- figurative language should be relatively scarce. Pollio, Smith, and Pollio (1990), however, have presented a good deal of evidence to indicate that this is not the case. For example: they cite a number of studies estimating that figures of speech occur 1 to 3.4 times for every 100 words in a variety of settings that include psychotherapeutic, rhetorical, and educational contexts. In addition, Corts and Pollio (1999) found that in three college lectures, as many as 80 metaphorical phrases were produced in about 300 sentences. On average, a one to four percent output rate may at first seem relatively sparse, although, as Glucksberg (1989) pointed out, this amounts to about five metaphors for every minute of discourse-- hardly a trivial number.

If these estimates seem higher than expected, that may be due to the fact that many current researchers include both frozen and novel figures in their counts. Frozen or cliched figures have been overlooked in earlier research largely because they were assumed to be relatively standard elements of the language; so much so that they would lack the appearance of being non-literal or figurative. Such phrases are not truly literal

lexical items, however, and Lakoff and Johnson (1980) have demonstrated how pervasive and significant such metaphors are on the basis of repeated analysis over a range of topics. For example, the phrase "we're getting nowhere fast" carries the literal meaning of a group of individuals who may be delayed in a journey. It is equally meaningful within the context of a group trying to solve a problem or to finish an assignment. According to Lakoff and Johnson, these figures are not "frozen" or "dead" metaphors, as some have suggested; instead, they are active participants in ongoing thought and speech. Using the metaphor of "we're going nowhere fast," one can also say the groups sometimes "fall behind," "work ahead," and "get lost along the way." Once contextualized in these terms, both novel and frozen figurative language must be recognized as significant in both our speech and our writing.

Is figurative language a distinct category of language? There is a long-standing tradition in philosophical and linguistic thought to draw sharp distinctions between the literal and the figurative and between the rational and the intuitive, with a decided bias towards the rational and the literal. As the frequency and pervasiveness of metaphor is noted-- especially in regard to cliched figures of speech-- the literal/figurative distinction has become much less clear. In fact, many of the figures identified by Lakoff and Johnson (1980) and in similar analyses (e.g., Reddy, 1978) are easily overlooked; so much so that Barlow and Pollio (1971) created an extensive training manual to teach individuals to identify many different types of figurative speaking and writing.

One way to evaluate distinctions between literal, figurative, and nonsense sentences is to ask research participants to categorize exemplars. Pollio and Smith (1979)

found that many subjects coded sentences as metaphoric even when researchers had designed them to be anomalous or nonsensical. Gibbs, Kushner, and Mills (1990) also had participants indicate whether a sentence was meaningful or not and, in a second study, asked them to paraphrase its meaning. Subjects were more likely to classify anomalous sentences as meaningful when told they were produced by a poet than when told they were generated randomly by a computer. What these studies suggest is that the researcher does not have the sole privilege of deciding what is literal, figurative, or nonsense. It appears that sense can be made, literal or figurative, of many word combinations that may initially seem anomalous, and this is especially true when the speaker is believed to be a competent and purposeful language producer.

Because the bias in scientific and philosophical analysis is to value the rational and the literal, researchers began work not only with the literal/figurative distinction in mind but with a belief in the primacy of literal language. Several generalizations are entailed in this assumption, most notably: (1) Anything talked about may be described in literal terms thereby implying figures of speech are nothing other than paraphrases of literal language, and (2) individuals must understand the literal meaning of an utterance before comprehending any figurative meanings.

There are several ways to address the paraphrase assumption. Fraser (1979) hypothesized that if metaphors are simply paraphrases of literal language, there should be a high degree of agreement between different subjects interpreting the same metaphor; that is, they should each give essentially the same literal meaning. In his study, however, there were significant discrepancies between subjects and very few gave similar

paraphrases. In addition, subjects interpreted the phrases differently depending on whether the metaphor described "he" or "she." Results such as these indicate that there is not a one-to-one correspondence between a figure of speech and its paraphrased, literal rendition.

While Fraser employed relatively novel metaphors in his studies, many of the more standardized phrases discussed by Lakoff and Johnson (1980; 1999) also demonstrate the unique qualities of figurative language. Phrases such as "I don't get it," which treats knowledge as a tangible object, abound in the English language. The fact that such phrases are so pervasive suggests it is easier to speak figuratively than literally in some cases, especially when dealing with a complex topic such as human understanding. Finally, many metaphors have a generative ability; when a new metaphor is spoken, it suggests an understanding that did not exist or was not explicit before. For example, describing depression as "wearing shoes of marble" does not rephrase that "getting depressed feels heavy"; instead, it affords a gestalt of ideas and emotions not easily or efficiently rendered in literal terms.

Because traditional theories described metaphoric meaning in terms of paraphrase, they implicitly suggested metaphor as a secondary type of language or meaning. More specifically, figurative meaning was derived from what is assumed to be the "real" meaning of the message; i.e., its literal meaning. One means of testing a derivation theory of metaphoric meaning assumes that it necessarily would take longer to produce or understand non-literal sentences than their literal counterparts. This hypothesis has been tested a number of times without corroboration in speech production (Pollio, Fabrizi, &

Weddle, 1982) or comprehension (e.g., Recanati, 1995; Hoffman & Kemper, 1987). In fact, studies of ambiguity and polysemy indicate that multiple word meanings are readily available during comprehension (Swinney, 1979; Williams, 1992), and even nonsense words are easily understood given a useful context (Sternberg & Powell, 1983). Because context and authorial intent influence interpretation (Gibbs, Kushner, and Mills, 1990), subjects do not need to interpret the literal meaning of a phrase before interpreting it figuratively.

While other factors may be involved, studies of paraphrasing, reaction time, and the structure of cliched figures suggest that figurative language is neither distinct from, nor secondary to, literal language. If these are not distinct categories, why do researchers continue to use them? Perhaps these categories are entirely for the convenience of researchers. Lakoff (1993), however, offered another suggestion: Define metaphor in terms of thought and not in terms of language. By doing so, one may address the final assumption of traditional metaphor theories; namely, that metaphors are merely ornamental and not conceptually useful.

Figurative language is not mere ornament, it is conceptually useful. Lakoff and Johnson (1980; 1999) argue that, instead of being a category of language, metaphor is better construed as a category of thought. If this is the case, then there does not need to be a distinction between how literal and figurative sentences are understood; language reflects concepts directly. Lakoff and Johnson have provided substantial evidence to support the view that metaphors are conceptual. Many topics, for example, are described almost exclusively in metaphorical terms-- particularly abstract, nonphysical concepts

such as fall in the categories of thought and emotion. Under scrutiny, it becomes clear that we not only use metaphorical terms but that individual phrases constitute a network of related meanings based on a small number of experiential domains. For example, when English speakers talk about knowing, they often do so by speaking in terms of vision ("I see what you mean," "It's not too clear") or about tangible objects ("It's difficult to grasp," "That news really hits home"). While it is possible that speakers only use metaphorical phrases for linguistic convenience or emphasis, it would be unlikely, if that were the case, to find so many phrases based seemingly on only a small number of root concepts. In addition, it likely would be difficult either to generate or comprehend novel figures of speech and gestures based on such clichés.

Another aspect of metaphor in thought relates to the paraphrase theory described earlier. Metaphors do not always restate a literal phrase, nor do they implicitly state a literally phrased comparison such as an analogy or simile (Gibbs, 1993). If this were the case, "my roommate is a pig" would be cognitively the same as "my roommate is like a pig." For this assumption, it would be similarity, or overlap, in attributes that allowed comparisons to be made. While there is no reason to doubt that some metaphors do make implicit comparisons, metaphor theories based on this principle encounter two difficulties: First, many figures of speech have no clear similarities between the two domains. For example, if someone describes aging in terms of an enemy (e.g., a marketing campaign asserting "Defy your age"), there are few, clearly defined similarities, between the two domains. The fact that people so often describe aging in this way suggests that the metaphor is useful or significant. A second problem arises even if

there are clear similarities between the topic and vehicle of the metaphor. If topic A shares one or more attributes with the metaphorical domain, B, one should be able to describe B in terms of A. In other words, it should be equally meaningful to say "A friend is an anchor" as it is to say "An anchor is a friend." Tests reversing such statements indicate that there is frequently an asymmetrical relationship between the two domains so that "A is B" is not the same as "B is A," (Gregory and Mergler, 1990).

Glucksberg and Keysar (1990) have postulated an alternative to the implicit simile view, the class-inclusion hypothesis. In this interpretation of metaphorical thought, when a topic in one domain is described or discussed in terms of another domain, it involves the same cognitive operation as an assertion to the effect that the topics are members of a common, superordinate category. In other words, saying "My roommate is a pig" is similar to saying "this animal is a pig." Instead of including the roommate in the formal category of pigs, however, the "pig" is a prototype for a superordinate category that includes beings who are generally sloppy.

One of the most significant properties of metaphor is its generativity. If a metaphor is used to describe a topic, it may generate both a new and unique understanding of the topic as well as a number of related ideas and/or phrases. In the example that began this paper, the speaker says that depression may be thought of as "shoes of marble and gloves of lead." This may be regarded as a relatively novel phrase, although, the source of the phrase may be traced to common conceptual metaphor, "Depression is the state of being pulled or pressed down." In fact, this analysis reflects the etymology of the word depression, which itself is a metaphorical extension of the

physical experience of depression. Thus, metaphors may be extended when speakers generate new phrases based on a common understandings, some of which become standard idioms of the language; "Depression," "Down in the dumps," its opposite, "Walking on air," and so on. In addition, it is important to note that the figurative equation creates a new and unique understanding of depression without affecting the domains of either footwear or gloves.

Once a metaphor is understood, it tends to generate a number of additional phrases and ideas. This process underlies not only figurative language but also intuitive and figurative thought. Scientists interested in metaphoric phenomenon have naturally been interested in observing metaphorical thinking across a variety of domains, and historical analysis reveals that many dominant philosophical or scientific paradigms were based initially on an innovative metaphor (Pollio, Smith, & Pollio, 1990). Descartes, for example, used the metaphor of human behavior as hydraulic activity whereas modern cognitive psychology depends on the mind-as-computer metaphor. After a metaphor is established, the new conceptualization is often corroborated by logical arguments and/or rigorous, scientific techniques. Similar psychological processes have been noted in domains such as problem solving groups (Gordon, 1961) and psychotherapy (Pollio, Fine, Barlow, & Pollio, 1973), and are relatively common in the history of science (Kuhn, 1962; Schon, 1963).

Metaphors in Teaching and Learning

If metaphor is such a significant aspect of thought, it seems likely that educators should be able to use it to their advantage. In fact, metaphor had been a frequent topic of research among educational and cognitive psychologists even before contemporary views were articulated. Most writers claimed that metaphors and analogies allowed teachers and students to discuss complicated topics in terms of something familiar and easy to understand. Differences between authors appeared, however, when researchers took sides over the effects of metaphorical thinking and speaking. The following section will discuss research concerned with the function of metaphor as a learning aid, a structure for shared information, and a reflection of personal educational experience and philosophy.

Metaphor in education I: Aid to learning, recall, and comprehension. In addition to being the most apparent role of metaphor in education, the use of metaphor as an aid to learning is the best documented and perhaps most the significant. Reviews of the literature in cognitive linguistics and education indicate differences between the metaphors which constitute an idea-- such as Lakoff's conceptual metaphor-- and metaphors which are used to describe an idea. In education, descriptive metaphors and analogies have been studied both as memory aids (mnemonics) and as thinking aids (heuristics). Because many educators regularly employ metaphors in their teaching, the primary emphasis has been on determining if they are effective as pedagogical tools. The questions raised through such research concern the following two issues: (1) do metaphors and analogies improve retention and comprehension, and (2) how does the use of a metaphor influence students' future performance on assignments and exams?

In terms of the first concern, Pearson, Raphael, TePaske, & Hyser (1981) addressed the mnemonic question with participants ranging in age from third graders to college students. This research involved the recall of a passage where the topic (e.g., Egyptian pyramids) was described both literally and figuratively. Results indicated recall was at least as good, and typically better, for metaphors than for literal phrases when the presented topic was unfamiliar to subjects. This suggests that the metaphors were able to aid memory, and, at the very least, did not hinder it.

In a more complex study, Hayes and Tierney (1982) presented written passages about the game of cricket to American high school students who were unfamiliar with the sport. Subjects in the experimental groups were first presented several paragraphs on American baseball, a more familiar topic which was to serve both as an advance organizer and as the basis for an analogy. Subjects were further divided into a group that read a description of cricket with baseball analogies (the explicit analogy condition) and a group that read descriptions of cricket without baseball analogies (an implicit analogy condition). To test comprehension, students were asked to generalize their newly acquired knowledge of cricket by making predictions about the outcome of a number of hypothetical situations. On this measure, students who read the material on baseball first outperformed those who read an unrelated passage, and students presented with explicit analogies outperformed those with implicit ones. Hayes and Tierney found that, across all independent and dependent measures, subjects who began the experiment with some knowledge about American baseball generally scored higher than others, whether their analogies were explicit or not. To control for individual differences in intellectual ability,

researchers also assessed verbal skill and found it was important only in terms of remembering verbatim material and not in terms of understanding the passage.

Both studies, along with several others (e.g. Mayer, 1975; Schustack & Anderson, 1979), provide evidence that a metaphor may serve as a mnemonic structure for new information. In general, students who are presented in advance with an analogy will use it when attempting to remember a new topic. As is the case with memory in general, subjects recall topical information rather than the specific words used to present it. In addition, the nature of memory for metaphors suggests a schematic process whereby students generate responses to questions about the topic based on the more familiar category of the metaphor's vehicle.

While this process appears to account for the effects of metaphors and analogies on memory, other researchers have attempted to examine the effect of metaphor upon subjects' comprehension and use of information when faced with new situations and/or problems. If students generalize from some metaphorical domain to some topical domain, it is likely that such generalization will occur when students encounter novel problems. Many researchers have proposed this hypothesis and have tested it in a variety of ways, some expecting it to be helpful (Hayes and Tierney, 1982) and others expecting it to be harmful (Gabel and Sherwood, 1980).

With an often studied set of analogies, Gentner and Gentner (1983) and Black and Solomon (1987) described an electric current as either a crowd of people (electrons) or as flowing water (flow and conductance). In both studies, it was found that students not only learned about the topic of electricity on the basis of the relevant metaphor but were able

to solve novel problems by using the analogical domain to answer questions about the topic. In addition, it was noted that certain metaphors were more useful for certain questions. For example: the crowd metaphor was more useful than the water metaphor in solving problems about resistors where it often led to the generalization that resistors function in the same way that a gate or obstacle affects a crowd. Students learning on the basis of the water metaphor were better able to solve problems dealing with batteries--combining two batteries has an affect analogous to connecting two water-filled reservoirs.

Evans (1988) conducted an experiment on metaphors in university lectures which were used to teach statistical principles (testing for group differences) to business students. One group of students was presented with metaphors from non-business domains (e.g., body weight before and after diet; fuel efficiency of an automobile before and after a tune-up) whereas a control group was presented with additional examples of business problems. Although subjects in the first group received fewer business-related examples, they were able to produce more valid examples of business-related situations in which the relevant statistical principles were successfully applied. Further, when students were instructed through the use of metaphors, they were more successful than controls at making inferences about statistical concepts such as null hypothesis testing. An analysis of the decisions actually made suggested that inferences were a transfer from analog to topic since the correct answers had not been presented in the lecture in terms of statistics.

As with memory studies, studies on the comprehension and application of metaphorically presented material suggest that there is a generative, schematic effect of

metaphor on knowledge. Students who learn in terms of a metaphor or analogy may both remember the subject and solve problems about it more effectively than peers taught on the basis of strictly factual information. This would tend to be the case when students retain several key pieces of information about the topic and use that information to draw inferences from the analogical domain. On this basis, subjects both remember more than is possible by rote methods and are able to solve problems not explicitly addressed in class.

Not all researchers agree with these conclusions, however, and a number of studies have found little or no advantage to using metaphors and analogies in teaching and learning (Gabel and Sherwood, 1980; Gilbert, 1989). In some cases, the inferences drawn by students have been found to hinder the learning process. Perhaps the best example of this finding concerns a study by Serge and Giani (cited in Duit, 1991) who attempted to teach chemistry students about transport processes using figurative analogies. They found their technique to be of little use, probably because their students were unable to visualize or otherwise represent the analogy used. Similarly, there are cases where students are less familiar (or altogether unfamiliar) with the analogical domain and, therefore, are unable to draw even rudimentary inferences (Gabel and Sherwood; Hayes and Tierney, 1982). In these cases, one would expect learning to suffer where students, in effect, are asked to learn two domains-- the analog and the topic-- instead of just one, the topic.

One of the most significant concerns among educational researchers is that metaphorical thinking may obscure certain reasonable conclusions just as it illuminates

others. The most familiar example of this effect concerns different problem-solving approaches found between groups of students who learned about electricity either by analogies or by scientific facts alone (Gentner & Gentner, 1983). In this case, students who learned through the water analogy were able to draw inferences that worked well in problems about batteries. Inferences from the same analogy, however, often obscured appropriate strategies for dealing with other electrical problems such as those concerning resistance. Not surprisingly, the reverse was true for students who learned on the basis of the crowd metaphor. One can easily make generalizations from either analogical domain, such as "a resistor narrows the path and makes a crowd even more crowded," although when pressurized water is constricted "it goes faster, as with a nozzle over the end of a garden hose." Likewise, if electricity is like water in a hose, then you may plug an exposed wire with you finger to stop the leak-- not a wise idea according to those familiar with electric currents. To some researchers, this evidence suggests that metaphorical instruction may do more harm than good (Gabel & Sherwood, 1980; Gilbert, 1989). Other researchers, however, view this as an example of the generative power of metaphor, and suggest what is needed is not to avoid metaphor but to use it properly (Glynn, Britton, Semrud-Clikeman, & Muth, 1989).

It is apparent that metaphors and analogies may provide the basis for increased recall, better comprehension, and generalized application of information. There is enough evidence to the contrary, however, to warrant careful consideration of any haphazard use of metaphor by instructors. Duit (1991) has summarized the effects of metaphor in education and has analyzed and enumerated the major factors that lead to positive and

negative results. The most successful uses of analogy and metaphor in education are those that meet the following conditions:

(1) students are familiar with the analogical domain,

(2) students are explicitly instructed in the metaphor,

(3) topic and vehicle both share surface and underlying similarities; that is, there is an obvious connection between domains as well as more complex relationships serving to bring about valid inferences,

(4) the topic addressed by the analogy is relatively difficult in comparison with other subject matter covered in the course, and

(5) students are instructed as to where the comparison breaks down.

Metaphor in education II: Structure, not content. In their analysis of college lectures, Corts & Pollio (1999) uncovered a structural, as well as a pedagogical, role for metaphor in lecturing. Figurative language is typically studied as a mode of presenting information although it is not uncommon for metaphors to provide a structure for the presentation. Many structural metaphors tend to share a single root metaphor, THE LECTURE IS A JOURNEY. By using figures of speech and metaphorical gestures related to this underlying metaphor, the lecturer speaks as if he or she were a tour guide for students. For example, Corts and Pollio found that a lecturer frequently used terms such as, "we'll come back to that," "when we get to…" In addition, an implicit JOURNEY metaphor also was apparent in gestures that occurred alone or in conjunction with spoken figures. The most frequent example of such a gesture included waving or

pointing backwards as a reference to material that had already been reviewed, either in the course of that lecture or of the term.

The JOURNEY root metaphor also provides a cohesive structure for other well known metaphorical structures such as IDEAS ARE OBJECTS and KNOWING IS SEEING OR HOLDING (conceptual) objects. Combining these metaphors provides for phrases such as, "you'll see in a minute." Ideas are often described as "vague" or "unclear," and it follows that the teacher's job is to lead the students to some place where ideas are "easier to see or to grasp." The use of the JOURNEY metaphor suggests the image of a group of students being led through a field of objects by their instructor. They stop at various points along the way where the instructor describes a present object, sometimes referencing and pointing to other objects. At times, the lecturer may lead the students to another point which gives them a new "perspective" or a new way of "looking at" an object already viewed.

While the evidence is clear that lecturers use structural metaphors, what is less understood is their significance in education. They clearly serve a unique function far from the specifically informational analogies previously considered in the educational and psychological literature. Little or no research has been conducted to determine whether or not structural metaphors are necessary or even helpful aids for students to "follow" the lecture, although results by Corts and Pollio (1999) would suggest that they are used to structure the course of the lecture and to orient students to new material.

Research on related linguistic phenomena has focused on the pragmatics of discourse during narratives rather than lectures. Deictic shift theory (Segal, 1995)

represents one attempt to explain cues in speech or text-- such as then, here, or now-- which allow the listener(s) to recognize their location within the events of the story. The usual assumption is that narratives supply readers or listeners with a deictic center of activity. The narrator may describe a scene which includes a geographical space or trajectory, and/or a series of events occurring over time. Shifts in the deictic center occur between these smaller segments of narrative and indicate a discontinuity in the narrative. While a deictic shift approach has been fruitful when applied to narratives, there would seem to be some difficulty in applying it to lectures where ideas and concepts are presented, none of which occupy physical space nor have a specific temporal order. It is a possibility that the spatio-temporal aspects of the JOURNEY metaphors allow for similar types of deixis to occur in the college lecture; little research, however, has been conducted on speech or text outside the narrative format.

Metaphor in education III: Teacher's reflective metaphors. Creton, Wibbels, & Hooymayers (cited in Korthagen, 1993) were interested in another type of metaphor; those used by instructors to describe their role as a teacher. The assumption here is that teacher-metaphors not only are used to describe their job but also to shape the ways in which teachers select and present material to students. In his paper, Korthagen describes the case of a young teacher who characterizes her job as "lion-taming." During extended discussions with her supervisor, she made statements such as "using the whip" for detention, feeling "caged" in the classroom, and treating her students as "lions." There were obvious relations between the teacher's emotional experience and her metaphors

since she soon came to feel anxious about the students "attacking" her and felt a great need to control the class for her own well-being.

Grant (1992) interviewed three teachers over the course of several years in an attempt to understand their metaphors of teaching. Each teacher appeared to settle on a single central metaphor when describing his or her style of teaching. These metaphors included teaching physics as magic, history as a political game, and literature as a journey. The metaphor was manifest in two other processes: planning the format of the class and selecting the material to be presented; for example, the history teacher who viewed history as a game presented it as a series of complex events based on a competition for power. As with many competitive games, the outcome of the event was unpredictable and unknown until its conclusion. For this reason, the teacher selected topics that were in accordance with this model, such as wars and great political debates. In addition, he designed his courses to arouse a feeling of cognitive dissonance since he believed the lack of a clear outcome was in some respects analogous to a competitive game. He also believed students would be motivated to resolve the situation while exploring the topic. The point Grant makes is that although specific metaphors may vary among teachers, making metaphors explicit serves to guide the teacher in course and professional development.

In one of the few studies to evaluate this claim, Tobin and Tippins (1996) provided a summary of popular metaphors and areas of teacher performance most affected by metaphor change. They suggest that metaphors affect change on the basis of their implicit referents (the network of associations implied by a metaphor) and that these

changes are most visible in terms of power, gender, and culture. For example, Gurney (1995) collected 130 metaphors from prospective high school teachers and found that 56 of the metaphors emphasized the power of the teacher, 27 emphasized shared power, and 13 emphasized the power of the student. Tobin and Tippins (1996) further suggested that metaphors of transmission and reception (e.g., Teachers give their students knowledge) may be tied to the imbalance of power whereas constructivist metaphors (e.g., Students build knowledge upon the foundation of what they already understand) are likely tied to a sharing of power.

In an interesting case study, Tobin and Tippins (1996) demonstrate how change also may take place with respect to power and gender. In this example, a male science teacher initially operated under the "Teacher as ship's captain" metaphor. In this framework, he exercised control over the students and spent a portion of his time as disciplinarian. When he switched to a "Teacher as entertainer" metaphor, his emphasis shifted from order in the classroom to the teacher's personality. Discipline was relaxed and students gained more power as the teacher tried to appeal to them. With this shift in power, there was also a change in the teacher's relationships with female students in the class. Tobin and Tippins note that the "entertainer" focused on his personality and therefore paid more attention to the female students he found more attractive.

Teacher metaphors also are closely related to their culture and they may be agents of change without a noticeable change in the metaphoric root. Tobin and Tippins (1996) demonstrate both principles by describing the case of a Navajo science teacher. Her metaphors of "Teacher as a gardener growing" were based to a large extent on the culture

in which she lived and worked. Rather than describing a change in metaphors, as was the case with the captain/entertainer, Tobin and Tippins describe how reflecting on an existing metaphor may generate new possibilities. For example, teaching and gardening may have several tasks in common: goals, an ongoing commitment, the need for the appropriate tools, and a reward for successful work. Further reflection indicates that both domains also require an appropriate context for growth and appropriate nourishment; in addition, both teaching and gardening produce benefits to those beyond the immediate situation.

Tobin and Tippins (1996) suggested that teacher metaphors might take effect through how learning is facilitated, how the classroom is managed, and how students are assessed. It is evident that many of the metaphors used by teachers could affect all three domains, although some metaphors may focus on one or another aspect of the figure. It is also apparent, especially in the case of the "Entertainer" metaphor, that not all metaphors are equally beneficial to teacher and/or students. Tobin and Tippins therefore suggest that, in addition to exploring possible metaphors for their practices, teachers should be clear about their values (e.g., gender equity, constructivist learning, etc.) to ensure that the referents of their metaphors fit within their frameworks in a useful way. Finally, it is essential to realize that teacher may develop their practice not only by changing their metaphors, but through increasingly narrow refinements of an existing metaphor already applied in the classroom (Bullough & Stokes, 1994).

Conclusion. Figurative language may take the form of elaborate metaphors or analogies used to describe a topic or of cliched phrases used to structure teaching

experiences. It appears that the explanatory function of metaphor is both its most studied and most important function. From the present review, it seems clear that figurative language does not provide a magical way of learning nor is it a panacea for teaching difficult topics. Despite this caveat, metaphors and analogies have been shown to be effective as mnemonics and heuristics under certain conditions and, therefore, should continue to be an aspect of educational practice.

Gestures in Communication and Thought

Gesturing is typically thought of as a behavior that sometimes occurs in conjunction with spoken language to emphasize the objects and actions described in speech. In this sense, gestures are thought of as secondary messengers-- reiterating the spoken message and neither changing nor adding to it. Consequently, much of the research on gesture production has treated it as a separate computational stage in the language process-- one that stems from producing language and, therefore, not directly related to thought (see Butterworth & Hadar, 1989). Recent research into gesturing, however, suggests that gestures can aid lexical access, serve as a tool of thought, and provide structure to speeches and/or conversation. In addition, several language theorists have suggested that gestures stem from the same neural or cognitive process as language (see McNeill, 1985; 1992; Armstrong, Stokoe, Wilcox, 1995). Obviously, gestures are now recognized to do more than just decorate or emphasize speech.

What are gestures? To study or describe gestures in detail, a taxonomy is required to categorize various movements and functions. A number of researchers have established individual coding and classification systems which overlap in varying degrees. McNeill (1992) developed and presented a detailed coding and classification system that will be employed in this research. In developing his system, McNeill began by describing three classes of semantically based gestures: (1) Iconics, gestures which create images that describe the topic of speech, (2) Metaphorics, gestures which also create images but which give form to nonphysical ideas-- to represent a difficult decision, a speaker may act is if they were comparing the weight of two objects, one in each hand. (3) Deictics, gestures which are used in a pointing or directional function; that is, to indicate people or objects present to the speaker, or metaphorically, the space between past and future.

McNeill described two additional types of gestures that are more motoric or temporally organized: (1) Beats, which are rhythmic motions of the hand that serve to emphasize certain portions of the speech and (2) Cohesives, which are repetitions of a gesture used to connect different segments of speech. For example, a speaker may produce a metaphoric gesture to introduce a topic, briefly digress with an iconic, and then return to the original metaphoric. This metaphoric gesture would also be classified as cohesive because it served to indicate continuity in speech before and after the digression. Because beats and cohesives are temporally oriented, they may overlap with spatially oriented iconics, metaphorics, and deictics. For example, the speaker may create an iconic gesture and, while holding the iconic gesture, also perform "Beats" with that hand.

In addition to these categories of spontaneous gesture, there are other hand shape or motions that have a predefined value, such as the thumbs-up, obscene gestures, and enumerating signals. These gestures, which may be called Emblems, are different from the first five categories in that each emblem has a specific motor pattern and a relatively fixed meaning. Image-producing gestures may reflect semantic content, although their meaning is often context-dependent and the other person may have difficulty understanding in the absence of accompanying speech.

The role of gesture in communication. Gestures are typically classified according to their role in communication; that is, used to present images and motions, orient the audience to space and time, and provide emphasis. These are perhaps the most familiar roles of gesturing. As gestures become more complex, however, they also may assume more sophisticated roles and follow more formalized rules. Kendon (1988a) describes a continuum in which gestures range from spontaneous gestures associated with spoken language, to emblematic gestures with relatively fixed meanings, to complex sign languages with an established vocabulary and syntax. In general, the more time an individual spends communicating manually, the more systematic their gesturing. The spontaneous gestures of a speaker are not usually systematic. Some groups of normally-speaking individuals, however, do resort to gesture systems of increasing complexity in situations where talking is neither wise nor permissible; such situations range from an American baseball manager sending signals to a batter to tactical police and military groups coordinating an ambush. In more complex form, some groups are required to be silent for extended periods of time due to cultural and/or religious reasons. The best

documented example of the latter case is Kendon's description of women's sign language in the Australian Walpiri tribe where women are prohibited from talking at certain times (Kendon, 1988b). Women in this tribe have developed a fairly complex form of manual communication to replace the spoken word.

In the most complex form of hand communication, non-hearing individuals communicate with sign languages that exhibit many of the same properties of spoken language. Within these primary sign languages, unlike other manual communication systems, signs are neither analogues to, nor substitutions for, words but serve instead all of the cognitive and communicative functions words fulfill in spoken languages (Armstrong, Stokoe, &Wilcox, 1995). The continuum of gesture complexity described by Kendon also may be seen to reflect the relative emphasis on gestures in the individual's or group's communicative repertoire-- baseball players signal for only a small portion of their communication whereas ASL users conduct most of their spontaneous communication manually.

At the spontaneous end of Kendon's gesturing continuum, most gestures do accompany speech. There is a bias among some researchers to interpret this co-variation as signifying the preeminence of language and to assume that gestures are invariably less informative than speech. Because the present analysis focuses on spontaneous gestures that accompany human speech, it is important to consider whether or not these gestures are important to the listener. Do they affect what the listener remembers or their subsequent thoughts about the topic? Although Krauss et al. (1981) suggest that gestures are not important in receiving some types of information, other researchers (e.g., McNeill,

1992; Horbury, 1999; Cohen, 1977; Thompson, 1995) have found evidence that gestures are able to supply information in addition to the spoken message and, therefore, to affect what is remembered.

Researchers addressing this question typically employ what McNeill (1992) refers to as mismatch studies. In these studies, some subjects view taped narratives, some of which show typical, unaltered speech whereas other subjects view a mismatch between some element of speech and the gesture presented. After subjects view a videotape, their retelling of the story is thought to reveal whether they remembered the mismatched segments according to speech, gesture, or some fusion of the two. It is interesting to note that subjects are usually unaware of any mismatches between speech and gesture, despite the fact that mismatches produced several interesting effects. One of these effects stem from situations in which the speaker moves the left hand for Character A and the right hand for Character B. In a videotaped mismatch, the speaker names Character B but moves the hand typically representing Character A. In such cases, many subjects retold the story based on the mismatched gesture and not on the basis of speech alone.

In a similar study, Horbury (1999) reported that subjects watching a video with typical synchronized and semantically relevant gestures recalled more specific information than subjects who were presented with asynchronous or semantically irrelevant gestures. For example, a story was presented about a visitor to an amusement park who wanted to go on a ride. One group saw a hand gesture indicating a Ferris wheel (the hand drew a vertical circle) whereas a second group did not. The group that saw the circular hand gesture were more likely to select "Ferris wheel" on a follow-up multiple

choice test. Subjects who saw an asynchronous gesture or no gesture at all were significantly less likely to report that detail.

Thompson (1995) provides evidence suggesting that the age of the listener may contribute how they pay attention to gestures and facial movements. In a study of vowel recognition, older adults were influenced by articulatory movements apparent in the speaker's face whereas young adults performed at the same level with and without visual input. A second experiment indicated that older participants were better able to repeat sentences when the face was visible where, again, younger participants performed equally well under both conditions. When iconic gestures were added to the study, the younger participants performed most successfully. Thompson interpreted her results to suggest that with age, individuals depend more upon the articulatory movements in the face of the speaker to understand the vocal output. While Thompson did not control for age-related hearing loss or cohort effects, one obvious explanation is that a number of participants in the older experimental group had experienced declines in their hearing and had developed a subtle means of compensating for that loss.

These studies address the degree to which gestures and nonspoken products of communication may be used by a listener either to recognize or understand the content of speech. Other types of information also are available in deictical forms of communication. As in the case of figurative language, gestures often relate pragmatic and not just semantic information. Bavelas, Chovil, Lawrie, and Wade (1992) have termed such movements <u>interactive</u> and <u>topical</u> gesturing. In their research, they found that interactive gestures were significantly more common during a narrative task performed in

a dyad than when the same task was performed alone; they also found a reversed trend for topical gestures. A second experiment revealed that dyads used significantly more interactive gestures when facing each other than when communication took place out of view. Topical gestures, however, were unaffected by the visual availability of the dyads.

In response to these and similar results, Bavelas, Chovil, Coates, and Roe (1995) created a taxonomy of interactive gestures based on the form of the gesture and the function it was believed to fulfill within communication. In a test of their taxonomy, 88 interactive gestures were produced by participants. Researchers compared the specified function of each gesture type as a prediction of the listener's behavior, and found that 78 out of 88 predicted responses were correct. This level of accuracy indicates that there is some systematicity to interactive gestures and that listeners are able to perceive these cues and respond appropriately to them. It cannot be ruled out from this study, however, that vocal cues, such as prosody or intonation, or semantic cues, such as the completion of a description, did not also serve as behavioral cues to the listener.

Given the results of these studies, it seems likely that gestures do affect listener understanding and behavior and it becomes important to ask if there are other functions for gesturing. Cohen (1977) notes that speakers often produce gestures freely and spontaneously even if their audience cannot see them, such as during phone conversations or in speaking over an intercom. In addition, people gesture more when addressing some topics rather than others (McNeill, 1992; Rauscher, Krauss, & Chen, 1986); for example, when speaking about stories or spatial relations. These facts have led some researchers to study the possibility that in addition to communicating messages, gestures also serve the

speaker by aiding lexical access and by providing representations for complex spatial relationships.

Gestures and lexical access. A commonly observed yet little studied function of gesture is to fill hesitative pauses in ongoing speech. During the course of natural speech, there are times when a normally fluent speaker does not produce a word. These gaps are generally marked by "filled pauses" (er, um, ah, etc.) or by gestures. In some cases, these gestures seem to represent an attempt to create the shape or motion associated with the lost word, in other cases they may be described best as a repetitive, motoric gesture. It is important to note that pauses typically are filled by one behavior or the other; rarely by both (Schachter, Christenfeld, Ravina, & Bilous, 1991). Schachter et al. interpreted these findings to suggest that filled pauses occurred while the speaker was trying to produce a word but was unable to recall it at the time-- thus, the vocal apparatus continued through the pause. They further assumed that once the "missing" word was found, the "umming" ceased and a gesture was initiated just as the speaker began to produce the newly found word.

While Schachter et al. did not link gesturing to the act of finding a word, this possibility has been experimentally studied by a number of other researchers. Part of the difficulty in performing these studies concerns the necessity of restricting speaker gesturing. It is quite possible that difficulties in retrieving words when physically restrained are due to divided attention where subjects alternate focus between the restraint and what they are saying. Perhaps the "friendliest" control of gesturing was enacted by Rauscher, Krauss, and Chen (1996) who had subjects hold their hands against electrodes

under the pretense of taking GSR measures. In another condition, subjects had the electrodes attached to the ankles allowing them to gesture freely. As predicted, subjects spoke at a significantly slower rate in the first condition, although this effect was observed only when subjects were describing spatial information. Subjects also paused more frequently when gesturing was restricted, and tended to pause during the middle of a phrase instead of between phrases-- a much more common occurrence during lexical access.

In addition to speech restriction studies, researchers have compared gesture production in spontaneous and rehearsed speech. Based on the above information, it is reasonable to expect that during spontaneous speech, pauses would be more likely to occur in the middle of phrases than at phrase junctures. Chawla and Krauss (1994) found this to be the case; in addition, they reported that lexical gestures-- gestures that reflect the topic of speech-- were significantly more common during this period than were motoric gestures that enhance the structure or rhythm of speech.

Through each of these measures, it becomes clear that lexical gestures are common when a word or phrase is difficult to recall. If gestures were produced independently of language we would not expect to find them quite so intimately involved in lexical access. Because they are closely related, theorists such as McNeill (1992) has come to describe communication as a single cognitive system where thoughts can be expressed by words, gesture, or words and gesture combined. Because thought may be expressed in these ways, researchers have begun to look at the relationship between thinking and gesturing.

Gestures and thought. There are several reasons to suspect that gestures also have something to do with thinking. As noted, speakers gesture even when on the telephone even though their motions do not present information to the listener (Cohen, 1977). In addition, gestures are much more common when talking about spatial relations than about other topics (Rauscher et al., 1994), a fact that holds true for congenitally blind speakers who would seem to have no visual model for spatial information (Iverson, 1998). If gestures center around a certain type of information, then it may be that gestures are necessary and not just ornamental when thinking about these topics. Because of these observations, researchers have examined relationships between gesturing, thinking, and talking.

Perhaps the best domain for examining the relationship between thought and gesture is in mathematics, particularly in graphing, where abstract relationship are presented spatially. Part of the math student's task is to translate formulae into spatial relationships. In a study of this process, Moschkovich (1996) observed students working in pairs as they first encountered the algebraic formula for a line and then attempted to understand how changes in the formula relate to changes in slope. Students came to understand the slope of the line by using their hands and objects such as pencils to represent various alternatives. For example, one student thought that if a line increased in slope it would appear parallel to its original position, but intercept with the y-axis at a greater value. Another student interpreted (as the teacher had hoped) that an increase in slope meant the new line, by definition, was not parallel to the first. It is obviously quite difficult to discuss this issue clearly without some visual representation of the line. When

students controlled a computer presenting lines in front of them, they continued to use their hands to describe the change. One student moved the pencil-- representing the line-- higher in front of them while his partner countered by pivoting a pencil so that the slope was greater. While one cannot conclude that gestures are necessary to talk and think about these phenomena although they do appear naturally under such conditions.

McNeill (1992) has analyzed a number of other studies that address similar issues and has described them in terms of contextual thinking. At any given moment in a conversation, there is a set of knowledge that is unique and intrinsic to the situation, and conversants must know what the topic of speech is and what is being said about it. Because language is serially presented, it tends to highlight only one possibility at a time. Gestures are more spatial and allow for simultaneous contrasts between alternatives either by holding one option in gesture as the other is spoken, or by contrasting ideas on the basis of two different gestures. Another occurrence is to speak rapidly and to allow the hands to present information that does not appear in speech. Perhaps the most influential role of gesture in thinking would be creative; that is, by using the hands the speaker is able to generate new options that might not have come about by speaking alone. In terms of the student example above, one could imagine a pencil moving up and down while remaining parallel. By having the hands representing this type of idea, other options, such as pivoting, may become more noticeable.

Language as gesture. From these descriptions, it is apparent that gestures serve more than one function. They serve as communicators, as the common-sense notion indicates, and people gesture freely when speaking although rarely when listening. In

addition, speakers use gestures for pragmatic purposes, relaying structural or deictic information, drawing attention, and/or sharing the floor with other speakers. Listeners also remember and understand what is presented in gestures when the information is not available in spoken language. Beyond these communicative functions, evidence suggests that gestures are a part of the processes of speaking and thinking (McNeill, 1992; 1985) and some researchers have claimed that gestures are the phylogenetic origins of speech and syntax (Armstrong, Stokoe, and Wilcox, 1995; Morford, Singleton, & Goldin-Meadow, 1995). Perhaps this conclusion would not be quite so unexpected if researchers in cognitive psychology did not tend toward structuralism, modularity, and computational explanations. As McNeill (1985) points out, research traditionally has been based on studying language as it is written, and what is not be written is considered to be nonverbal or nonlinguistic behavior. Because written language is static, research has tended to treat phonemes, words, and syntax as abstract and unchanging formal categories. Many of these arguments, however, do not fit behavioral data well, and this is particularly evident in the work of sign language researchers such as Armstrong, Stokoe, and Wilcox.

Not surprisingly, much of the research focused on language as gesture has derived, in part, from studies involving sign languages (SL). Many researchers in this area have worked to overcome a bias against sign languages and have invested much effort in demonstrating ASL is indeed a language like any other. To this end, they have demonstrated that sign language has properties analogous to formal categories of spoken languages such as phonemes and morphemes (Armstrong, Stokoe, & Wilcox, 1994). This has been a difficult task at times because the seeming iconicity inherent in sign languages

suggests that duality of patterning does not exist; that is, there often are visible similarities between the sign and the signified within SLs. These same relationships are thought to be arbitrary within spoken language where there exist very few instances of lexicalized onomatopoeia. This arbitrary sign-signified relationship is often considered a significant distinguishing feature of spoken or written languages (Hockett, 1958; Morford, Singleton, & Goldin-Meadow, 1995).

Are sign languages truly iconic? A study by Morford, Singleton, and Goldin-Meadow (1995) challenged this assumption by suggesting a dimension of gestures which, similar to Kendon's continuum, is based on the formalization of movement. These researchers studied gesture systems at varying levels of formality which may be summarized as:

(1) spontaneous signs produced by hearing speakers who are asked to gesture instead of speak;

(2) first-generation sign language, produced by a homesigner (a nonhearing child developing an idiosyncratic sign system in the absence of any formal SL);

(3) formalized sign language, produced by deaf, signing children whose parents are native signers.

Subjects at each level completed a test in which their handshapes were compared to adult, expert ASL signers. In this test, individual participants viewed a series of short videos in which toys or other objects moved in various paths. The participant was then asked to describe what he or she saw in the video with instructions to avoid using their usual language, be it speech, homesign, or ASL. If ASL is simply a series of icons, however,

one would expect all groups to approximate ASL signs equally often and with high frequency.

The researchers then examined the relationship between the signs of each group and ASL. Results indicated most subjects represented the various motions in similar ways although there were significantly different patterns of object representation. Non-signers spontaneously created iconic gestures to resemble objects. Nonetheless, only 17% of their gestures matched an appropriate ASL sign. In addition, after one to two weeks, retested subjects used different iconic representations two thirds of the time. The authors interpreted this to suggest that non-signers spontaneously produce iconic signs. Their apparent inconsistency in the retest indicates that there is little or no systematicity to such signing, even though subjects tended to rely on rather obvious iconic features when creating signs on both occasions.

In contrast, a case study of a homesigner, representing the first generation of an idiosyncratic sign language, matched ASL 50% of the time despite the fact that he had no exposure to formal sign languages. It was further noted that the homesigner had developed a system of signs, not unlike ASL, that are based on semantic categories, such as vehicles, people, and animate objects. These signs, however, are not always iconic since they do not necessarily look like the category they represent or, in some cases, resemble only certain members of the category but not others. These results were interpreted to suggest that a homesigner may independently generate a sign system with the properties of formalized language. The homesign and ASL systems diverge, however,

in that the homesign system was less consistent; for example, some objects or actions were represented by multiple semantic classifiers at different times.

Finally, when second generation signers were tested-- those exposed to and learning formal ASL-- these children produced the correct ASL shapes 66% of the time. The mistakes they made, however, were perhaps more informative then the signs they made correctly. Out of over 150 sign errors produced by native signers during the testing sections, two thirds of the signs were rated as less iconic than the proper ASL sign. In other words, when these children made mistakes, they did so by misapplying formal ASL properties to a sign rather than by creating an incorrect iconic representation of the concept. In this sense, learning sign language is similar to learning a spoken language where children frequently overextend rules and category names as a natural and pervasive part of the language acquisition process.

Other studies have produced similar results demonstrating that individuals acquiring a native sign language pay little attention to any iconicity within that system (Meier, 1987) and that the iconicity has little effect on the developing structure of a sign language (Wilbur, 1987). These studies, along with those by Morford, Singleton, and Goldin-Meadow (1995), indicate that sign languages are not based on making images of objects and actions, although many spontaneous gestures are created iconically. By studying cross-sections of a sign system as it develops, Morford et al were able to demonstrate that there is a continuum between informal gestures and the morphemes of ASL. The most significant conclusion to be reached on the basis of this set of studies is that signed languages must be seen in the same light as spoken languages--when

formalized, both reveal duality of patterning where the sign, word, or morpheme is not motivated by the perceptual attributes of that which it represents.

While Morford, Singleton, and Goldin-Meadow (1995) have demonstrated that formalized signs may be viewed as language, Armstrong, Stokoe, and Wilcox (1994; 1995) have taken the gesture-language link one step further by developing a theory of language origins based upon gestures. In their approach, an established syntax is considered the hallmark of language, although they challenge traditional views of syntax. In fact, the authors state that formalist theories of syntax have obscured the nature of language, spoken or signed, by emphasizing abstract categories such as phonemes. According to such theories, language is the correct ordering of discrete segments. Problems with such categories occur when they are examined in ongoing communication contexts. Phonemes, for example, are never produced independently; they are co-articulated rather than simply ordered and may be affected by other sounds up to three phonemic segments away. For example, the sounds /s/, /p/, and /n/ will be produced with a wide mouth for "span" and with a rounded mouth for "spoon."

While the articulation of consonants varies according to the vowels sounds in the word, it is interesting to note that people are much better at identifying a word when the middle vowel sounds are carefully removed than when the vowel sounds are played alone (Strange, 1987; 1989). Moreover, speakers spend much more time beginning and ending articulations than maintaining a fixed sound once achieved (Fowler, 1985). Based on these data, it appears that information produced by changes in the vocal signal are more important during speech perception than are static phonemes (Tuller, Case, Mingzhou, &

Kelso, 1994). Taken together, these facts suggest that formal, static linguistic categories, while useful, provide an incomplete picture. Armstrong, Stokoe, and Wilcox have suggested it is more useful to view both signed and spoken language as a series of articulatory gestures. Although these gestures may rely upon different neuromuscular physiology, the common vocabulary provides a means of viewing spoken and signed languages as related processes-- processes based on the changing verbal or visual signal, rather than on discrete, abstract categories.

After contrasting the fluidity of language with static, formal categories, Armstrong, Stokoe, and Wilcox (1995) suggest that viewing all language as articulatory gesture may provide insights into the origins of language. By developing a theory of semantic phonology, these researchers, led by Stokoe, have attempted to explain the origins of syntax using an embodied, phylogenetically continuous approach in opposition to the predominantly discontinuous, formal approach emphasized in formal linguistics. In brief, semantic phonology emphasizes the availability of the primary syntactic elements within simple gestures. For example, by touching one's head, a gesturer may be implying "I know that." In this case, a single gesture includes the syntactic elements of a noun or an actor (the hand) and a verb or an action (motion towards the head). From this perspective, the same syntactical elements are present in both spoken and gestured language although the manifestation of syntax depends on the perceptual qualities of the signal. A single gesture may include both the actor and the act because it appears in four dimensions; three-dimensional space plus time. Further, a sign held in place may reveal its phonetic structure. The auditory signal, although created by changes in three-dimensional space of

the vocal apparatus, is perceived as the voice changes over time. When held static, it is possible at times to detect the phoneme although there is no real chance of understanding the word. Thus, Armstrong, Stokoe, and Wilcox, have begun to make a case for the underlying similarity of gestured and spoken communication. By viewing both as neuromuscular gesture, and by couching syntax in semantic phonological terms, these authors offer a paradigm which allows for the simultaneous study of language and gesture as a unified system where differences lie in the spatial-temporal qualities of the output rather than in the abstract form of the language.

Although some researchers, such as Morford, Singleton, and Goldin-Meadow (1995), have indicated that sign languages are truly linguistic, others have theorized that spoken languages may be described as a type of gesture (Armstrong, Stokoe, & Wilcox, 1995). Finally, McNeill (1992) argues that the gestures of hearing speakers are generated as a component of speech. Although these approaches to language differ in many respects each represents an attempt to unite manual and vocal communication in a single framework, albeit one that varies in neuromuscular activity rather than in cognitive or linguistic processes.

The impact these ideas will have on language research remains to be seen; they may, however, influence research in figurative language in a number of ways. First, research suggests that both gestures and speech are able to communicate complex relationships involving syntactical and morphological elements. While most spontaneous gestures by speakers do not appear to be based on morphological patterns (Morford, Singleton, & Goldin-Meadow) these results open the possibility that gestures may be

motivated by a linguistic as well as by an iconic process. Second, despite the fact that many spontaneous gestures are iconic, it is also common to observe metaphorical gestures that create representations of abstract entities, even when such metaphors are absent from speech. This suggests gestures not only relate to linguistic output, they also have refer to metaphorical thought, even in cases when spoken language is without such reference. Finally, Armstrong, Stokoe, and Wilcox (1995) suggest that the main difference between manual and spoken communication concerns the fact that gestures present information spatially whereas speech is temporal. Figurative language, however, operates by creating a figure or image of a topic and ,therefore, gestures and figures of speech may serve the same purpose: both are produced linguistically, both reflect the sometimes metaphorical nature of thought, and both serve to abbreviate or concretize ideas that would be extremely difficult to present using only literal, spoken language.

Currently, these ideas do not dominate psychology or linguistics and are resisted by many researchers. Nonetheless, there are clear connections between the ways in which people speak and the ways in which they gesture. The relationship between figurative language and gesture is not well understood at this time, in part because gesture researchers have focused on narratives (which tend to include few metaphors) and not on other formats, such as the lecture, where figurative speech occurs more frequently. Figurative language researchers have paid little attention to gestures because their focus has been on comprehending and learning from metaphors. In addition, linguists have tended to focus on the grammar of literal language and have attempted to define language by what can be written instead of in terms of what is actually spoken (McNeill, 1992).

CHAPTER 2: METHOD

Most research on figurative language has not been concerned with its function in natural speech contexts, focusing instead on testing theories of comprehension and word meaning under restricted experimental settings. Studies by Pollio et al., (1977) and Corts and Pollio (1999), however, have addressed the production properties of figurative language and have demonstrated that it co-varies with the purpose and content of the communication. Within psychotherapy, for example, Pollio et al. found that dialogue begins with a generally literal discussion of the presenting problem involving only a few figures of speech. At unpredictable moments in the dialogue, figurative language output was found to increase to an unusually high rate for a short period of time. These "bursts" of figurative language were predominately composed of novel figures and were associated, in their study, with subsequent ratings of therapeutic insight. Following a burst, figurative production returned to a slower rate similar to the basal rate found at the beginning of the session.

Corts and Pollio (1999) conducted a similar analysis of figurative language production in college lectures. In addition to figures of speech, the imagistic and directional gestures produced by the speaker were considered in this study. In support of earlier claims, figurative language was produced in bursts of mostly novel figures of speech. Gestures also were produced in bursts, often in conjunction with figurative language. When figurative language and gestures overlapped, they presented the same metaphorical concept rather than two different or independent representations of the concept. A further analysis revealed that bursts tended to concern central topics of the

lecture, especially when the topic was particularly abstract or challenging. One of the most apparent properties of these bursts was their conceptual coherence. Each novel metaphor or gesture within the burst could be related to the same underlying conceptual metaphor. In between bursts, the lecture dealt either with more concrete material or with narratives and largely involved a series of literal statements. In these sections, both figures and gestures were produced at a relatively consistent, albeit slower, rate.

The present analysis is an attempt to evaluate further the spontaneous production of both figurative language and gesture in college lecturers. The generalizability of previous research is limited by its reliance upon a single participant and a limited domain of educational material. The present research concerns an analysis of lectures from the natural sciences and the humanities and will compare these results with data deriving from the earlier analysis of social science lectures. There are a number of benefits to expanding this research to include other lecturers and other content areas. First, the results of the present study may provide further evidence in support or refutation of previous findings. If present results are in support of previous findings, then these studies together would suggest a linguistic phenomenon capable of including a variety of speakers and topics. If present results differ from previous findings, however, it is then likely that factors such as personal communication style and/or lecture content may be accountable for observed trends in figurative language and gesture production. Finally, by considering a different sample of speakers and content areas, there is an opportunity for previously unobserved patterns of figurative speaking and gesturing to be identified.

Participants and Classes

With the goal of making comparisons across disciplines, two lecturers were selected from different departments at a large southeastern university. Requirements for selection were: (1) that the individual had attained the rank of assistant professor or higher (e.g., not a GTA or Instructor), (2) that the individual was recognized as a good instructor on the basis of either above average student ratings or by receiving faculty teaching awards, and (3) that the individual taught primarily on the basis of a lecture format.

In addition to these requirements concerning the lecturer, the following criteria were used to select specific courses: (1) each course was required to present a different academic discipline, with these disciplines falling into the relatively broad categories of natural science and the humanities, (2) each course was required to be roughly the same size, and (3) each course was required to have similar, lecture-oriented formats. The resulting collection of participants and lectures included two male professors, one each from the departments of Geology and Classics. Because a previous study (Corts and Pollio, 1999) involved three lectures by a professor of psychology, his results will be considered together with those of the Classics and Geology professors when appropriate. The specific classes studied in the present case include two sections of an introductory course in Geology and two sections in an intermediate course in Classical Greek Mythology. The earlier study concerned lectures in Abnormal Psychology. Each of these courses was held in large lecture halls with approximately 80 to 100 students in attendance.

Data collection and preparation

After lecturers and courses were selected and both professors had agreed to participate, two consecutive Geology and Mythology classes were videotaped. To minimize any impact on the class, all video equipment was in place before students arrived. The research team had no interaction with students or professor during class time, and the lecturer was debriefed as to the purpose of the study upon completion of the taping. Research assistants prepared the data for analysis by transcribing each of the lectures. Completed lectures were divided into sentences and printed copies were used for the identification and classification of metaphor and gestures.

Identification of Figurative Language and Gestures

Two independent researchers reviewed each of the transcripts to identify instances of figurative language. These reviewers were instructed to select language as figurative based on the training manual prepared by Barlow, Kerlin, and Pollio (1971). Instances of figurative language included metaphor, analogy, personification, metonymy, and other major categories of figurative speech. Once a phrase was identified as figurative, researchers further categorized it according to novelty, topicality, and coherence. Novelty was operationalized in terms of a three-point ordinal scale ranging from: 0, a highly cliched or frozen figure of speech (e.g., "this concept is difficult to grasp"); to 1, a clichéd or frozen metaphor that is rephrased in a relatively novel expression (e.g., "this is a slippery little concept"); and 2, a novel metaphor. Topicality also was scored on a three-point ordinal scale: 0, a phrase that explicitly describes the lecture or the class; 1, a

metaphor appearing as the lecturer addresses the topic of the lecture, but not serving any apparent pedagogical or conceptual function (such figures may be omitted or replaced without affecting the meaning of the phrase), and 3, a highly topical metaphor where the metaphor is the topic (i.e., if the metaphor is changed the meaning is changed). Finally, raters identified whether each figure was conceptually related to other figures of speech within the same lecture. For those figures that were rated as coherent, raters were asked to provide a name for the root metaphor. For example, the passage at the beginning of this paper would include "shoes of marble...gloves of lead" categorized under the root metaphor, DEPRESSION IS A HEAVY WEIGHT.

To identify and classify gestures, two independent raters viewed each videotape with an unmarked transcript. McNeill's (1995) classification system was used as a guide, and any gesture appearing to represent an image, shape, or direction was included. Most gestures were spontaneous and therefore the novelty classification was limited to verbal figures. Because gestures serve both topical and structural functions in the course of a lecture they were classified accordingly. A topical gesture was defined as one which illustrates or describes the subject matter of the class whereas a structural gesture was defined as one which serves to refers to the class, the lecturer or the act of lecturing.

Inter-rater agreement

Two raters worked independently to identify figures of speech and gestures. To establish the reliability of the coding systems, raters met to compare ratings. Inter-rater agreement was satisfactory, with 8 to 18% of the figures and gestures in the initial

screening identified by only one rater. In those cases where a phrase was identified as figurative by one rater and not the other, both raters discussed whether or not the figure should be included in the analysis. If after discussion both raters could not agree that a phrase was figurative, it was excluded from the analysis. The same procedure was employed for the identification of gestures. Thus, there was complete inter-rater agreement for figurative phrases selected for study in the present analysis. A similar system was employed for the selection of gestures where raters initially agreed on over 90% of the gestures in each lecture. If both raters could not agree that a motion was an imagistic or deictic gesture, it was removed from subsequent analysis.

After raters agreed on the phrases and gestures to be included in the analysis, they independently reviewed the figures and scored them according to novelty, topicality, and coherence. To establish the reliability of novelty and topicality ratings, kappa coefficients were calculated for the first Geology lecture. There was significant agreement between the two raters indicating a reasonable level of reliability for the categories of novelty (.76) and topicality (.79). When raters disagreed on the values for topicality and novelty, the lower of the two ratings was used in the analysis. Therefore, no figures were discarded due to disagreement over topicality or novelty. Raters did agree completely regarding coherence which was coded as a dichotomous variable.

Quantitative Procedures

The frequency and distribution of figurative language and gesture were analyzed on the basis of a centered moving average (CMA) procedure. This procedure has been

adapted from quality-control or process methodology, and is often used in contexts such as manufacturing to detect changes in an ongoing process. In the context of the current study, this procedure was used to select portions of the lecture in which an unusually high number of figures and/or gestures was produced. This procedure began by setting an arbitrary number of sentences-- in this case five-- and then calculating the mean number of figures (and later gestures) in that set of five consecutive sentences. After the mean is calculated for sentences one through five, a mean is calculated for the next consecutive group of five sentences; sentences two through six, three to seven, and so on until the means of all possible sets of five consecutive sentences in the lecture are calculated.

The motivation for using moving averages rather than the simple frequencies of metaphor and gesture for individual sentences lies in the fact that the CMA procedure smoothes the output across sentences. This is beneficial to the analysis because both the raw frequencies and the CMA values increase during output bursts and return to a lower value once the burst has run its course. When raw data is analyzed, however, a single sentence having an unusually large number of figures may stand out, whereas a prolonged period of only slightly increased output might go unnoticed. By smoothing the output on the basis of the CMA procedure, figurative output may still be greater within a single sentence but a prolonged series of figures or gestures over two to five sentences will likewise be identified and selected for further analysis.

The number of figures, or gestures, per sentence ranged from zero to four in most lectures. The distributions consisted solely of positive integer values, and therefore, were best described in terms of Poisson distributions. For the purposes of this study, only the

highest 10% of this distribution was considered to define unusually high levels of output and these sections were identified as bursts.

CHAPTER 3: RESULTS

Rates of Output for Figurative Language

The first analysis concerns the rate at which college lecturers in both Geology and Classics produce figures of speech and gestures. Cumulative output curves (see Figures A1-A4, pp. 105-108) present the total number of figures of speech produced as well as the distribution of novel and frozen figures for each lecture. Total cumulative figurative output ranged from 131 in the first Greek Mythology lecture to 63 in the second Greek Mythology lecture, with a mean of 101 figures of speech per lecture across both lectures. With the exception of one lecture, there was little variation in the total number of sentences produced, ranging from 369 in the second Mythology lecture to 486 in the second Geology lecture. Variation in the rate of figurative output ranged from .18 figures per sentence (second Mythology lecture) to .27 figures per sentence (first Mythology lecture), with a mean rate equaling .22 figures per sentence (see Table 1).

These data indicate different rates of figurative language production among lectures although there also were fluctuating rates of output within each individual lecture as well. During the course of each lecture, figurative language was produced at a relatively even rate for the majority of the period, with several small bursts containing a large number of figures (depicted by the boxes in Figures A1-A4). These bursts were defined by the CMA procedure described in the preceding chapter and, on this basis, the number of bursts varied from two in the first Mythology lecture to five in the second Geology lecture. On average, across both sets of lectures, these bursts contained approximately one third of all figurative language within the lecture despite the fact that they only included

Table 1: Figurative Language Output Statistics for Four Lectures

Lecture	Total Figures	Total Sentences	Figures per sentence	% topical	% novel	% coherent
Geo 1	127	486	.26	37	53	39
Geo 2	82	476	.17	50	41	78
Myth 1	131	477	.27	47	9	60
Myth 2	63	369	.18	69	34	74
Mean	101	452	.22	51%	34%	63%

6% of the total number of sentences (see Table 2). Averaged across the four lectures, figures were produced at an average rate of 1.26 figures per sentence within bursts; a value over eight times the rate of figures not occurring in a burst. Because these bursts demonstrate such a concentration of figurative language, they will be examined in greater detail later.

Rates of Output for Gestures

In addition to describing figurative language output, it was also possible to develop cumulative gesture output curves for each lecture; these are presented in Figures A5-A8. An examination of these figures indicates that two aspects of these curves were similar to those describing figurative language output: First, the total number of gestures produced within a lecture varied to some extent, ranging from 132 in one lecture to 252 gestures in a different lecture (see Table 3). This latter value is a relatively large one since values for the remaining three lectures only varied between 132 to 168 gestures. A second feature shared by the output characteristics of figurative language and gestures is that neither tends to be produced at a consistent rate throughout the lecture; instead many gestures and figures appear within relatively concentrated bursts of activity. The CMA procedure identified between three and five bursts of gestures for each lecture. As noted in Table 3, averaged across the four lectures, gestures were produced at a rate of 1.29 per sentence when they occurred within bursts; approximately 3.4 times the rate of .38 gestures per sentence overall, and four times the rate of .33 gestures per sentence for items not falling within bursts.

Table 2: Properties of Figurative Language Occurring Within Bursts

Lecture	% of figures in bursts	% of sentences in bursts	figures per sentence	Percent of figures coded as topical	novel	coherent
Geo 1	35	9	0.77	84	75	96
Geo 2	45	6	1.24	63	65	89
Myth 1	16	3	1.54	43	5	67
Myth 2	38	5	1.50	83	54	83
Mean	33%	6%	1.26	68%	50%	84%

Table 3: Properties of Gestures for Complete Lectures and for Gestures Occurring Within Bursts

Lecture	Entire Lecture			Within bursts		
	Total Gestures	Total Sentences	Gestures per sentence	% of Gestures	% of Sentences	Gestures per sentence
Geo 1	138	486	.28	22	5	1.25
Geo 2	132	476	.27	15	4	1
Myth 1	252	477	.52	20	8	1.3
Myth 2	168	369	.46	22	7	1.4
Mean	172	452	.38	20%	6%	1.29

Bursts of Figurative Language and Gesture

The CMA procedure is designed to recognize output bursts in which a relatively high number of figures is produced. Because variations in output rates are expected, it is possible that these sections may reflect random changes in figurative activity. Alternatively, bursts may represent a change in pedagogical goal or technique, a different manner of communicating, or some combination of the two. To examine these possibilities, lectures were examined individually and will be presented below. For each lecture, bursts of figurative language or gesture were compared to other portions of the lecture where figures of speech or gestures were produced at a much lower and more consistent output rate. Specifically, these comparisons will involve the ratings of novelty, topicality, and coherence for figures within bursts when compared to those outside of the bursts.

Geology lecture bursts. In Geology Lecture 1, bursts of figurative language were recorded after approximately 270, 315, 335, and 360 sentences; in Lecture 2, bursts were recorded around sentences 45, 100, 115, 140, and 180. Cross-tabulations indicated that in Lectures 1 and 2, figures produced during bursts were significantly more likely to be topical than structural whereas figures outside of bursts were equally (Lecture 1) or more likely (Lecture 2) to be structural than topical (Table 4). In addition, figures within bursts were more likely to be coded as novel whereas figures outside of bursts (in both lectures) were more likely to be coded as frozen. Finally, in regard to coherence, figures within bursts in both Geology lectures were significantly more likely to be classified as coherent than those produced outside of bursts.

Table 4: Number of Figures in Various Categories for Items Falling within and Outside of Bursts in Both Geology Lectures

	Location in Lecture					
Category	Geology 1		Geology 2		Chi-Square[1]	
	Not in burst	In burst	Not in burst	In burst	Geo 1	Geo 2
Structural	42	7	27	14	14.6**	3.9*
Topical	41	37	18	23		
Frozen	48	11	35	13	12.5**	15.2**
Novel	35	33	10	24		
Not Coherent	16	2	14	4	5.1*	4.9*
Coherent	67	42	31	33		

Notes: [1]Values represent chi-square ratios. * $p < .05$; ** $p < .01$.

There were two possible ways of understanding the coherence found within bursts. First, it was possible that the specific figures in a burst were not coherent with each other but instead were related to figures produced throughout the lecture. An examination of the specific figures defining the bursts indicated that this was not the case. Instead, a second understanding was supported; namely, that figures within bursts tended to be related to a single root metaphor serving to define the burst. In Geology Lecture 1, for example, an initial burst occurred at around 270 sentences made use of an elaborate "iced tea" analogy (Table 5). In this segment, the lecture described Bowen's Reaction Series-- changes in chemical composition of magma-- by drawing comparisons with dilution in the more familiar case of the sugar settling in tea. The third burst in this lecture, around sentence 335, made a similar analogy in which the instructor described chemical changes in rock during weathering by asking students to describe what might happen to an abandoned sports car. In the fourth burst, after sentence 360, the lecturer returned to the sports car ("Ferrari") analogy to clarify details. In each of these three bursts, the speaker presented a single topic that was central to the lecture by using an elaborate, novel figure. Moreover, the figure employed in the burst did not just describe the topic, it served to represent it. The effect is that replacing the "red Ferrari" in bursts three and four with a different type of object, such as a red pepper, would lead to quite different outcomes. Burst 2 did not follow this pattern, however, and will be discussed later.

In the second Geology Lecture, similar patterns were found for four of the five bursts as the instructor tried to describe the effects of gravity. These bursts-- the third

Table 5: Excerpts from Geology Lecture Bursts

Geology Lecture 1, Burst 1

[269] That's a glass with ice tea in it...this is the tea, and that is the ice... [272] so much sugar in there that it is very sweet...you drink that tea when it first arrives...it tastes very sweet...you come back later, and what's happened to the iced tea there? ...[276] The temperature melts the ice...changes the composition of the tea, and as you pointed out, it's diluted...[279] The tea has a different chemical composition.

Geology Lecture 1, Burst 2

[316] That gets us to the end of...igneous rocks. Now I want to step across this line...move on to Objectives 3 and 4...[319] This is kind of a gear shift...I want to help you through this gear shift.

Geology Lecture 2, Figurative Language Burst 4

[142] We have planes of weakness parallel to slope. Yeah, the best way to do that is a deck of cards. Take this deck of cards [places hands parallel to each other horizontally] and you tilt it [tilts hands]. Now, they'll start sliding off one right after the other [after hands tilt, the top hand 'slides' off the other]. That's in essence what we're doing here--we're taking a deck of cards...water gets in here...and then they'll just get and go off these surfaces [hand slides off again].

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through sixth-- each addressed this topic differently by introducing metaphors such as a roller coaster, a deck of cards tilted so that the top cards may slide off (see Table 5, previous page), a collection of "greased ball bearings" and, finally, the effect of height on downhill skiing. Again, all of these bursts were defined by a series of novel, coherent phrases based on a single underlying metaphor concerning the primary content of this portion of the lecture.

Three of the nine bursts from both Geology lectures did not fit this pattern (Burst 2 in the first lecture; Bursts 1 and 2 in the second lecture). In these cases, the CMA procedure identified a cluster of phrases that may be described best as structural and not topical and novel. These clusters did, however, exhibit some measure of coherence, although to a lesser degree than topical bursts previously described. Table 5 presents the content of the second burst from Geology Lecture 1 in which the speaker produced several small sentences based on two separate metaphors. First, he employed the TEACHING IS A JOURNEY metaphor where his objective was to "move the class forward." The second root metaphor used again related to the JOURNEY metaphor, when the lecturer noted that the class must "shift gears" to continue moving forward. In each of these bursts, the speaker employed structural figures to make a transition between topics.

In addition to these bursts of figurative language, the lecturer also produced a number of gestural bursts both in conjunction with, and independent of, figurative language bursts. Gesture bursts occurred around sentences 180, 270, 315, and 390 in the first Geology lecture, with the second and third bursts overlapping bursts of figurative

language. In the second Geology lecture, gesture bursts occurred around 140, 245, and 450 sentences, with the second burst overlapping a burst of figurative language.

The first burst in Geology Lecture 1, which did not overlap a burst of figurative language, concerned instructions given by the lecturer on how to complete a worksheet. In this process, the lecturer made several deictical movements identifying individual students and groups of students. Intermingled within these gestures were a series of iconic gestures used to demonstrate shapes and objects on the worksheet. For example, the speaker said, "which [minerals] would be the top of these bands...which would crystallize first. Or I would ask you to identify which minerals would melt first-- which would be at the bottom of these bands." During this passage the lecturer used his hands to represent different colored bands displayed on a chart, which he accomplished by positioning his thumb and forefinger about an inch apart and moving his hand horizontally as if he were outlining the band.

A similar pattern was noted in Geology Lecture 2, during the third burst (which also did not overlap a figurative language burst), where the lecturer described the effect of slope on water and rocks. In this case, the speaker used a series of iconic gestures, tilting his hands for slope and moving his hands horizontally for the flow of water. During this period, the lecturer also used deictic gestures to denote certain locations, such as the Mississippi River. Thus, bursts of gestures that were not related to figurative language bursts served to engage or direct attention either to the class or to demonstrate visible images and did not directly concern the content or topic presently under consideration.

In contrast to this, the second and third gesture bursts in Geology Lecture 1 did overlap bursts of figurative language, as did the first burst in Geology Lecture 2. Each of these bursts began with the verbal presentation of a metaphor (see Table 5, Geology Lecture 2, Figurative Language Burst 4). As the instructor proceeded with an explanation of the topic, the novel, coherent metaphor defining this burst was expanded, and the accompanying gestures were coordinated in time and form with the metaphor. In the case of the DECK OF CARDS metaphor, the gestures represented either a deck of cards or the rock formation the instructor is describing.

The fourth gesture burst in this lecture did not overlap with a burst of figurative language, however, metaphor was not completely absent from this segment of the lecture. In this burst of gestures, a small number of metaphors were produced and, in these cases, were represented in gestures. One of these occurred when the lecturer was describing rock compression and expansion, "someone who's been stuffed at the bottom of a phone booth [hand pushes down toward floor]...and the person at the bottom becomes two-dimensional [palms come together, horizontal to floor]." In this example, the gestures were iconic, presenting the shapes and actions described in speech, although the speech itself was metaphorical. The primary difference between those bursts in which metaphors and gesture overlapped and this burst of gestures is that in this burst, metaphors were not central to the instructor's explanation-- he used them in one sentence and then moved on. Thus the pattern was similar, even though the specific figure was not developed across the next few sentences.

Mythology lecture bursts. The CMA procedure identified two bursts of figurative language in Mythology Lecture 1-- one after 190 sentences and the other after 200 sentences-- and three in Mythology Lecture 2, this time at around, 65, 160, and 330 sentences (See Figures A3-A4,). In the first lecture, there were significantly fewer figures in bursts (16%- see Table 2) than was the case for any other lecture. Moreover, figures within bursts occurring during Lecture 1 were coded as novel far less often (5%) than those occurring in bursts in other lectures (mean values ranging from 54% to 75%). Figures within bursts during this first lecture were predominately coherent (67%), but not to the same degree as in bursts from the other three lectures (83%, 89%, 96%). Instead of the pattern found in other lectures, bursts in Lecture 1 tended to be frozen, structural figures. One of these bursts was unusual in that it established a transition between narrated action and plot development. This occurred in the second burst when the lecturer said, "[201] You ran into Antiphus in the Aphrodite chapter early in the term...Remember that story, but we will leave that line and follow another now to get to the bottom of the royal line." This type of burst is quite different from those produced during the Geology lectures in which the speaker used novel figures to focus the class on the topic of the lecture.

The second Mythology lecture shared more similarities with both Geology lectures where the majority of figures occurring within bursts appeared to be topical and not structural, novel rather than frozen. A chi-square test indicated there was significantly more topicality and novelty for figures within bursts than for figures not produced in bursts (see Table 6, next page). The differences between the two Mythology

Table 6: Number of Figures in Various Categories for Items Falling Within and Outside of Bursts in Both Mythology Lectures

	Location in Lecture					
Category	Mythology 1		Mythology 2		Chi-Square[1]	
	Not in burst	In burst	Not in burst	In burst	Myth 1	Myth 2
Structural	57	12	16	4	.20	4.0*
Topical	53	9	23	20		
Frozen	100	19	29	11	.43	5.1*
Novel	35	2	10	13		
Not Coherent	45	7	12	4	.42	4.7*
Coherent	65	14	27	20		

Notes: [1]Values represent chi-square ratios. * $p < .05$.

lectures are due in part to the nature of the second lecture in which the instructor spent more time discussing the nature of epic poetry rather than outlining a series of events, as in Lecture 1. In the first burst of the second lecture, for example, the instructor noted that, "literature does not generate the real world, it reflects it." As he expanded this figure, he described the property of reflection thereby creating a temporary increase in figurative language production. Later, in burst three, the lecturer produced a similar burst, this time describing literature as cooking: "combine these...and we get the Iliad. All you need is tradition...add to it an encounter between Mycenians and Greeks...sprinkle in an existing Epic about a siege at Troy...mix these things together and you're going to have a story." In addition to these two bursts, in which the topics concerned more general aspects of literature, the second lecture included a series of cliched figures describing a power struggle within the context of the poem. This burst was based on the POWER IS UP metaphor and included phrases such as, "the fall of Troy," "he is under Achilles," and "the hero who is at the lowest possible point."

Gestural bursts in Mythology Lecture 1 that occurred after 305, 330, 395, and 410 sentences had little overlap between gesture and figurative language bursts. In Lecture 2, bursts of gestures occurred after about 60, 75, 105, 265, and 330, with the first (60) and last (330) of these bursts overlapping bursts of figurative language. In the Mythology lectures in general, there were fewer overlapping segments of figurative language and gestural bursts than in the Geology lectures. There was one case, however, during the second lecture (occurring around sentence 60) in which substantial overlapping did occur.

In this portion of the lecture, the speaker described the nature of epic poetry in a burst of figurative language:

> ...human behaviors in this era are driving [right hand pushes forward] the description of behaviors in the poems...we know that literature does not generate human life, it's the other way around [right hand loops backwards]. Literature, especially oral literature [right hand loops backwards], reflects the way [right hand moves back and forth, flipping from palm up to palm down] the world is. It doesn't generate the world [hands flip backward, palm down], it reflects it [hand flips forward, palm up].

This excerpt provides an example of a burst of metaphorical gestures in which the instructor also used figurative language to describe literature as a mirror and not as a driving force. The hand motions coordinated with these descriptions appear to be based on the following metaphors: (1) human behavior is a bounded entity; therefore it may be pushed and/or reflected in a mirror, (2) literature is an entity with similar properties, and (3) there is an appropriate sequential order that determines causal relationships. In the Geology lectures, it was not uncommon to find iconic gestures representing physical objects in figurative language bursts (e.g., DECK OF CARDS). In the case of the Mythology lecturer, however, the metaphor is based on a relationship (reflector and reflected) or an event (reflecting) rather than on a shape. Despite these differences, the speaker readily used metaphoric gestures in his description. Iconic gestures appeared in the fifth burst

of Mythology Lecture 2, where the speaker related the "recipe for a story" metaphor. In this case, a series of iconic gestures were used to depict cooking terms, such as "add," "sprinkle in," and "mix," while including several iconics in an adjacent passage acting out elements of the story-- "shooting arrows," "back and forth," and "battering rams."

Apart from these periods of overlap, all remaining gestural bursts in both Mythology lectures centered around a short portion of the lecture during a narrative. In one case, the lecturer described people digging and finding a tomb. Gestures indicated both the layout of the tomb as well as the actions of the people who dug into the tomb, left an offering to the deceased, and covered the opening. In another example, the speaker described a device that sends sound waves underground and detects them as they return. This description was accompanied by acting out the process of carrying and using the machine, as well as by using one hand to represent waves moving underground and then returning to the device.

The Structural Functions of Figurative Language and Gestures

Present results indicated that approximately one third to one half of all figures produced did not describe or create a representation of the topic under discussion. Instead, such (non-topical) figures of speech referred to the class or to the lecture itself. This use of figurative language was found in each of the lectures and involved figures that were almost exclusively frozen in nature (94%). When such figures are used throughout

the lecture, they commonly were produced in a group at the beginning of the lecture to introduce the day's topics; they also tended to appear in a different cluster at least once through the course of the class. An additional property of such usage is that the figures produced tend to be based on a small number of familiar metaphorical domains. The most common of these structural metaphors was based upon the conceptualization of the class as a journey, although other root metaphors also were used and will be discussed on a class by class basis.

Geology lectures. Many structural figures appeared at the beginning of each lecture, with varying numbers of figures following at some point during the middle of the lecture. Unlike novel topical figures, which frequently occurred in bursts, structural figures tended to be produced alone or in clusters too small to be selected by the CMA procedure. In the Geology lectures, approximately one third of all structural figures were produced in the first 10% of the sentences. In the first lecture, this was followed by a cluster of eight structural figures halfway through the lecture-- around 250 sentences-- and another cluster of 15 figures after approximately two thirds of the lecture-- around 300 sentences. Although these structural figures were produced within a short time, they were not produced with enough density to be statistically defined as a burst.

The majority of structural figures, whether or not in clusters, were coherent with respect to a conceptual metaphor. In the first Geology lecture, there were 21 figures associated with the metaphor, TEACHING IS A JOURNEY; these figures included items such as, "our progress has slowed," "we will go back and review," and "I'm going ahead.... " Sixteen JOURNEY figures also appeared in the second lecture. Six figures in

each lecture also were associated with the conceptual metaphor KNOWING IS SEEING; these included items such as, "we've looked at this before" and "let's look at what this means." Associated with the SEEING metaphor, the first Geology lecture also employed nine figures based on the underlying metaphor, IDEAS ARE OBJECTS. For example, the instructor emphasized that one subtopic was the "cornerstone" of an example and further suggested that students "build connections" between specific concepts.

The second Geology lecture was unique in its use of a structuring metaphor, A CLASS IS A MILITARY MISSION, in which the instructor used six figures to describe the material as a challenging enemy against which instructional "weapons" may be employed, described here by "When I deploy an answer key...I'm on a mission," and "[topics] two and three just died, alright?"

Each of these conceptual root metaphors appeared to serve a specialized function within the lecture. The JOURNEY metaphor was typically used to set the pace of the lecture, to introduce new topics, and to provide a framework for comparing a current topic with one already discussed. The KNOWING IS SEEING metaphor was used for comparisons between topics, but unlike the JOURNEY metaphor, did so in terms of student understanding rather than in terms of the pace of the lecture. The IDEAS ARE OBJECTS metaphor suggested that certain topics could impede the JOURNEY, or that certain ideas could build upon one another to form a greater scientific concept. Finally, the MISSION metaphor was used to prepare students for an examination by suggesting the difficulty of certain materials, the irrelevance of certain topics (those which had "died" and now longer needed attention), and the methods to use (e.g., [to] deploy an answer key).

Mythology lectures. The lecturer in Classics used structural metaphors in a manner similar to the Geology lecturer. Within the first 5% of the sentences in Mythology Lecture 1, the speaker produced 10 structural metaphors (15% of all structural figures), later producing clusters of approximately equal size and duration after 170 and 200 sentences. In the second Mythology lecture, there was a much lower total number of structural metaphors; despite such a low rate, 25% were produced within the first 5% of sentences in the lecture.

As in the Geology lectures, many of the structural metaphors were based on two root metaphors. The KNOWING IS SEEING metaphors accounted for 19 (28%) of structural metaphors in Mythology Lecture 1 and 4 (20%) in Mythology Lecture 2. A portion of these were unique to the Mythology course since they presented mythological characters as individuals the class "will meet" (e.g., "We've already met his sons in yesterday's class.") The JOURNEY metaphor accounted for 31 (45%) figures in Mythology Lecture 1 and 13 (67%) in Mythology Lecture 2. The classics lecturer also employed a unique structuring metaphor, MYTH IS A FABRIC. Based on this metaphor, the lecturer was able to describe "strands leading to the Trojan War," a "wrinkle" in the story, and describing the tempo of a story as one that "takes a little longer to unfold."

Other structural figures. Each lecturer used the JOURNEY and SEEING metaphors to structure the flow and content of the lectures. While these and other coherent metaphors made up the majority of all structural figures, a small number of structural figures of speech-- between 8% and 15% in each lecture-- did not have any apparent connection to other metaphors. These figures were classified as hyperbole,

sarcasm, and/or easily recognizable idioms, all of which served to comment on the lecturer or the class, often in fun, rather than to organize or compare information. For example, the Geology professor joked that he, "failed tree-drawing class" to refer to the quality of a tree drawn on the board and later asked if the class "want[ed] him to be short" when he was concerned about blocking a visual aid. Similarly, the Mythology professor jokingly claimed to be "an idiot" when discovering an error in his materials.

Lecturers sometimes presented structural information in gestures. In each of the lectures described above, gestures accompanied structural metaphors between one and six times (ranging from 5% to 13% of structural figures), in each case presenting an iconic or metaphorical agreement with the verbal figure of speech. In a number of other cases, however, gestures alone were used for structural information. In this situation, the gestures tended to be metaphorical, based on the JOURNEY metaphor: Thus, the speaker pointed to upcoming material or motioned behind or backward to suggest material had been covered previously.

Additional Types of Figurative Language and Gesture Usage

Figurative language has been addressed to this point by its relation to the content of the lecture. Structural figures were generally frozen, produced at an even rate, and coherent with the JOURNEY metaphor whether they were produced within or outside of a burst. Figurative language rated as highly topical tended to be novel, produced in bursts, and coherent only with other figures within the same burst. In addition to these two primary classifications and patterns, there remains the intermediate level of topicality.

These figures described the topic but they were neither coherent nor produced in bursts and were novel less often than those that did appear in bursts. Because they were unrelated to other figures in terms of root metaphors and location within the lecture, these were termed independent figures. Although topical in content, independent figures of speech did not seem as significant to the lecture as those produced in bursts. In this usage, figurative language appears to serve as an adjective or a descriptive phrase; that is, these phrases appear to be largely decorative since synonymous terms are readily available. For example, the Mythology lecturer said, "These Einsteins couldn't figure it out." He might just as easily have said, "These geniuses couldn't figure it out," without sacrificing the meaning conveyed in the sentence. In contrast, figures of speech within bursts did not merely describe the topic, they represented it. It follows that changing a figure of speech within a burst would produce a noticeable effect, including a change in the other figures coherent with it, as well as with the students' understanding of the topic. For example, changing the iced tea metaphor used in Geology Lecture 1 to another beverage, such as water or milk, would produce a different understanding as settling is generally not so noticeable with these examples.

Independent topical figures included common forms of metaphor and simile ("he fell like the coyote in those cartoons") found in the bursts but also included less common types of figurative language such as eponymy ("these Einsteins couldn't figure it out"), euphemism ("he had access to the princess on the wedding night"), litote ("he served his son as a light lunch to the gods"), and zeugma ("He won the race and her heart"). Each of these examples were rated as topical, but at an intermediate level since it appeared to be a

decorative description rather than an attempt to represent the topic in a different or more revealing way.

Independent figures of speech tended to be rated at the intermediate level of topicality. It was not possible to rate gestures at three levels of topicality since the gesture represented or referred to either a topic or the lecture itself in all cases. There were distinct types of gestures, however, within the classification of topicality; those that occurred within bursts and the independent gestures that occurred outside of bursts. Relative to those in bursts, independent gestures were less coherent and produced were surrounded by longer intervals without gesturing.

CHAPTER 4: DISCUSSION

Most research to date has treated figurative language and gesture separately, focusing on one or the other aspect of communication. Previous findings (e.g., McNeill, 1992; Corts and Pollio, 1999), however, suggest that gestures have a good deal in common with figurative language: Both serve to make the abstract concrete and the unfamiliar familiar, to emphasize important topics and, finally, to contribute to the ongoing structure of the discourse. In the present study, these properties were evaluated by examining the functions of figurative language and gesture and their varying rates of production in different sets of college lectures. The works cited above, combined with research in education (e.g., Duit, 1993) and in the cognitive sciences (e.g., Lakoff & Johnson, 1980; 1999) challenge the traditional notion that figurative language and gestures are no more than decorative ways of communicating. In the case of metaphor, they offer an alternative view of figurative language as a conceptual rather than linguistic phenomenon. Similarly, gestures are treated as a part of language, and they too may be seen to reflect conceptual activity. In this light, figurative expression in speech and gesture are a vital part of teaching and learning, domains in which communicating and thinking about complex ideas are among the primary goals.

A Comparison of Current Results with Previous Research

The present study is an extension of Corts and Pollio (1999) and therefore current results may be viewed most profitably with respect to past findings. Perhaps the most notable observation linking both studies is that figurative language and gestures both have

a relatively even rate of output throughout the course of a college lecture. Despite this general tendency for both modes of communication, there were several segments of the lecture during which the rate of figurative language and/or gesturing increased before returning to its basal output rate. The fact that each lecture kept a somewhat consistent pace-- aside from these bursts of figurative language and gesture-- makes it tempting to assume that there is an average, relatively stable rate of production for lectures or lecturers in general. This conclusion does not seem to be warranted, however, as there were differences in average rates and total output between the two instructors in the current study and between these instructors and the professor evaluated in Corts and Pollio (1999). Moreover, each lecturer produced figures and gestures at different average rates from one lecture to the next. On this basis, it seems clear that figurative language and gestural output are not determined solely by the communication style of the individual professor nor by the subject area in which he or she lectures, although both are likely to influence figurative language and gesture production.

In addition to these trends in output rates, it seems useful to view the college lecture as defined by two different streams of communication: (1) the topical, in which the primary concepts, images, analyses, and arguments are presented, and (2) the structural, in which the topical stream is maintained in manageable order. It is important to note that across all three lecturers in both studies, 75% of all figurative language bursts concerned the topical stream. In terms of gestures, approximately 50% of the gestural bursts concerned the topical stream. Before generalizing these results, it is important to realize that the majority of the lecture is spent in the topical mode, thereby providing less

opportunity for structural bursts to occur. It would be difficult to quantify the time spent in the structural mode since structural information, almost by definition, appears in small segments separating longer periods of topical information. What is possible at this point is to examine differences between figures and gestures in terms of the attributes that have just been described; whether they addressed topical or structural information and whether they occurred in or outside of the bursts.

Structural Figures of Speech and Gestures

The JOURNEY metaphor. Across all lectures in both the current study and in Corts and Pollio (1999), structural figures of speech tended to be frozen and were widely dispersed throughout the lectures. Structural figures of speech tended to be based primarily on a JOURNEY type metaphor which characterized the lecture as a guided tour through a series of ideas. Structural figures were produced most frequently at the beginning of each class, and appeared to provide advance organization by previewing what would be discussed during the lecture. Throughout the remainder of the lecture, items deriving from the JOURNEY metaphor occurred one or more times, usually marking a transition from one topic to another. Items deriving from this metaphor appeared in both of the current lectures and in the previous study without receiving any special attention from the lecturers, thereby suggesting such figures and their derivatives were indeed cliched. Reliance on the JOURNEY metaphor also suggests that it may be useful to the class to use such figures, although this could not be directly evaluated in the current study.

Structural figures sometimes occurred in bursts; these bursts accounted for one-fourth of all figurative language in all three lecturers in both studies. When these bursts occurred they invariably were characterized by a transition from one topic to the next, as was the case with most structural figures occurring outside of the bursts. These specific transitions usually involved mention of previous segments of the lecture, e.g., "This is different from what we've seen so far," the forthcoming segment of the lecture, e.g., "you'll see that in a minute in a minute," and that segment of the lecture in which the class now rests, e.g., "We're now in the position to tackle the Trojan War." These elements were identical in content and function to structural figures found outside of bursts, with the exception that these bursts, by definition, involved an unusually large series of such phrases. Such a change in output rate seems to have been determined in part by the lecturer presenting a set of comparisons between two portions of the lecture. While this was sometimes presented with little figurative language, at other times the lecturer structured the comparison by comparing what had been "seen" to what "will be seen."

Gestures also occurred within the structural stream and, for the most part, involved deictic gestures referring to the class or the classroom; this was the case in both the present and prior studies. Each of the lecturers also produced gestures based on the JOURNEY metaphor. These gestures presented spatial aspects of this metaphor; in other words, the hands acted out portions of the spatial dimensions of the lecture. Typically, this involved having previously discussed material "behind" the professor with forthcoming material in "front." Structural gestures also sometimes appeared in bursts; in these cases,

they marked a particularly long transition in the same manner that figures of speech had been observed to do.

Other structural figures and gestures. To this point, figurative language and metaphorical gestures found in the structural stream have been related to the JOURNEY metaphor. This metaphor appeared to be significant because it allows topics to be characterized as objects and the presentation of the ideas as moving past these topics or objects. This is a somewhat common way of describing any temporal event (Lakoff and Johnson, 1999); for this reason, such metaphors were rated as frozen. In two cases, both within the Geology lectures, alternative root metaphors appeared in the structural stream. In these cases, both alternative figures remained spatial in nature. For example, the Geology professor employed the conceptual metaphor, CLASS IS A MILITARY MISSION, which included "being on a mission" and "killing" topics. Although "being on a mission" does imply covering ground, the major emphasis seemed to be that the concepts were difficult to learn. Thus, concepts in both the JOURNEY and MISSION metaphors were treated as physical objects, and the lecture was treated as moving forward. The primary difference between these metaphors concerns whether the students "grasp" the ideas or "attack" them. While the JOURNEY metaphor was common, appearing in each of the four lectures in evaluated in the present study (and those lectures studied by Corts and Pollio, 1999), the MISSION metaphor was used primarily by the Geology professor (although it is similar to a figure in Mythology: "We are now in a position to tackle the Trojan War.").

Another alternative to the JOURNEY metaphor was the root metaphor of CLASS IS A TELEVISION PROGRAM, e.g., "This mineral will make a guest appearance later on in the lecture." This metaphor was produced in a Geology lecture and tended to be used in the same way that other structural metaphors were used with the exception that it occurred only four times and only within a single lecture. As in the case of the JOURNEY and MISSION metaphors, figures deriving from the TELEVISION metaphor appeared to provide a familiar spatial image for the lecture; namely, that college lectures are like television programs.

There was one final classification of structural figures noted in the current study that was not addressed in the Corts and Pollio study (1999). These figures focused on the lecturer rather than the class and did not seem to play a vital role in ordering the presentation of topical material. Instead, such figures mostly consisted of self-deprecating humor and provided both excuses and corrections for errors made by the lecturer, as well as a chance for the lecturer to lighten the classroom atmosphere. Because these phrases were humorous, and tended to occur around errors, then they did not appear to be based on the same types of conceptual metaphor as the JOURNEY or related metaphors. Humorous remarks appeared to function by contrasting the ideal lecturer-- one who knows all and presents the material perfectly-- with the real professor who had just committed a rather obvious blunder. These phrases included quips regarding speech (e.g., I can't talk today), drawings (e.g., I failed tree-drawing class in kindergarten), and misprints (e.g., Don't look at this-- I'm such a moron!). Data from the Corts and Pollio study indicate that, while the Psychology professor did commit errors, he simply corrected

himself and continued with the lecture. The use of humorous figures of speech appeared to be an area in which personal styles influence what is said more than content.

Summary of structural figures. The production of structural figures appears to be based on the ability of a figure to represent class topics as objects and the lecture as a process of encountering these topic/objects through seeing, touching, or confronting them. The JOURNEY metaphor accomplishes this and, in addition, provides a generic framework to discuss any idea, whether it concerns topics in Mythology, Geology, or Psychology. Figures not only present the lecture in physical terms but, by doing so, make the task of referring to other portions of the lecture simpler. The speaker may refer to what has been seen or encountered without recapitulating specific details-- this purpose may even be accomplished by gesturing towards what has been covered or towards material that is forthcoming. Finally, the simplicity of these figures does not render them conceptually inactive. Instead, they may be produced individually without any explanation as to their meaning, allowing the instructor to "move on" to other topics. The result of such use is that bursts tend to occur less often in the structural mode than in the topical mode. When such bursts did occur in the structural mode, they did not appear to represent a special type of speech or a special purpose; instead, they simply represented an increase in the same the types of figures and were used to cover a more significant or complicated transition between segments of the lecture.

Topical Figures of Speech

Topical metaphors within bursts. Structural figures of speech and gestures typically were frozen and most often based on a single, well-known root metaphor, regardless of their location in or outside of a burst. This is presumably because they all related to a single topic: the nature of the ongoing lecture. Topical figures, however, addressed a wide variety of concepts and issues and, therefore, involved a greater number of root metaphors. When bursts occurred in the topical stream, each figure within the burst tended to be related to a single conceptual metaphor that served to characterize the topic under consideration. Despite an extensive list of conceptual metaphors compiled across both the present and prior study, there were no cases in which the root metaphor from one burst was applied to another concept, suggesting an unique relationship between figures in the burst and the concepts they addressed.

In the Mythology lecture, as well as in the Psychology lectures studied by Corts and Pollio (1999), the most common type of topical burst was one in which an abstract concept was described in terms of a concrete object or familiar act; for example: AGING IS AN ATTACK, from a Psychology lecture, or STORIES ARE RECIPES from the Mythology lecture. It was also common in these lectures to present abstract relationships in terms of a more familiar relationship such as: "Literature reflects the world, it doesn't generate it" from Mythology and "Drug abuse is a complicated social game, not a social disease " from Psychology. It is interesting to note that, in terms of relational metaphors, the lecturers included alternative conceptualizations of the relationships in the explanation (e.g., the subject is not A) before presenting his own metaphor (e.g., the subject is B, not

A). Although this was observed in both examples, it is not clear that this is a necessary condition for producing this type of figure.

Topical bursts also occurred in the Geology lectures, although the subject matter here tends to deal with physically real objects rather than with abstract concepts or ideas. Therefore, the results of the Geology lecture contribute new information beyond those provided by the Mythology or Psychology lectures. When the concepts in a Geology lecture were of an imperceptible scale-- spatially or temporally-- they were usually rendered in more manageable and more familiar terms through a burst of metaphor or analogy. Examples of this type of figurative burst included the description of chemical reactions as sugar in iced tea, geological weathering as an abandoned car, and various geological forces as downhill skiing, ball bearings, roller coasters, and a tilted deck of cards.

Figurative bursts produced by all three lectures share several traits in common with one another: (1) each burst served the function of making the unfamiliar more familiar (2) each burst used objects, events, and relationships that are commonly understood, and (3) each burst used metaphoric vehicles capable of being understood in terms of some sort of spatial image. These bursts may be seen to differ, however, in terms of the significance of the metaphorical vehicle in representing the concept. For example, it would be difficult to create new metaphors with meanings identical to "Aging is an attack" or "Literature reflects the world." It would not be difficult, however, to generate related metaphors from the conceptual roots of these figures. When considering the Geology lectures, however, it would seem easier to create alternative metaphors for physical objects than is the case for

abstract concepts. A deck of cards could be represented as a stack of books, dishes, or just about any other physical object that might slide in a similar manner. Therefore, it appears that a topical burst expresses single concept in terms of a single root metaphor. For bursts describing abstract concepts and relationships, concepts are understood through metaphor, and the particular metaphor used appears essential to the understanding of the topic. With metaphors for physical phenomena, however, the metaphor may be an efficient way of conceptualizing the topic, although the understanding does not appear to be as restricted to the conceptual vehicle used to instantiate the central metaphor.

Topical metaphors not in bursts. When topical figures of speech occurred outside of bursts, they were much less likely to be coherent with other topical figures in the same lecture and less likely to be novel. Because these topical figures appear to be independent of other figures, rather than coherent with them, they do not appear to have the same level of impact on the lecture as was found among the coherent figures produced in bursts. As noted in the results section, independent figures could be replaced with other expressions, figurative or literal, that were perfectly synonymous. Within topical bursts, however, this was not the case: A change of figures would change the meaning of the expression. In addition, topical figures of occurring speech outside of bursts were less likely than figures in bursts to be metaphors or similes; instead, they included cases of metonymy, hyperbole, euphemism and other types of figurative language.

Factors Contributing to Figurative Language Bursts

A number of characteristics differentiate between figures within a topical burst and those produced outside of it. Figures in a topical burst are generally novel and more likely to be coherent than those not in a burst. In addition, they employ analogies and metaphors more often than other categories of figurative language. Finally, figures contained within a topical burst, being generated from a common root metaphor, usually appear essential both to the presentation and understanding of the topic being presented.

Each of these characteristics contributes to an increase in the production rate that defines a burst. Because the figure is essentially the conceptualization of the topic, three conclusions follow: (1) Because the metaphor is a concept, rather than a decorative manner of speaking, it is important for the class understand the metaphor; therefore, the lecturer will spend more time on that topic. If the metaphor were simply decorative, it would not require as much attention from the lecturer. (2) Because the topic is understood through metaphor, the concept is described in terms of that metaphor; using an alternative metaphor would change the understanding of the concept. Therefore, only figures coherent to the root metaphor will be presented. (3) Because the topic is being introduced to students, it is not likely that the topic is already well-understood. Therefore, the figurative language will be novel. As a result of the time spent on the concept and the metaphoricity of the concept, the speaker will produce a burst of topical and coherent figurative language.

For a burst to be identified by the CMA procedure, it need not be coherent, novel, or topical, rather this procedure simply identifies a quantitative increase in production to a

rate much higher than normal. As the results indicate, however, the more concrete topics in the lecture do not generate figurative language in this way and the periods of the lecture in which these concepts are described are not identified as bursts. When the lecturer encounters an abstract or challenging concept, these sentences will stand out as a burst against the ground provided by the less metaphorical portions of the lecture. For the most part, it appears to be the conceptual understanding (and coherence) of a topic that explains the increase in production rate. Topicality and novelty are significantly more likely to be found within bursts but a number of structural, frozen have been observed.

Finally, it is important to note that there is a difference between the types of figurative language bursts described in the topical and structural streams. Topical bursts appear to be a change in the type of figures produced, but the change appears to begin at the conceptual and not linguistic level. This is because the duration of the burst occurs in direct relation to a topic: It begins with the introduction and definition of the topic and continues until the speaker changes to a more literal presentation (e.g., providing statistics or examples to the class). In addition, topical bursts are largely coherent with a single root metaphor for that topic and cannot be replaced with another metaphor. Therefore, each of these changes in the description of figurative language may be tied to a conceptual metaphor. Structural bursts, on the other hand, do not change in type from other structural figures. Instead, they tend to remain frozen, serve the same purpose, and focus on the same topic-- the lecture itself-- inside and outside of the burst. Structural bursts merely define a brief period of increased production rate using the same language and serving the

same purpose, unlike topical bursts, they do not define a shift in the manner of thinking or speaking.

Gesture production in the topical stream. When topical figures of speech are produced in bursts, there is a noticeable change in the type of figures produced and not just their quantity. Topical gestures, however, do not always change in type during a burst. This may be due in part to the fact that figurative language bursts relate to a fundamental root metaphor. Reducing gestures in an analogous manner is only possible with metaphorical gestures. Bursts of gestures generally represent a number of different objects and events and, therefore, do not have a common conceptual background. Iconic gesture bursts do tend to revolve around one specific topic-- a set of objects or series of events-- although this would not be identifiable without speech, i.e., by gesture alone.

Perhaps the best way to describe a burst of gestures is to note that they are useful for representing spatial information, including shapes and motions of real or abstract objects, events, and directions. When a burst of gesture occurs, the speaker seems to be addressing a topic that involves a great deal of spatial information that needs to be maintained in order to produce and/or comprehend the meaning. It is interesting to note that bursts of gestures occurred not only in terms of spatial representations of physical objects and locations but also in combination with bursts of metaphor. Structural and topical metaphors both operate by describing abstract or otherwise non-perceptible concepts in more manageable spatial terms. In cases of analogies for physical topics (such as occurred in the Geology lectures), the gestures may be seen as representing the topic or the vehicle of the metaphor. In cases of structural bursts, and especially in cases of

abstract and relational bursts, however, any spatial representation would almost certainly concern the metaphor vehicle since the topic usually has no spatial form of its own. In no cases of metaphorical speech-gesture overlap was there a contradicting metaphor produced by the hands.

Addressing the Larger Issues

Present results indicate a relatively stable pattern across three different lecturers, particularly in terms of the properties of figurative language and gestural bursts. Although teaching within similar formats, each instructor seemed to bring his own unique communication style and pedagogical techniques to the classroom. It is, therefore, reasonable to assume that the patterns found in figurative language and gesture production reflect the nature of communication and/or thought rather than the individual styles of the three lecturers. Instead of simply describing patterns of output, these data may be related more directly to some of the larger issues concerning language, gesture, and thought within psychology and education. These topics will be addressed in the following section.

Frequency of figurative language One of the assumptions of early linguistic research was that figurative language is an infrequent and unusual way of speaking. The present series of results (of the current study and those of Corts & Pollio, 1999) speak directly to this issue and indicates that figurative language is actually quite frequent. Perhaps this difference between earlier assumptions and current evidence may be attributed to varying definitions: The current study included as figurative many phrases and words that were deemed "frozen" or "dead" metaphors. Far from being dead,

however, Lakoff and Johnson (1980; 1999) have demonstrated that such phrases are active elements of language and, in fact, have heuristic functions. For this reason, frozen figurative phrases were included in the present analyses. A close examination suggests that the traditional definition of metaphor is most similar to what has been identified as bursts in the present study; a relatively noticeable, and extended, novel metaphor. Occurring about two to five times in an hour of lecture, bursts of this type, or may not, be considered an infrequent type of speech depending on one's definition of frequent. With an average value of 3.5 for the 40 sessions of a college class, 140 novel metaphor bursts may be expected over the course of the class. With four classes a term, a student may be exposed to 560 developed metaphors in a semester, and 4480 over an eight-semester college career.

Figurative language is not a distinct kind of language. Related to the definition of figurative language is the idea that literal and nonliteral are distinct categories of meaning. In the present study, this distinction was considered in terms of the following three categories: literal language, frozen figurative language, and novel figurative language. Among claims proposed by traditional views of metaphoric comprehension and production are that: (1) Frozen figures are essentially dead metaphors; phrases that once were metaphorical but through repeated usage, have become clichéd. (2) Frozen figurative language is therefore understood like any other word because it is just another lexical entry. (3) Frozen figures of speech should be categorized and treated as a type of literal language; that is, as any other word with a relatively fixed meaning. Based on production rates in the current series of studies, there are indeed noticeable differences between the

types of figures found in bursts (i.e., mostly novel, topical, coherent figures) and those found outside of bursts (i.e., typically frozen, and more often structural and/or non-coherent). There also are cases in which "dead" metaphors seem very much alive. Corts and Pollio (1999) present the example of an extended description of "THE MIND IS A PHYSICAL STRUCTURE," in which the speaker described the deterioration, flexibility, and restoration of the mind during senility. In the second Mythology lecture, there was the claim that, "literature reflects the world, it doesn't generate it." Both of these examples indicate that even somewhat common phrases may be expanded, both in language and in gesture, based on their underlying conceptual metaphor. In other words, these phrases may become "unfrozen" and used to present concepts in a fresh and innovative way.

While frozen metaphors may become novel, novel metaphors may seem frozen at times. When introduced to the class, topical, novel gestures tend to be produced in a burst and this burst affords an opportunity to understand the metaphor more fully. Once the metaphor has been expanded, however, the speaker may then refer to it as if it were as frozen and, therefore, similar to other idioms and clichés in the language. For example, the psychology professor evaluated in Corts and Pollio (1999) created a figurative burst based on the conceptual metaphor of "AGING IS AN ATTACK." Later in the lecture, he simply referred to the "attack of old age." Similarly, the Mythology lecturer referred to his earlier metaphor by reminding students that "Literature reflects the world."

In these examples, it is as if novel figures have become frozen and frozen figures have become novel (at least in the present contexts). Either way, it is seems as if the properties of figures within and between bursts do not define vastly different types of

language, but different conceptual or pedagogical needs. It may be possible to generalize this understanding of figurative language by extending it to the a sample of literal language; a sample which, had been rated literal and therefore excluded from the analyses. In one example of this type, the speaker was tracing a contemporary English word to its Greek roots, saying, "within the word intoxicated, is this word, toxin, which means poison. So in the very word we use, we say that to be intoxicated is to be poisoned." It would be unusual to claim that "intoxicated" is a non-literal term in this phrase and, in fact, it was not selected by raters in this study as figurative. The production properties surrounding this word, however, operate in the lecture very much in the same way as items in a metaphoric burst; the word is presented, described, and its implications then developed and discussed. As a result, the class is then able to understand "John was intoxicated" as "John was poisoned;" certainly a more figurative and provocative phrase than the original version. These output properties may be interpreted to suggest that the distinction between literal and nonliteral is better described as one of degree. It also may be profitable to treat such distinctions as the difference between usual or unusual uses of a word as well as of the novelty of understanding permitted.

Is figurative language decorative or is it conceptually useful? Along with a change in the definitions of what is literal and what is figurative, the roles of figurative language in discourse have become more apparent. Traditional ideas, such as the paraphrase theory, suggest that figures of speech are simply decorative or more roundabout ways of saying what was literally meant. Results of the present set of observations indicate that while this

may be true some of the time, there are certainly other uses of figurative language that appear essential to a specific understanding of the topic being considered.

To understand the difference between ornamental language and conceptually useful metaphor, it is perhaps simplest to view items in a figurative burst as conceptually significant and single topical figures (outside of bursts) as "just interesting" ways of speaking. For example, the Geology lecturer, along with his class, described a chemical process (Bowen's reaction series) as a glass of sugary iced tea. This rendition allowed for several parallels to be drawn between the sugar in the tea and elements in the earth's mantel. Similarly, when the Psychology lecturer (Corts & Pollio, 1999) described "aging as an attack", he would have produced quite different results by saying, "aging is a fight." In these cases, the specific metaphors used would seem intrinsic to the lecturer's understanding of the topic: A change in either metaphor would have lead to a quite different understanding.

This is not to say that all figurative language is conceptually essential. In many cases, the lecturers used a figure that was not coherent with other figures and did not appear in a burst (e.g., "These Einsteins couldn't figure it out"). In such cases, the phrase included a variety of different categories of figurative language (eponymy, litote, etc.) whereas bursts largely contained metaphors and/or analogies. More significant, however, is the fact that these types of figurative language only describe the topic whereas figures occurring within bursts often <u>are</u> the topic. This may be demonstrated by changing the figurative element of the phrase to another figure (These <u>rocket scientists</u>...) or a literal paraphrase (These <u>geniuses</u>...). It seems that such non-burst phrases are not central to a

conceptual understanding, but instead are produced because they are more interesting ways of speaking.

Gestures are also conceptually useful. Gestures often have been characterized as ornaments in much the same way as figurative language. They, too, are sometimes described as a sort of "paraphrase"-- simply an iconic representation of what is described in language. Such claims seem only partially accurate since results of the present study indicates that gestures are much more active in the communication of ideas, particularly those involving complex shapes and motions. Results also indicated that gestures are not always a simple representation of what is in speech, thereby suggesting that the hands do more than merely decorate and/or reiterate the spoken message. For example, the Geology professor used gestures to describe people "cramming into a phone booth." The specific verb used in this figure suggested either a great deal of force was involved or that something might happen because of the pressure. In its verbal form, it was not exactly clear which consequence was intended; the walls bowing outward or the ceiling being forced off from the pressure within the booth. The correct interpretation, however, was readily apparent when the speaker used his hands to indicate the weight bearing down. Thus, the intended meaning may be seen quite easily through the combination of gesture and speech-- namely, that the rocks were being compressed from above.

Results such as these suggest that gesture does not simply paraphrase or decorate, but takes an active role in communication. There are cases, however, where it is true that gestures paraphrase what was said. In the case of the previous example, the speaker could have verbally described exactly what he intended. Gestures, however, appear to shorten

the presentation and free the speaker to continue his description without pausing to explain the direction of the force. This role of gesture would appear to apply to any spatially complex information, especially in deictic information. In such cases, it is simpler to point in one direction while describing a topic than to stop the presentation and linguistically indicate the location of an object.

Do gestures require a separate computational stage? To describe gestures as iconic paraphrase or an ornament is to ignore the complexity of this behavior. Such simplified descriptions are often accompanied by the belief that gestures are generated by a secondary cognitive process or computational stage derived from the language system (a system which is believed to be primarily vocal). The fact that gestures are not limited to paraphrases of spoken language suggests that they must have some sort of access to the intentions of the speaker, thereby leading to the possibility that gestures and spoken language are similar in origin. Moreover, gestures frequently present metaphors, at times without any accompanying figurative language. One of the most common examples is the CONDUIT metaphor, a widely used metaphor for communication in the English language (Reddy, 1979) and one which has also been used in the case of gesture (McNeill, 1992). This metaphoric gesture was used by each lecturer in the current study and in Corts and Pollio (1999). It may be described as a gesture in which the speaker is emphasizing the act of communicating itself. In words, this often appears as "trying to get this across;" in the hands, it is often produced by holding a cupped hand and moving towards the listeners. In some cases, the speaker produces the gesture but does not vocalize the metaphor, such as the Geology lecturer saying, "Is this making sense?"

Figurative language and gesture in education. The theme unifying each of the arguments in this paper is that although figurative language and gestures are manifest in communication, they are also functional parts of thought. The analysis indicates that both create images, abbreviate speech, and contribute to the overall structure of the lecture. The two roles that seems to be most integral to the figure-gesture relationship, and the roles that makes them conceptually significant, is the manner in which they give spatial form to ideas that have no spatial extension, by which they provide familiar models for objects and events typically beyond the experience of undergraduate students. Because these are conceptual functions rather than linguistic, it seems likely that such behavior would be useful in other educational contexts where the goals are to develop new and challenging concepts.

It is not possible to evaluate the pedagogical effectiveness of the metaphors produced in these lectures given the current design. Based on the results of previous research (see Duit, 1993 for a review), it appears that metaphors may serve as useful memory aids and heuristics when students have appropriate background knowledge. It does appear that metaphors were produced somewhat in accordance with the model described by Duit in which the metaphor first was presented and parallels were drawn between the topic and the vehicle of the metaphor. The presentation style in each of these lectures differed from Duit's model, however, since each professor did not necessarily point out where the metaphor might be inappropriately applied. This is an interesting finding as two of the lecturers, when debriefed, indicated that they had no instruction in the use of metaphors or analogies (the third one did not address this issue) yet they

approximated the model to a large extent. Specifically, this was accomplished during the bursts of figurative language in which metaphors with the greatest conceptual significance were presented and dealt with in the greatest detail.

Conclusion

There is a long-standing tradition in academic research to draw clear boundaries between the rational and the intuitive; between the literal and the figurative. In the present study of language use, this tendency is most clearly manifest in the distinction between vocal and manual communication. In the study of cognition, this bias has translated into a division between research in thinking and language. Throughout much of the earlier research, there was a decided emphasis on the rational and a decided subordination of figurative activity of any sort, spoken or gestured. Recently, however, a number of researchers have begun to challenge such distinctions as artificial. McNeill, for example, has suggested that languages have typically been studied as they are written and not as they are spoken (1992). As a by-product, gestures have been dismissed as a non-linguistic process; a claim McNeill has been instrumental in challenging. At the same time, Lakoff and Johnson (1980; 1999) have argued that metaphor should not be treated as an unusual manner of speaking or as a subservient component of a rational linguistic system. In fact, they have argued that metaphor serves an integral function within an embodied conceptual system.

This present research is not intended to oppose rational thinking or literal language. Instead, its purpose is to address the claims that categories such as literal and

non-literal are psychologically distinct. In natural use, the difference is not at all clear at times. In addition, present results suggest that relations between speech, gesture, and thought are more integrated than previously thought. The emphasis on literal rationality are challenged to some extent since figurative communication appears to be conceptually useful at times when literal language will be more difficult to produce or comprehend. Finally, these topics were addressed through the study of language in the specific context of the college lecture. In this context, figurative language and gestures are given the opportunity to be conceptually useful, an opportunity not afforded to them by more typical laboratory or analytical approaches to language.

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APPENDIX

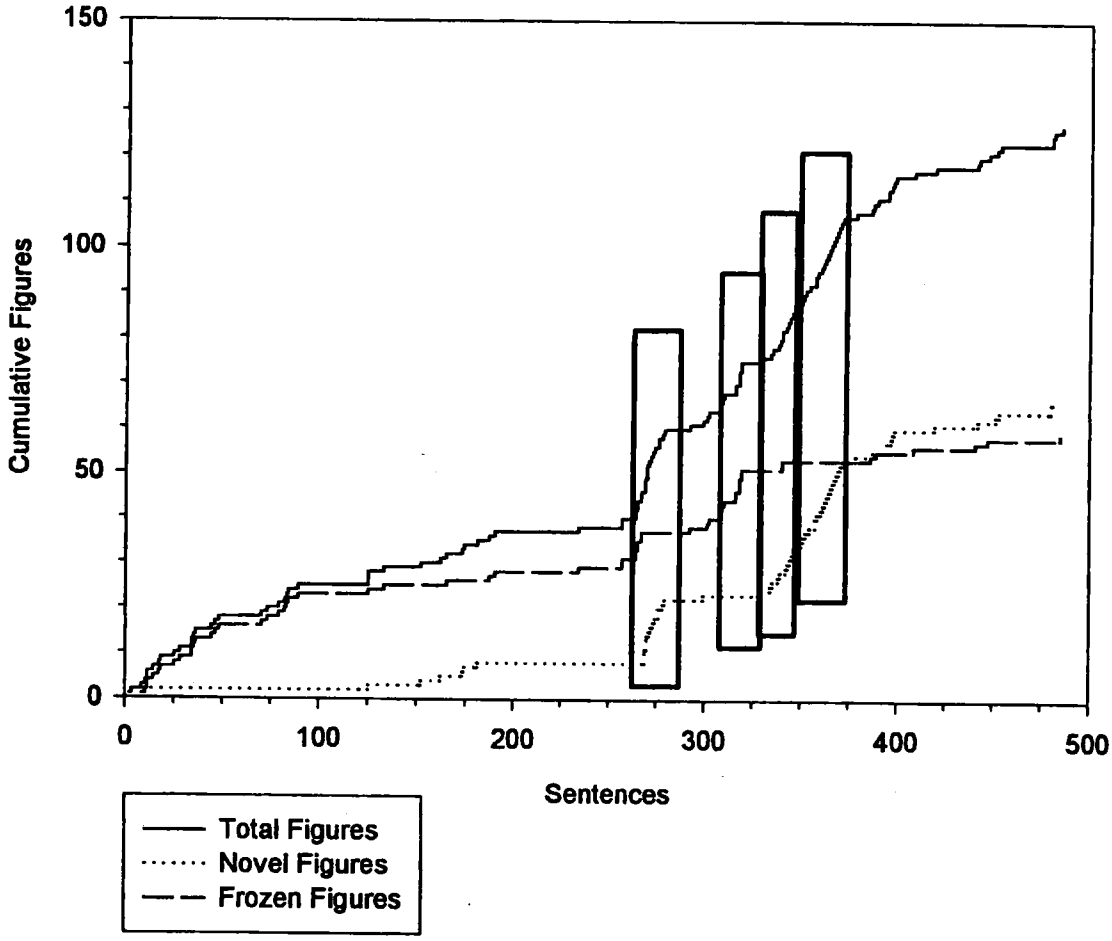

Figure A -1: Cumulative Figures of Speech in Geology Lecture 1.

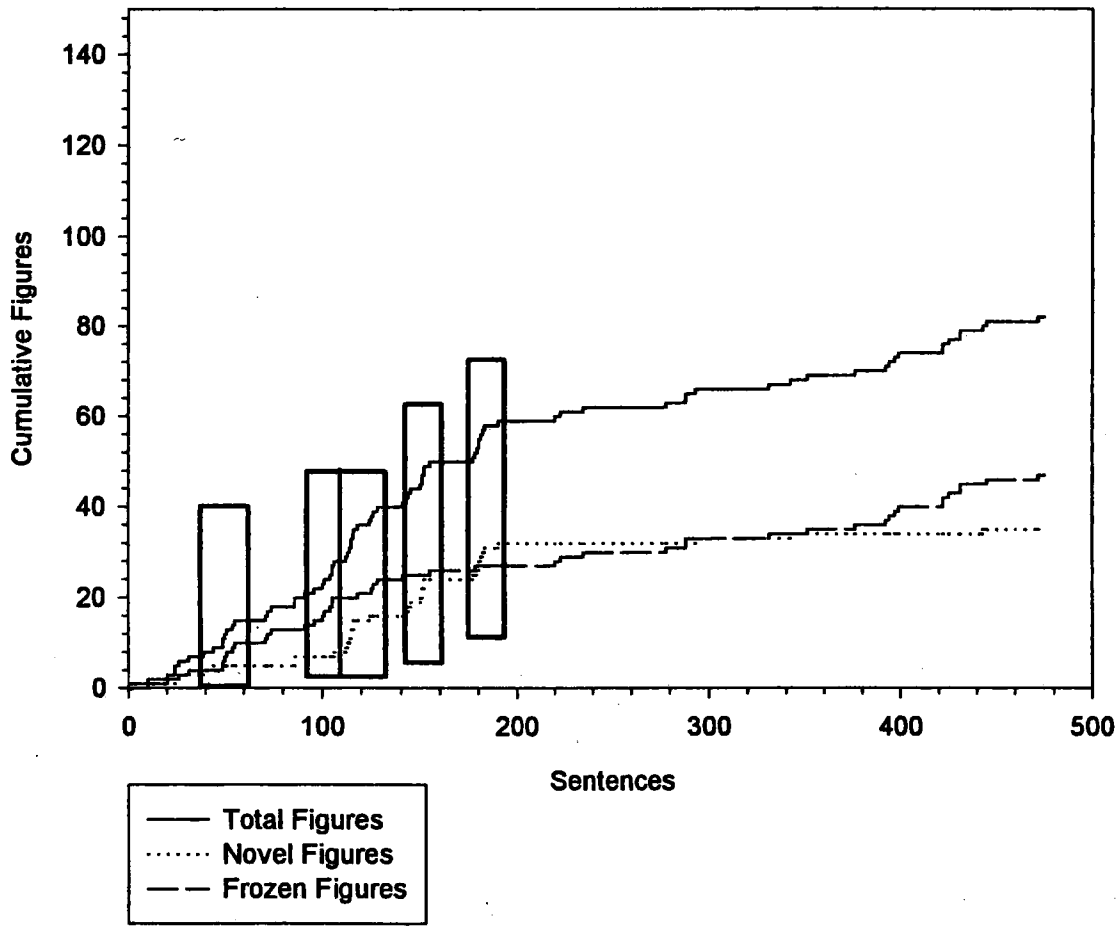

Figure A - 2: Cumulative Figures of Speech in Geology Lecture 2.

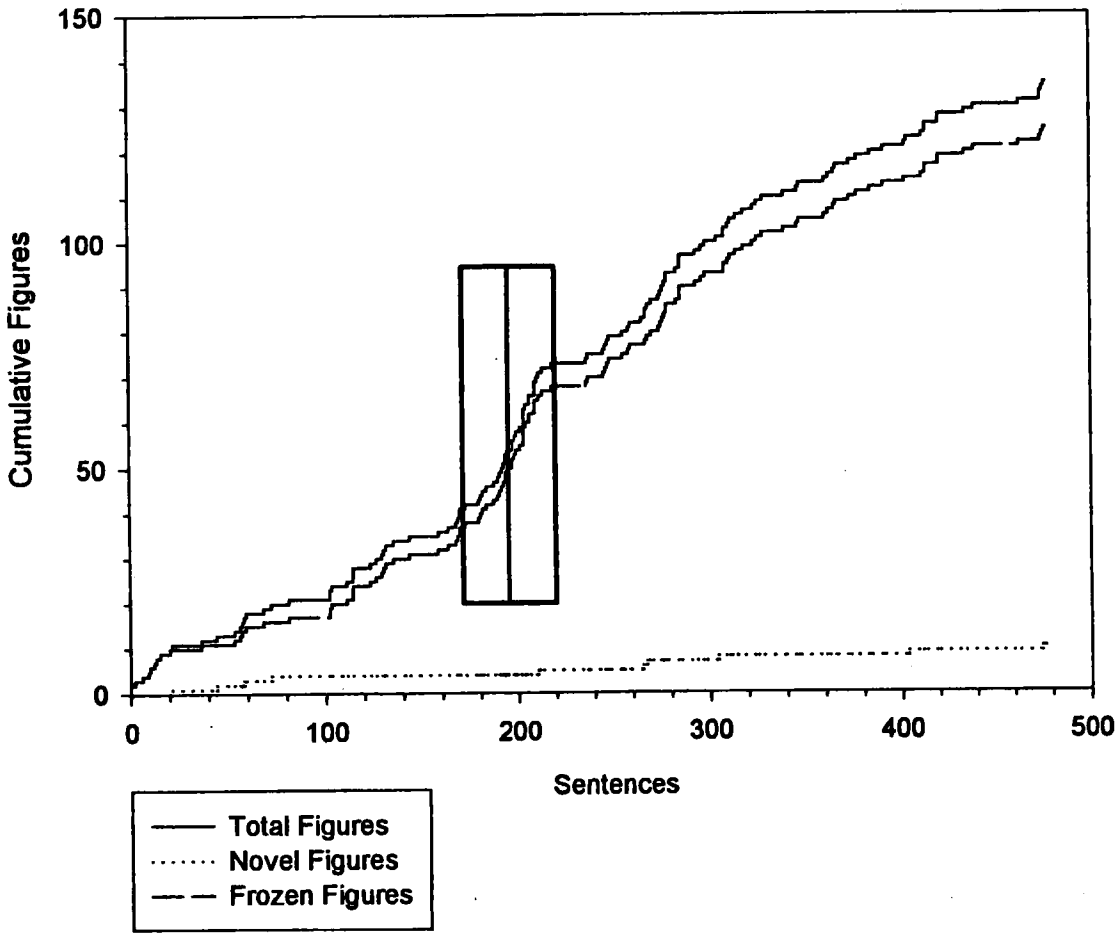

Figure A - 3: Cumulative Figures of Speech in Mythology Lecture 1.

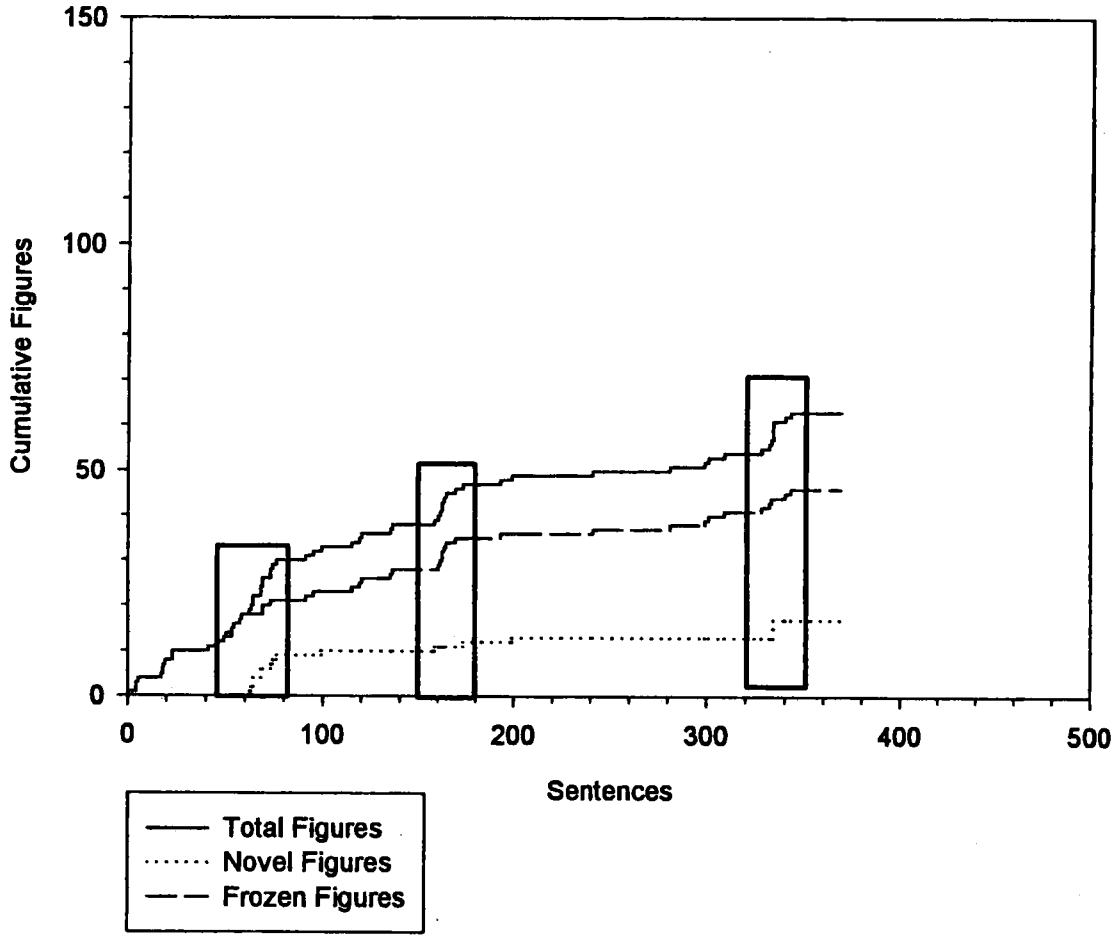

Figure A - 4: Cumulative Figures of Speech in Mythology Lecture 2.

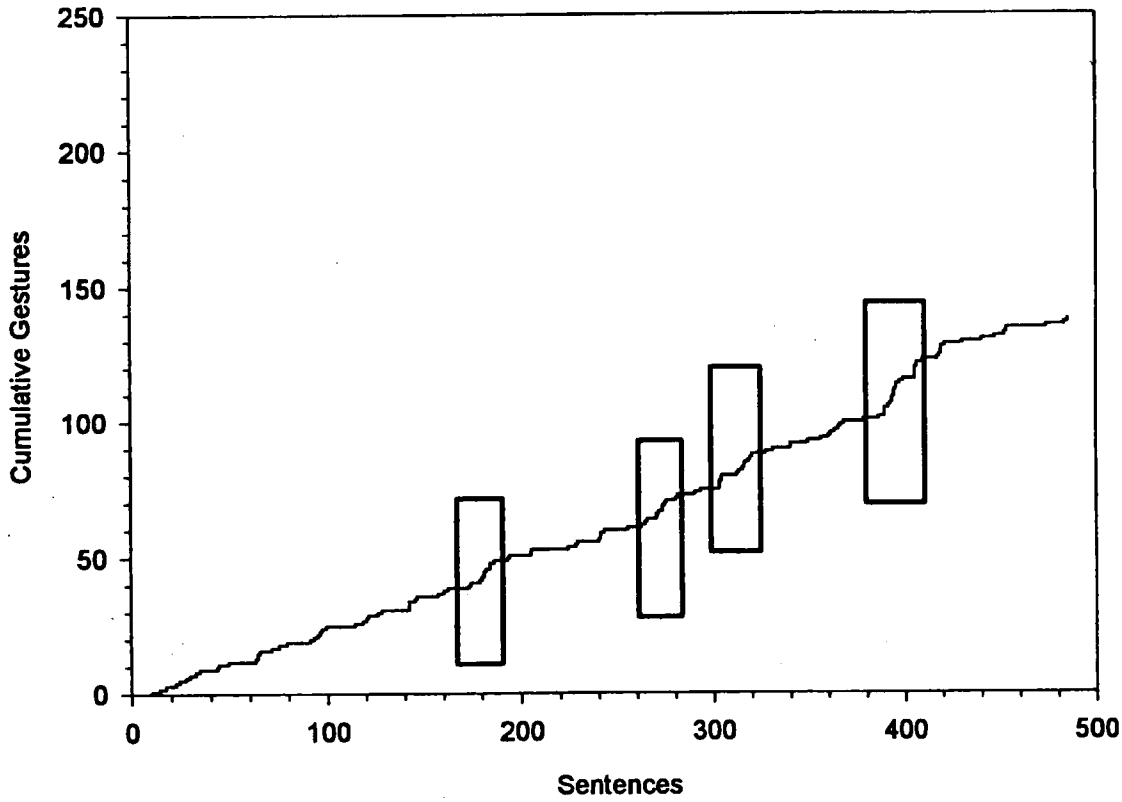

Figure A - 5: Cumulative Gestures in Geology Lecture 1.

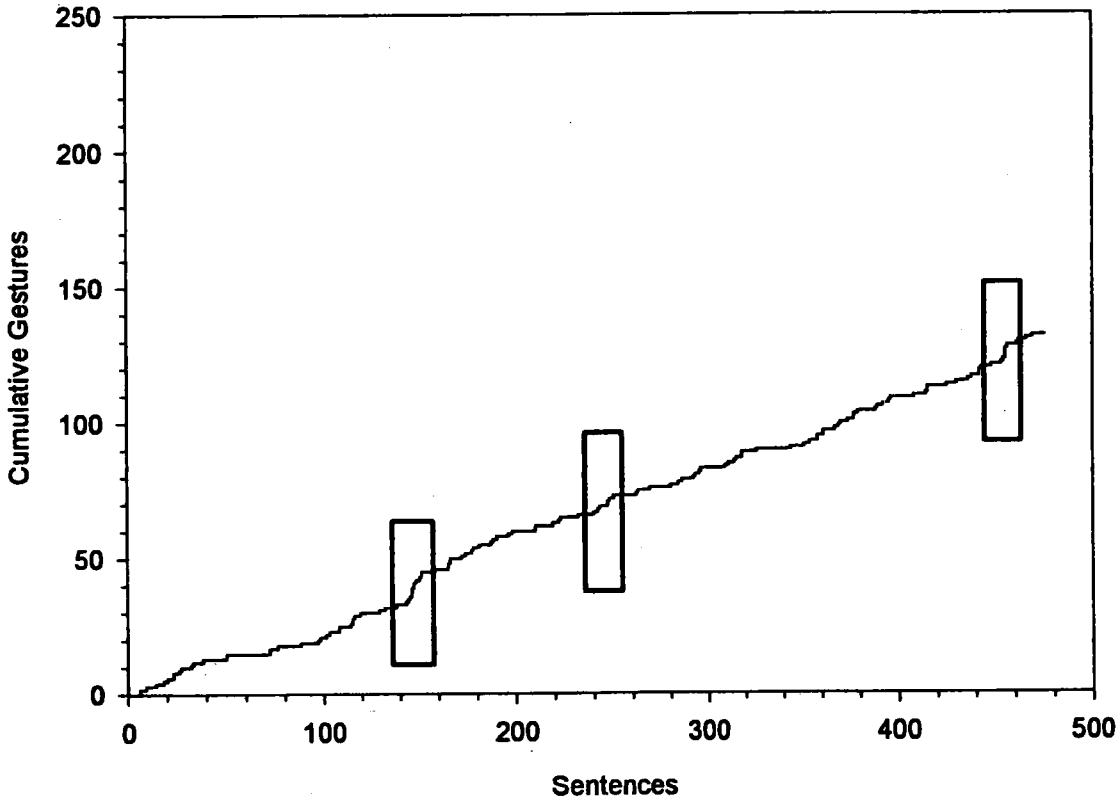

Figure A - 6: Cumulative Gestures in Geology Lecture 2.

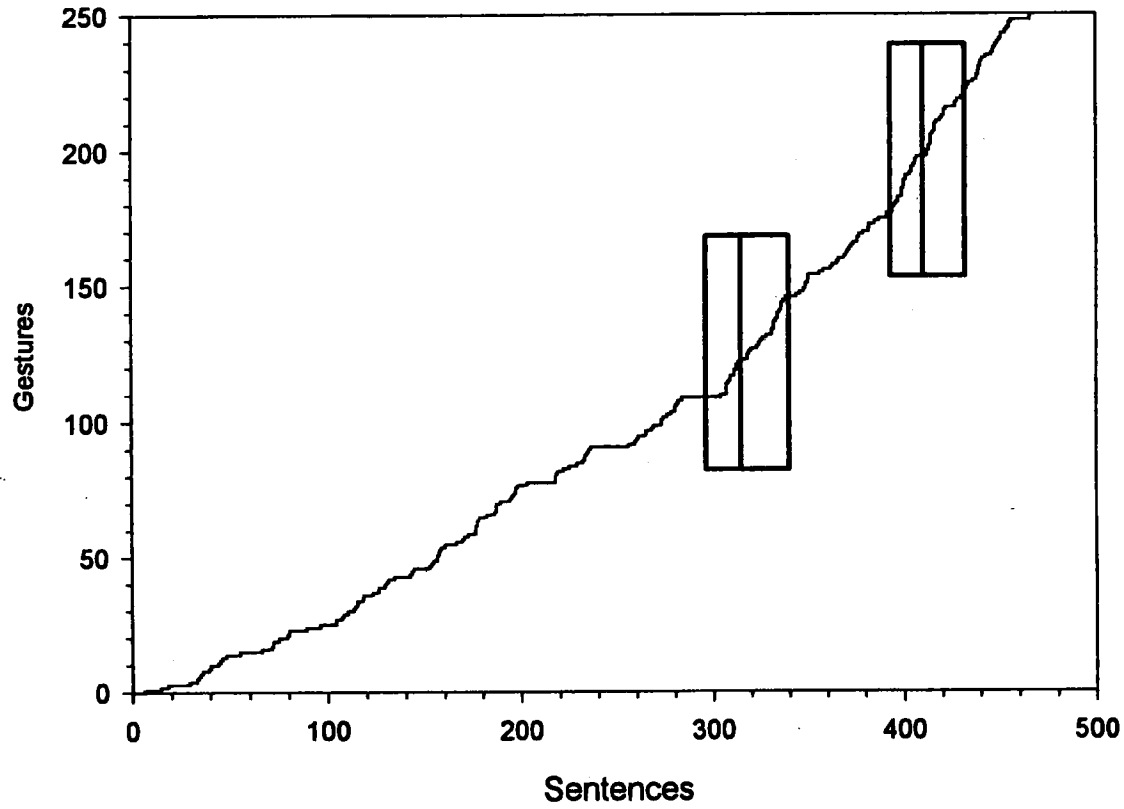

Figure A - 7: Cumulative Gestures in Mythology Lecture 1.

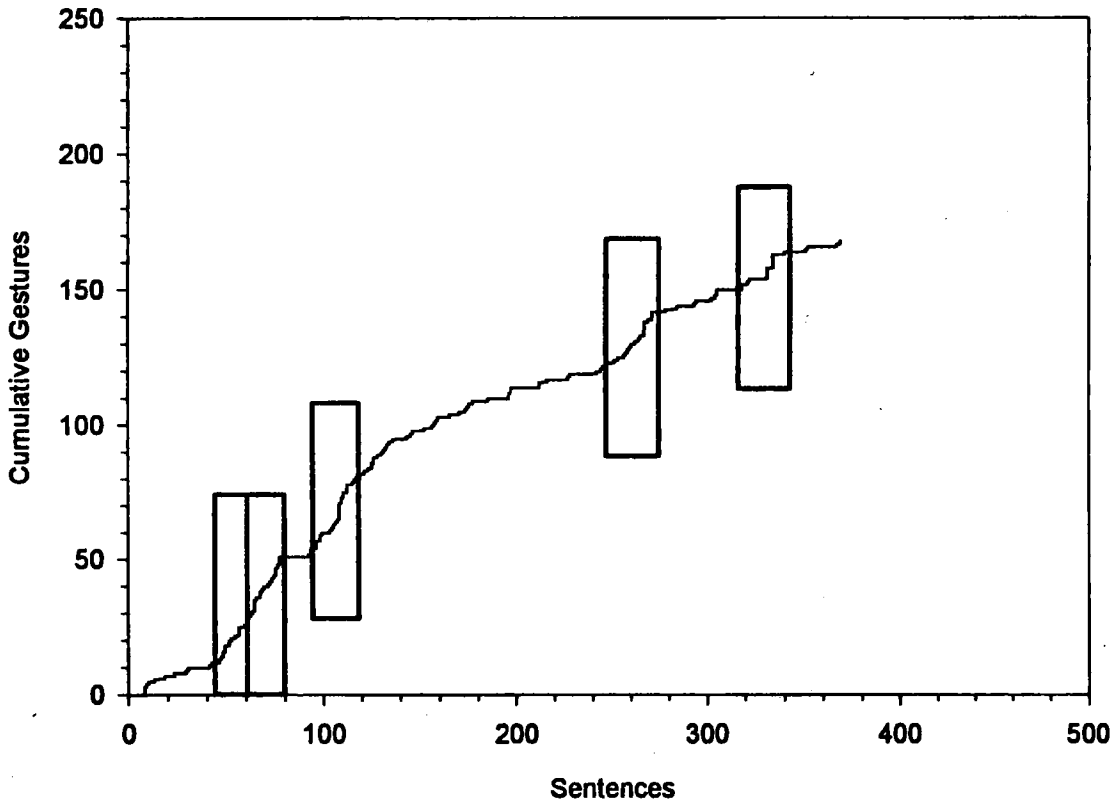

Figure A - 8: Cumulative Gestures from Mythology Lecture 2.

VITA

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