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Cognitive Processing Patterns in the Production of Metaphors
by In-service Teachers in the Sciences and Social Sciences

by
Manjari Gopal

Thesis submitted to the School of Graduate Studies
of the University of Ottawa
in partial fulfilment of the requirements
for the Degree of Doctor of Philosophy in Education.

Ottawa, Canada, 1993

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Dedicated to my family,
who very selflessly gave me
the freedom to take up the challenge
to make this "conceptual leap"!

You have taught generations of Amherst students that
for gaining an insight into life,
a metaphor is a sharper and brighter instrument
than a syllogism.

D. Litt. citation for Robert Frost.

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Abstract

The human mind has the ability to advance its mental grasp on any problem or situation by using metaphoric reasoning processes (Beek, 1987). Metaphors help in capturing multiple meanings and unexpected discrepancies in experience. They provide a conceptual framework for thinking about diverse concepts (Lakoff & Johnson, 1980; Ortony, 1979). Metaphors thus serve an important and indispensable function in language and thought. The importance of incorporating metaphorical thinking in the classroom lies in the role that figurative language can play in stimulating the intellect, in exciting the imagination and also in problem solving through the use of metaphors as heuristics (which are general strategies and creative guidelines used in solving problems).

A focused review of the literature provides evidence that the research and theoretical formulations about metaphors and other forms of figurative language have generally been influenced (and are usually constrained) by some basic, underlying assumptions that have been inherited from different research traditions (Pollio, Smith & Pollio, 1990). The psychometric measures that have generally been utilized also provided limited information which dealt with the products of metaphorical reasoning, while little was known about the process itself.

The identification and understanding of human thought processes is of particular relevance to educators since it provides an insight into the patterns of thinking that lead to success or failure in problem-solving. The purpose of this exploratory study is primarily to identify and examine the processes and patterns that are employed by Secondary and Intermediate school teachers in the production of metaphors. The research objectives that were explicitly explored were

1. the examination of the characteristics of the statements produced as metaphorical descriptions by Secondary and Intermediate school teachers.

2. the exploration of the differentiating characteristics of the statements that discriminate between the Secondary and Intermediate school teachers across gender and domain of specialization.
3. the identification of the cognitive processes that were employed in the production of metaphors by groups of Secondary and Intermediate school teachers differentiated by gender and specialization.
4. the identification of the distribution patterns of cognitive activity or global strategies that were observed for the groups of Secondary and Intermediate school teachers, differentiated by gender and domain of specialization.

The mental models framework proposed by Holland, Holyoak, Nisbett and Thagard, (1986) provides a basis for understanding and explaining different aspects of human cognition. This framework was adapted for the present study; Holland et al. (1986) posit that people represent the world with which they interact in the form of mental models which are dynamic and transient representations of the given situation or problem.

The data collection methodology comprised of obtaining the concurrent verbal protocols of participants as they "thought-aloud" while performing the tasks of describing eight topics in metaphorical or figurative language. Twenty-four volunteers were drawn from the population of In-service Secondary and Intermediate school teachers equally balanced for gender and domain of specialization (Science/Math, Social Science/Humanities). The analysis of the transcribed protocols follows the guidelines provided by Ericsson and Simon (1984) for verbal protocol analysis.

The development of a coding grid for identifying the cognitive processes utilized by the participants helps in the categorization of the data into 29 activities grouped into six episodes. A classification scheme to examine the nature of the descriptive statements made provides three types of statements (Structural, Functional and Evaluative), that are analyzed for five levels of complexity of mapping (ranging from Basic to Complex). The categorization of the cognitive processes utilizing the specific coding grid developed and the

classification of the metaphorical statements are qualitatively analyzed. This is followed by a quantitative analysis of the stimulus-topics and the targets which are further analyzed for patterns of observations across gender and specialization. While some differences in the categories of statements produced can be ascribed to gender and specialization differences, other variables that influenced the task performance were contextual. The format of presentation of stimulus-topics (visual-verbal) and the types of verbal stimuli presented: abstract and concrete forms of nouns and adjectives affected the types of "targets" used and also the types and categories of statements produced.

The frequency and duration of episodes were extracted through 'process strips' to analyze the distributions of occurrences. "Participant profiles" that show the global strategies used by each participant are then obtained. These profiles can be used as a diagnostic tool in the classroom since it can help in the identification of the weaknesses and strengths in an individual's profile, particularly when the absence or limited use of certain cognitive activity is observed in the profile. Intervention measures can be planned to remedy and compensate for any limitations in processing activity observed in the profiles. Other implications of this study include the recognition of the important role played by personal experience for producing figurative language. The need to include the students own experiences in the classroom are stressed. Further research using this methodology is recommended for studying other aspects of figurative language processing, particularly those involved in the interpretation and comprehension of metaphors.

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CHAPTER 1

INTRODUCTION

One of the most remarkable human cognitive capacities is that involved in the acquisition and use of language (Lasnik, 1990). It is recognized as a rich system of knowledge and is central to human success in society. As an instrument which adapts to an unforeseeable variety of social, personal, and intellectual demands, language is very complicated (Miller & Johnson-Laird, 1976). The literary critic Philip Wheelwright (1962) observed that "in order to speak as precisely as possible about the vague, shifting, problematical and often paradoxical phenomena that are an essential part of the world, language must adapt itself somehow to these characteristics". It performs, what Patricia Churchland has aptly called "cognitive compression" and helps to categorize the world by reducing the complexity of conceptual structure to a manageable scale (Damasio & Damasio, 1992). It would be impossible to speak of new ideas or insights if language had only fixed, literal meanings. Aristotle suggested that we need metaphors to express new insights "Strange words simply puzzle us, ordinary words convey only what we know already, it is from metaphor that we can best get hold of something fresh" (Rhetoric 1410, Lines 13-15). Metaphors serve an important and indispensable function in language and thought. If people were limited to strictly literal language, communication would be severely curtailed, if not terminated (Winner, 1982).

The vitality and freshness generated when we speak metaphorically can be demonstrated by critically examining a metaphorical statement. The statement "Education is not the filling up of empty pails, but it is the lighting of a fire" draws the reader (or listener) to the metaphorical depictions of the subject matter, education. The initial part of the statement depicts education as not being the "filling up of empty pails" and this is interpreted to mean that education is more than just the pouring in of information and facts into the minds of the educand. The connotation attached to the filling of a pail is that of a passive receiver (in this

case the educand or the learner), who takes in and stores the information and facts that are poured in and does not actively react or interact with the information or the individual who pours in this information. This static and stagnant depiction also seems to stress the product of the educational process (the "filled up" brain of the educand).

On the other hand, the second part of the statement depicts education as the "lighting of a fire" which, once lit, consumes the individual and surroundings. Just as a lighted fire spreads, so too education can be seen as quickly spreading and engulfing its surroundings. The active and dynamic role ascribed to an educand who is consumed by the fire of education and learning, offers a stark contrast to the passive role depicted for the educand who has information poured into her brain.

Another interpretation of this metaphor can be that if one considers good education from a standpoint of its being a "product," it can be depicted as being similar to the filling of a pail; whereas the depiction of education as a "process" can lead to it being likened to the kindling of a fire. Similarly, there are other interpretations that can be drawn which focus on different attributes or underlying relationships that are noted for the principal subjects (empty pail and lighted fire).

This metaphorical statement describes education in a way that is both more meaningful and even more interesting than would be possible to depict with a more prosaic statement. The statement depicts education in two different ways but its underlying connotations provide elaborations that expand and have a "snowball" effect on the implied relationships and possible meanings. The statement engenders feelings of excitement and interest, which are triggered by the novelty and speculative nature of the generalizations that are suggested by the relationships. Miles and Huberman (1984) have commented on the qualities of metaphors that help them dramatize, amplify and depict rather than simply describe phenomena.

The metaphorical statement is introduced here as an example to help express (or imply) comparison which simultaneously produces meaningful intellectual illumination and provides emotional excitement. The two most familiar cases of metaphor are analogies and similes and

both of them provide some insight through explicit comparison, usually with "as" or "like" in their syntax. An analogy seems logical or scientific since it focuses on a similarity of relations or of function. General analogy illuminates demonstrable points of similarity and is widely used in the description and explanation of scientific and logical ideas. Simile, on the other hand, is a more poetic form of comparison. It uses the overt reminder "like" or "as" but in contrast to analogy, it does not apparently emphasize the similarity, but focuses on the excitement that is generated when two relatively unlike things have qualities attributed to each other. Similes share a two-directional motion with metaphors. The metaphorical statement presented earlier does not merely attribute the qualities of the *lighting of the fire* to *education*, but it also refines the *lighting of a fire* in the light of its connection with *education*.. A metaphor (and a simile) are not complete since not all possible points of connection are intended to hold. It is left to the mind of the producer or the listener or reader to complete the connections. This encourages a diverse level of feelings, depending on the richness of associations of the individual and providing (or at least suggesting), the possibility of putting the preconscious mind to work. The intoxicating joy and exhilaration experienced in such depictions is described by Emerson, "The Poet," as:

If the imagination intoxicates the poet, it is not inactive in other men. The metamorphosis excites in the beholder an emotion of joy. The use of symbols has a certain power of emancipation and exhilaration for all men. We seem to be touched by a wand which makes us dance and run about happily like children. We are like persons who come out of a cave or cellar into the open air. This is the effect upon us of tropes, fables, oracles and all poetic forms. Poets are thus liberating Gods.

Introduction to Alfred Corn's *Metamorphoses of metaphor* (1987)

Role of Metaphorical Thinking in the Classroom.

Metaphorical thinking is the ability to make connections between two unlike things by recognizing that in some way they share a common trait or exemplify a common principle (William, 1984). This form of thinking is particularly epitomized in the creative aspect of producing or generating metaphors, although it may be inferred from tasks involving interpretation or comprehension of given metaphors. Competence in this form of thinking represents an important aspect of categorizing, conceptualizing, learning and understanding the world (Honeck, Case, & Firment, 1987). Beck (1987) recommends that instruction in figurative language be made an integral part of the school curriculum, particularly due to the prolific usage of this form of language in the media.

Commenting on the prevalent and widely accepted practices, Eberle (1970) lamented the fact that philosophers had tended to emphasize the virtues of precision rather than those of suggestiveness, and the importance of investigating constructed theory rather than the methods which lead to their construction. He believed that this could be why the notion of a metaphor (which smacks of poetic vagueness) and the subject of models (which seems to pertain to methodology) have not received the attention they deserve. An appreciation of the importance of incorporating the use of metaphorical thinking in the classroom may be achieved by acknowledging the role that the figurative (and imaginative) use of language can play in stimulating the intellect and in exciting the imagination. The effect of this form of thinking on the motivational components particularly on the confidence, beliefs, characteristics of the learning environment, to name a few aspects, can further strengthen the case for using it in the classroom.

Aristotle (Poetics, 1459) had said " The greatest thing by far is to be a master of metaphor. It is the one thing which cannot be learned from others. It is a mark of a genius." While Aristotle's respect for metaphor is justified, his pessimism about the possibility of teaching and learning that process is not (William, 1984). While emphasizing its value as a

tool for teaching substantive material and in promoting its power as a way of thinking, the aesthetic and emotive powers inherent in metaphorical thinking should not be underscored. The mystery and creative potential inherent in the process make it a viable tool for classroom interaction and activity.

Implementation of Programs Designed for Enhancing Thinking and Problem solving.

Research on cognition and instruction and on programmes to improve thinking skills have taken on the characteristics of another cognitive revolution (McGuinness & Nisbet, 1991). There is general agreement that to develop capable learners and thinkers, more than rote memory, factual knowledge and the routine application of familiar procedures will be needed (Glaser & Bassok, 1989). Educational institutions are being urged to focus on teaching students **how** to think and not just **what** to think. These institutions (and society in general) have generally over-emphasized the need for objectively measurable outcomes, which has led to more concern for what answers were given rather than with how these answers were produced (Lochhead, 1979). A process oriented approach can be expected to avoid the general restrictions inherent in traditional studies which have neglected to tackle such issues as the underlying cognitive processes involved in task performance and also the identification of the components that might be responsible for observed differences in performance. A healthy concern for the "outcomes" of performance helps in gaining an awareness of the content and structure of the cognitive processes that are a part of performance.

The goal of effectively teaching reasoning, thinking and problem-solving is being pursued with new vigour (Ogle, 1992; Bransford, Sherwood, Vye, & Rieser, 1986). The relevance of this goal has been recognized for centuries, but it has become more meaningful in the present era of technological advancement. Many classical philosophers (e.g. Plato, in *Erasmus*) considered the true goal of education to be the fostering of **study**, which in modern

terms can be described as constructive cognitive activity. Competence is fostered not primarily by teaching to deliver knowledge, but through teaching to engender specific kinds of cognitive activity (Glaser, 1991). Cognitive process instruction is a view of instructional design which emphasizes the teaching of thinking skills over the transmission of factual knowledge (Lochhead, 1978).

The need for a "thinking curriculum" is vital for educational institutions as they prepare their students to become productive and competent members of society, capable of adapting and adjusting to the changes that will take place in their constantly changing lives. The call for making thinking and problem-solving the focus of education can be found in various research reports that are critical of the inadequacies of the present situation. The assessment of students' achievement in many educational institutions suggests a failure in the development of effective thinking and problem-solving skills. Kuhn (1986) recognized the need for critical research that would identify precisely what the skills are and how they are manifested across a wide variety of contexts. To meet these needs, she stressed the importance of understanding the mechanisms that govern the acquisition of these skills.

Gamlin (1989) discusses two theoretical approaches that have generally been used to address the issue of the thinking skills that need to be taught. They include the teaching of **general** skills or problem-solving strategies which may transfer across classes of problems, and the teaching of **specific** skills across multiple contexts to observe generalizations to these skills in different contexts (Campione & Brown, 1984). The same differentiation has been presented by Perkins, Jay, and Tishman (1993), who analyzed the different conceptions of thinking into two dominant views: (a) the general processes view and (b) the expertise view. The two views differ principally on the importance of general cross-domain processes versus particular highly contextualized knowledge and processes. However, both reflect a process perspective and respect knowledge compilation of learning.

Some of the generalized process approaches for teaching thinking skills have met with modest success, providing evidence that cognitive rehearsal, self-verbalizations to slow-down

and think, and self-regulation skills, in general are valuable in remedial situations. However, there is limited optimism regarding the acquisition of conceptual skills necessary for generalizing original learning across multiple contexts. Teaching individuals to use general thinking skills or metacognitive strategies has not met with unqualified success. Gamlin (1989) ascribes some of the difficulties encountered in the development and implementation of such instruction to the limited availability of theoretical guidance. A major stumbling block is the lack of information about the possible concepts or strategies that could yield transfer of knowledge across the widest range of tasks. Duit (1991), while recognizing the importance of instruction that is geared to the acquisition of subject matter knowledge, affirms the importance of instruction that is aimed at "metaknowledge". This, he contends, would make the role of analogies and metaphors in different subjects an essential aspect of instruction. There is an apparent inadequacy of information available to educators pertaining to the ways in which to successfully incorporate strategies to utilize metaphorical thinking in instruction. Due to diverse notions about the nature and functions of metaphors, there are many misleading and contradictory views prevailing on this topic. A focused survey of the literature on metaphors and metaphorical thinking confirms the lack of a coherent and cohesive approach to metaphorical thinking.

Rationale for Study

The era of 1970s and beyond saw a general surge of passion which came to be known as "metaphormania", with a proliferation of interest in metaphors which seems to have levelled off now (Van Noppen & Hols, 1990). However, metaphor continues to remain a topic of interest for scholars in many disciplines throughout the world, with some interesting shifts in emphasis.

The elusive and abstract nature of metaphorical thought has led to a dearth of empirical information on the phenomenon. Attempts to remedy the situation were hampered by the lack

of a viable approach for tapping or accessing information of this kind. The identification and understanding of the cognitive processes and patterns used in the processing of metaphors (including the activities of production, comprehension and interpretation) could help in understanding the phenomenon itself. A comprehensive understanding of the phenomenon is needed in order to develop instructional procedures that focus on helping students improve the skills they need to become more competent at metaphorical thinking. The need to develop a clear understanding of the attributes that distinguish metaphors in order to knowingly employ metaphoric language has been reiterated by Joyce, Weil and Showers (1992).

The study of the human mind and the complex nature of its structure and functioning are the focus of interest of various disciplines. Cognitive science is a multi-disciplinary field of inquiry that provides a comprehensive and enriched approach for understanding various aspects of human cognition. Recent research in cognitive science has shown that it has been successful in providing a viable approach for the study and understanding of underlying cognitive structures and processes.

The lack of available information on the mechanisms that underlie the different aspects of metaphor processing has made the implementation of teaching metaphorical thinking skills and strategies a difficult task. To succeed in its goals, instruction has to focus on what the problem-solvers must go through as they consider a problem, relying on the process itself and not just the final answer. In other words, the instructional approach that is suggested has to provide specific strategic information or teaching strategies which are not just descriptive. Simply providing students with a set of heuristics to follow would be of little value since there is quite a difference between understanding a strategy on an intellectual plane by recognizing and describing it, and actually being able to **apply** the strategy (Krulik & Rudnik, 1980).

The present investigation forms a part of a larger study that is primarily concerned with exploring and identifying some of the cognitive processes and patterns that may underlie metaphorical thought. The broad scope of the study includes the objectives of acquiring a comprehensive understanding of the nature of metaphorical thought by investigating the

different activities of production, comprehension and interpretation. An investigation of the cognitive mechanisms that underlie metaphorical thought would help provide a functional model of the phenomenon. Such information is particularly relevant for educators who generally find the paucity of information on the topic to be a major constraint in the implementation of programs that attempt to suggest and teach metaphorical thinking skills.

Teachers, because of their training and practical experience, have a general propensity to use and produce metaphors regularly, particularly during the teaching-learning interactional situations with students. This propensity to use metaphors was one of the primary reasons for limiting the present investigation to teachers. The use of teachers as the target population provided adequate observations of metaphorical descriptions under the experimental condition, ascertaining the collection of a rich database. A corollary of investigating teachers' metaphor production was that an understanding of the phenomenon and its underlying processes would provide information of direct relevance to the classroom situation. This, in turn implies that the identification of the component processes could possibly lead to the devising of curricula that would aim at helping enhance the children's acquisition of metaphorical thinking skills.

The exploratory nature of the present study was necessitated by the limited availability of information that was directly related to such an inquiry. This afforded the investigation with an openness and flexibility that was particularly appropriate for a study involving an encompassing and often controversial phenomenon. The research objectives for the study were aimed at identifying and examining:

1. the characteristics of the statements that are produced as metaphorical descriptions by Secondary and Intermediate school teachers,
2. the differentiating characteristics of the statements that discriminate between the Secondary and Intermediate school teachers across gender and specialization,

3. the cognitive processes employed in the production of metaphors by groups of Secondary and Intermediate school teachers differentiated by gender and domain of specialization,
4. the distributions of the cognitive activity or the global strategies in the production of metaphorical descriptions that were observed for the groups of Secondary and Intermediate school teachers, differentiated by gender and domain of specialization.

The methodology of obtaining concurrent verbal protocols of individuals as they performed assigned tasks that led to the production of descriptive metaphors is utilized to access the internal thought processes employed in the execution of the task. These "think-aloud" protocols provide indices of thought processes that are employed in the execution of the task and these form the data base for the present investigation. The data collected are analyzed using the guide-lines provided for Concurrent Protocol Analysis by Ericsson and Simon (1984). The focus of the present investigation is on qualitative data, although both qualitative (identification of cognitive processes and patterns that are applicable to the task at hand) and quantitative (generally the frequency counts of the different observations) measures are used for the analysis.

Format of Presentation

An INTRODUCTION to the investigation on metaphorical thought processes is presented in chapter 1, which briefly outlines the role of metaphors and metaphorical thinking particularly as it applies to the implementation of the "thinking curriculum" in the classroom. This is followed by the presentation of the rationale for the study and the statement of the research objectives.

The initial focus of chapter 2, which presents a REVIEW OF THE LITERATURE, is a brief introduction to the field of cognitive science and some of its paradigmatic manifestations

that are of relevance to the present study. The review then continues with a discussion of the various theories, approaches and underlying assumptions about metaphors and figurative language which help in situating the theoretical framework that has guided the study. This leads to chapter 3: the presentation of the **CONCEPTUAL FRAMEWORK** and the **RESEARCH OBJECTIVES** that provides the rationale and the guidelines for the present research. Chapter 4 elaborates on the **METHODOLOGY** utilized for the study followed by chapter 5, which presents the **ANALYSIS and INTERPRETATION OF RESULTS**. Chapter 6 concludes with some **DISCUSSIONS** of the results and general issues arising from the present research.

CHAPTER 2

FOCUSED REVIEW OF THE LITERATURE

The intricacies of the human mind and the nature of knowledge and intelligence have perplexed human beings for a very long time. Simon (1992) describes the question of the nature of the mind as one of the four great questions that have obsessed humans for long; the other three questions are the nature of matter, the origins of the universe, and the nature of life. Gardner (1985) has traced the roots of this fascination with the exploration of the mind and knowledge to Socrates in the Platonic dialogues of the *Meno*.

Among the earliest recorded inquiries into the nature of knowledge were those undertaken by epistemologists who began with the establishment of a rationalistic tradition of scholarship and a theory of valid reasoning which was propounded by Aristotle and other Greek philosophers and reaffirmed centuries later by Descartes. This was followed by the theological debates of the Middle Ages and the new empiricism of the Renaissance and Enlightenment periods whose exponents included Hobbes, Locke, and Kant. The end of the nineteenth century saw the emergence of various new disciplines (psychology, linguistics, anthropology, neurology, computer science etc.) which were all particularly concerned with human thought and behaviour from different perspectives. However, this piecemeal or fragmented approach was considered unsatisfactory by many researchers who recognized the similarity of the concerns of these diverse domains of study. Pylyshyn (1984) has stated that the issues of knowledge, mind and intelligence (all mental events) belong to a "natural domain" which corresponds very closely to what has been called "cognition." The interdisciplinary study of all aspects of cognition has been undertaken by researchers in cognitive psychology, linguistics, philosophy, computer science, anthropology and neuroscience. This diversified approach saw the emergence of "Cognitive Science" which has been called "the science of the mind" (Stillings, Feinstein, Garfield, Rissland, Rosenbaum, Weisler, & Baker-Ward, 1987)

and has been described as "the domain of inquiry that seeks to understand intelligent systems and the nature of intelligence" (Simon, 1981).

Contributions of Cognitive Science

The uncharted wilderness of the human mind is being treated as one of the last frontiers as cognitive scientists investigate, observe and attempt to understand and describe thinking. The remark about psychology that was made by Ebbinghaus (1913) that "It had a long past, but a relatively short history" can now be applied to the field of Cognitive Science as it presently stands. The evidence of the progress that has been achieved in appreciating, and to a certain extent, in unravelling the complexities of human cognition over the last thirty years has spurred researchers to explore more challenging and intricate aspects of higher order mental activities. The need to understand the human cognitive system is particularly relevant for educational practice since the system functions as a tool for interacting successfully with the environment (Osherson & Smith, 1990) and the specific circumstances of its use can require various adjustments and fine tuning for optimal utilization. The aims of education to optimize learning and cognitive ability can be tackled in a meaningful way by understanding the structure of the cognitive system and basic mechanisms that govern human thought. Cognitive scientists posit that

The brain is not a passive consumer of information, (rather) it actively selects, attends to organizes, perceives, encodes, stores and retrieves information. Sometimes it generates a whole picture from one half of a chimerical stimulus. Other times, it analyzes complex spatial patterns into simpler imbedded ones.... A multiplicity of operations, interpretations and inferences characterizes the complex reality constructed by the brain.

(Witrock, 1978. p. 78)

This dynamic view of the human mind as an "information processing system" assumes that

1. There are law-like similarities (patterns) between stimuli and responses and the intervening mental processes (Flanagan, 1991).
2. All activities that make up the operations or the intervening mental processes between the input and output (at the conscious and unconscious levels) functionally reflect a flow of information. Thus the entire sequence of events when one acts in a particular way as a result of the occurrence of an event is seen as a flow of information -- data (input) is received by the senses, interpreted with the aid of what is stored in memory, translated into a goal to produce a certain response and then the goal is realized by recourse to certain mechanisms (Sanford, 1985; Palmer and Kimchi, 1986).
3. All complex mental events can be decomposed into a number of components to processes and structures (Palmer & Kimchi, 1986).
4. The mind is a representational system and in order for it to function correctly, a representation must have the same structure as the part of the world that it represents (Stillings et al., 1987).

The information - processing approach provides a unifying framework for the structural and functional description of human activities that are obtained through the articulation of normally complex and covert events. The decomposition of these complex events into component parts is then represented in ordered sequence to analyze the operations and products of knowledge acquisition and use in terms of process (Anderson, 1985). The understanding of the processes and structures that result provides a particularly appropriate framework for studying a broad spectrum of activities called problem-solving.

Problem-Solving Paradigm

Most cognition and thinking, particularly the aspects that are dealt with in the educational milieu, are goal directed and in the terms proposed by Newell and Simon (1972) can be characterized as problem-solving. The pivotal role played by problem-solving in human competence has led cognitive scientists to use it as a framework for investigating a wide range of activities and situations. This necessitates the distinction of various issues like: What are problems? What is problem solving? and What features differentiate problems?

Duncker (1945) suggested that a problem arises when a living creature has a goal but does not know how the goal is to be realized. In a similar vein Davis (1973) defined a problem as a stimulus situation for which an organism does not have a ready response. Thus all problems can be described as having a starting point (the initial state or given conditions), a set of mental operations each of which transforms the current state into some other state, and a goal state (the solution). All the possible sequences of operations make up the "problem space" and a sequence of these operations forms a "path" from the starting point to the goal. A successful plan generates a path that solves the problem. Solving a problem consists in transforming the initial state into the goal state by applying some sequence of operations (Perkins, 1990). The wide range of situations that can thus be called problems lead to the need for a better understanding of the nature of problems.

Arlin (1989) elaborated on a taxonomy of problem types and solution forms to compare the problems. The different categories analyzed are recognized as being on a continuum, rather than being purely dichotomous variations. The categories to distinguish among and within problems according to problem type are:

Presented and Discovered problems. Problems are classified on the basis of what is known and what is unknown in the problem situation. Getzel's (1964) typology included eight different distinct types of problems according to this criterion.

Ill-structured and Well-structured problems. Problems that vary in terms of completeness with which the problem can be specified and the certainty with which a solution can be recognized as being either correct or optimal. The criterion for goal attainment in ill-structured problems is more complex and ambiguous (Simon, 1978), often requiring the solver to contribute to the definition of the problem from his/her own repertoire of resources (Hayes, 1981). The problem space does not provide all the essential information needed to solve the problem, leading to the lack of any simple paths for solution. This leads to action on the part of the problem solver in an atmosphere of uncertainty.

Well-defined and Ill-defined problems. While well defined problems contain all the information necessary to solve the problem and have single correct solutions, ill-defined problems neither provide all the information that is necessary to reach a solution, nor do they have a single established correct solution. Holyoak (1990) characterized problems as being ill-defined when the representations of one of the more basic components (the goal, the initial state, operator and constraints) are incomplete. Problems encountered in real life are usually ill-defined, but it is generally found that well-defined problems are those that have been studied by researchers.

Some characteristics of the problems that affect the solution and the certainty with which one attains that solution are subjected to analysis through "problematics", which entails the study of that which makes a problem problematical. Ferkins (1990) analyzed the level of challenge offered by problems that call for different cognitive abilities, styles and strategies of thinking. An understanding of problems, the nature of different problems and the problem solving behaviour of individuals and groups has become the focus of research for many cognitive scientists.

Cognitive scientists thus believe that a comprehensive understanding of the processes and structures of the human cognitive system as it is involved in a broad spectrum of problem-solving activities can be obtained through the use of the information-processing framework. The relevance of this approach for educators and instructors has gained credibility as the success of the theoretical aspects has been realized in practice. The age-old issues of

understanding the intricacies of the human mind and answering the questions related to human cognition are of particular relevance to educators as the call for a move "back to basics" has come to include thinking as a basic skill that should be taught in school. The complex and intricate nature of human thought has to be analyzed and understood if an attempt has to be made to teach these skills in the classroom.

Metaphorical Thought and Human Cognition

One aspect of human cognition that is indicative of a more general ability to engage in abstract reasoning and creative thinking is believed to be the metaphorical nature of human thought (Honeck & Hoffman, 1980; Ortony, 1979). The human mind has been characterized as having the "striking ability to advance its mental grasp on an interesting problem by the use of metaphoric reasoning processes" (Beck, 1987). Metaphors help in capturing multiple meanings and unexpected discrepancies in experience. It has been proposed that metaphors shape and influence our thinking by providing a conceptual framework for thinking about diverse concepts (Lakoff & Johnson, 1980; Ortony, 1979). MacCormac (1985) has described metaphor as an evolutionary knowledge process that combines brain, mind, and culture in the creative formation of language. Metaphor is acknowledged as being a device which plays an important role in the growth of language through the elaboration of word meaning (Kroll, Kreisler, & Berrian, 1989). However, it is now generally agreed that metaphor is not merely a matter of words but it is a fundamental mode of cognition affecting all human thought and action, including everyday and poetic language (Turner, 1987; Yoos, 1971). The pervasiveness of metaphors and its special role in the context of human thought and cognition makes it of pivotal interest to educators to understand the phenomenon.

What Are Metaphors?

The Oxford dictionary describes a metaphor as a "figure of speech in which a name or descriptive term is transferred to some object different from but analogous to, that to which it is properly applicable." The origins of this definition can be traced to Aristotle who had described metaphor as consisting of "giving a thing a name that belongs to something else; the transference being either from genus to species, or from species to genus or from species to species, or on grounds of analogy." Interest in the study of metaphors was believed to have arisen because it throws into relief the intimate relationship between the symbolic modes, meaning and language (Paivio, 1971).

The diversity of traditional definitions for metaphor do differ in details, but two central classes of definitional criteria, based primarily on semantic dimensions that can be isolated, are the substitution and the similarity criteria. Black (1962) analyzed previous accounts of metaphor into three "views"; besides the substitution and comparison criteria he discusses the interactional view.

The substitution criterion involves "transfer" and the metaphor is said to involve translation or replacement (substitution) of a usual linguistic sign by an unusual one. The most influential tradition in rhetorical theory treated metaphor as a kind of error in diction and logic (Verbrugge, 1980). An "intruding term" is thought to substitute for a literal term that constitutes the true underlying intent (Verbrugge, 1980) and the entire sentence that is the locus of the metaphor replaces some set of literal sentences (Black, 1979). The substitution view is not applicable when novel interpretations of a topic are intended, and when the sentence effects a nonliteral experience.

On the other hand, the comparison criterion treats entire sentences as aberrant, rather than just focusing on component words. On the surface, the sentences presuppose some relation of identity or class membership, at a hidden or implicit level, they state a well-formed comparison. Metaphors transfer meaning and understanding by comparison. But comparative

metaphors do not serve to make the acquisition of radically new knowledge intelligible . Ortony (1979) contended that the fact that metaphors are frequently used to make comparisons (if it is a fact) does not mean that metaphors are comparisons. A metaphor is a kind of use of language, whereas a comparison is a kind of psychological process, which while quite possibly an essential component of certain kinds of language use, is not the same thing as such a use.

Dismissing the substitution and comparison views (with some qualifications), Black (1962) found that the interaction view, presented by Richards (1936) offered some insight into the uses and limitations of metaphor. Richards defined a metaphor as "... when we use a metaphor we have two thoughts of different things active together and supported by a single word or phrase, whose meaning is a resultant of their interaction." (p. 93.). Black (1962) favoured the image of a "filter" and explained the metaphor-word (which Richards had called the "vehicle") as the "focus", which calls up a system of implied cultural beliefs and personal attitudes or "associated commonplaces." These associations are in turn related with various aspects of the principal subject. Black contends that a metaphor selects, emphasizes, suppresses, and organizes features of the principal subject by implying statements about it that normally apply to the subsidiary subject. An effective metaphor acts as a screen through which the world is perceived, or in other words, it filters the facts, suppressing some and emphasizing others.

Some Operational Definitions

The ambiguity surrounding the term "metaphor" can be traced to the different connotations attached to the terms generally associated with the phenomena. The terms metaphor and figurative language are often used interchangeably, and in a similar manner analogy and metaphor are depicted as being equivalent. The fuzzy distinctions in the literature have made the task of differentiating between these terms quite difficult, but a conscious effort

has been made to keep the following operational definitions in mind whenever these terms are used in the present study:

Figurative Language Verbal expressions that signify one concept by using words that would normally be used to signify some other concept as a result of a conceptual analogy or qualitative similarity between the concepts. Figurative language can be produced in different forms of which metaphor is probably the most common.

Metaphor A metaphor holds two thoughts of different things together in simultaneous performance upon the stage of a word or a simple expression whose meaning is the result of their interaction (Ricoeur, 1977). It epitomizes the notion of qualitative similarity or conceptual analogy. Metaphors, according to the experiential alternative espoused by Lakoff and Johnson (1980), provides a way of partially communicating unshared experiences and it is the natural structure of human experiences that make this possible.

Analogy An analogy generally involves four terms since they are patterned after the arithmetic analogies of proportionality. For example 3 is to 4 as 9 is to 12 or, the toes are to the feet as the fingers are to the hand (Miller, 1979). In its more complex form an analogy is a device for integrating diverse knowledge sources to model new situations (Holland, Holyoak, Nisbett, & Thagard, 1986). An analogy thus serves as a necessary but not sufficient condition for the existence of a metaphor.

The three terms depict phenomena which are very closely linked and interrelated and this relationship can be represented by depicting figurative language in the form of the genus, metaphor being a species of this genus and analogy, usually an example of the species. Hoffman (1980), like many researchers studying the use of metaphor in science, found that imagery, models, analogies, metaphors and scientific theories were all interrelated.

Despite the burgeoning information about metaphors that is now available, the interconnected nature of the phenomena of imagery, models, analogies, metaphors and scientific theories have defied complete understanding of the scholars and researchers who are

experts in different domains of knowledge. Observing the lack of progress despite the concerted effort of the experts for so many generations, could lead to the comment :

Metaphors can never be entirely rationalized; they continue to generate the energies of meaning as long as they are interrogated. To comment on a metaphor in a work of art is an act in divination or, at least, like a Rorschach inkblot. Indelible and fixed themselves in a literary text, they induce non-fixity in the "text" of the reader. Metaphors metamorphose under our very own eyes.....

(Corn, 1987, p. xi.)

However, the ambiguity surrounding the phenomenon has not deterred the scholars from continuing their quest for generating feasible hypotheses and explanations about metaphors since they dominate many aspects of human cognition. One approach that has been used to understand metaphors is to analyze the two main ideas that form the metaphor. The terminology varies for different theorists, but what is in common is the view that metaphors are composed of two principal terms. Richards (1936) called these the **tenor** (or topic) and the **vehicle** and the relationship between them as the **ground** of the metaphor. The topic is usually in the subject phrase of the sentence and may be explicit or implicit. The vehicle is the second structural part of a metaphor and it makes comments on the topic. The ground is an implicit part of the metaphor and imposes extension of meaning upon the focal word requiring attention to both the old and the new meaning together. Black (1979) refers to the "ground" as the "frame" of the metaphor which requires the connection of the two ideas and it is said to form the essence of the metaphor. Gentner (1988; 1983) refers to the "mapping" of knowledge from one domain (the base) into another (the target) which conveys that a system of relations that hold among the "base" objects also holds among the "target" objects. This framework can be applied to various forms of similarity matches, but it is particularly suitable for analogies and some forms of metaphors (Gentner, Falkenhainer & Skorstad, 1988).

Function of Metaphors

The metaphorical relation has been variously described as comparison, contrast, analogy, similarity, juxtaposition, identity, tension, collision, fusion, and different views have been held regarding the nature, operation, and function of metaphors (Encyclopedia Britannica, 1990). There are generally two main roles played by metaphors: as a means of communication and as a tool for thought. The complex nature of metaphors and figurative language leads these two roles to be translated to a variety of functions and uses in different contexts. These functions have generally been agreed upon (Paris, 1988; Newmark, 1985) as being:

1. Metaphors help in communication. Linguists have argued about the primary function of metaphors as being "catechresis" or lexical gap filling. Metaphors serve to describe entities (objects or persons), events, qualities, concepts or states of mind more comprehensively, concisely, vividly, and in a more complex and informative way than is possible by using literal language.
2. Metaphors are entertaining. They serve to please, sometimes aesthetically; by entertaining, amusing, often drawing attention to a technical and physical subject (to humanize matter), and helping clarify -- often conceptually.
3. Metaphors are provocative. They compel consideration of phenomena in new frames of reference, forcing the repackaging of old beliefs according to new structures (Tourangeau, 1982).
4. Metaphors are informative. The similarities and dissimilarities highlighted help in informing how a new object is like or unlike something familiar.

Ortony (1975) elaborated on the role of metaphor as a tool for overcoming active memory limitations in the use of spoken language. He elaborated on three different theses to explain how metaphor may facilitate learning: a) the compactness thesis, which asserts that metaphors work by transferring chunks of experience from well-known to less-well-known contexts; b) the vividness thesis, which posits that metaphors permit and impress a more

memorable learning due to the greater imagery or concreteness or vividness of the "full-blooded experience" conjured up by the metaphorical vehicle; and c) the inexpressibility thesis, which mentions that certain aspects of natural experience are not encoded in language and that metaphors carry with them the extra meanings never encoded in language.

Perceptual Basis of Metaphors

Metaphors are often discussed in terms of images, but images with general rather than specific meaning. Susanne Langer (1948) has depicted metaphor as "our most striking evidence of abstractive seeing, of the power of human minds to use presentational symbols" (p. 14). On the other hand "the symbolic function of images is revealed in their tendency to become metaphorical... (they are)... our readiest instruments for abstracting concepts from the tumbling stream of impressions" (p. 117). Psychologists have emphasized the perceptual basis of metaphor, without necessarily referring to imagery.

Metaphors are generally expressed through the medium of words but it is being recognized as a cognitive rather than a linguistic phenomenon. Yoos (1971) believes that metaphors are a cognitive process that involve thought and the shaping and directing of one's thoughts. When metaphors are inspected and analyzed at the level of thought, they are recognized as being descriptions of a sort. The Gestalt psychologists emphasized the role of endogenous perceptual factors as mediators of metaphoric similarity. Synesthesia concerns cross modality matching, in other words a sensitivity to the similarities between visual, auditory, tactile and other types of sensory stimuli. Gardner (1974) employed the term "synesthetic metaphor" in a developmental study of cross-modality matching. Another construct that overlaps with metaphor is "physiognomic perception" (Werner & Kaplan, 1963; Werner, 1948). This refers to the fusion of postural-affective states and objectively neutral stimuli (for example - the attribution of emotional properties to line patterns). Kogan, Connor, Gross, and Fava (1980) place the constructs of synesthesia and physiognomic perception

under the rubric of non-verbal metaphors since both rest on the capacity to define an event or object from one category in terms of the attributes of objects or events that belong to a different category.

Arguments in favour of nonverbal metaphors (Kogan et al., 1980) have been presented by demonstrating the ease with which verbal metaphors can be converted into the non-verbal forms. Verbrugge (1977) suggested that the ease with which verbal-visual conversion can be performed is due to the fact that figurative language is simply a vehicle to express the novel perception of resemblances. In other words, figurative language evokes images, and it is the cognitive operation in this non-verbal realm that represents the mediating process in metaphor interpretation.

Ricoeur (1980) also acknowledged the role played by imagery in metaphor when he described the vividness of good metaphors to be their ability "to set before the eyes" the sense that they display. Metaphors thus are said to suggest a kind of pictorial dimension, which can be called the picturing function of metaphorical meaning.

Imaginal and verbal processes are said to jointly contribute to metaphor comprehension and production (Paivio, 1986). A dual coding approach is hypothesized and it is suggested to

1. enhance the probability of finding a common ground, that is, a connection between the topic and vehicle, in long term memory,
2. enable large amounts of potentially relevant information to become available quickly due to the synchronous or integrated nature of imagery, if at least one term in the metaphor is high in image-arousing value,
3. ensure processing flexibility because imagery is relatively free from sequential constraints;
4. act as retrieval cues for relevant information, and
5. keep search and retrieval on track with the help of verbal processes because of their sequential nature.

This implies that the metaphorical terms themselves and the verbal associations they arouse constrain the search and retrieval processes more than imagery does, since imagery is relatively free from sequential constraints and, therefore, is more likely to lead to irrelevant flights of fantasy. The imagery value of the metaphorical vehicle (predicate) was suggested to be especially important (Paivio, 1986) on the assumption that processing begins and is guided by the vehicle because its meaning determines the metaphorical interpretation of the topic (Black, 1962; Verbrugge & McCarrell, 1977).

Despite the spurt of interest in the study of metaphors witnessed in the "metaphormania" of the 70s, the lack of progress in unravelling the complexities of the phenomenon are apparently puzzling. Various controversies and ambiguities surround the subject of metaphors and these have often led to limited breakthroughs in the understanding of the subject. It is therefore important to be aware of the issues that have led to this situation.

Assumptions Underlying the Studies on Metaphors

Theoretical formulations about the role of metaphorical language have a long history in different disciplines, but a major portion of the empirical research concerned with the different forms of figurative language started less than two decades ago and most of it has been conducted by psychologists, linguists or psycholinguists. Till the mid-1970s most discussions of such language were undertaken from the perspectives of literature and/or philosophy and the empirical work done concerned the analysis of figurative usage in the literary works of one or another classical or more modern writer. The focus was on the product of the metaphoric process and few attempts were made to understand the process itself. A focussed review of the literature has provided evidence that the empirical researchers who attempted to study different aspects of figurative language were constrained by the assumptions and beliefs that have surrounded this subject. (Pollio, Smith and Pollio, 1990). The entrenched beliefs about metaphors are not widely acknowledged but are ubiquitous in the literature. The need for a

cognitive approach to mental phenomena (which attempts to study and understand the cognitive processes and structures that underlie various tasks) requires a critical appraisal of these assumptions.

Assumption 1 *Metaphors and other figurative language are special linguistic events that do not occur frequently in everyday speaking, writing or thinking.*

The belief that metaphors and other forms of figurative language are rare occurrences led to a lack of concern in most traditional philosophies of language and even in much of Chomskian linguistics. The attitude that because figurative language is a special language event, it must wait until the problems associated with literal language and meaning have been solved predominated the field (Chomsky, 1965; Katz & Fodor, 1963). Within this literalist framework, metaphorical language was considered to be agrammatical because it would not fit neatly into the logical structure of a linguistic theory of the type advocated by Chomsky (1965) and Katz and Fodor (1963). Prior to that, the influence of the Behaviourists on Psychology, Linguistics and Education led to a preference for reliably acquired data that could be subjected to objective analysis. The stringent standards and requirements for the study of behaviour led to the exclusion of metaphorical and figurative language from the research agenda.

However, various studies (Smith, Pollio & Pitts, 1982; Dixon, Ortony & Pearson, 1980; Pollio, Barlow, Fine & Pollio, 1977; Arter, 1976) have documented the prevalence of metaphors and figurative language in human cognition and language. Pollio et al. (1977) estimated that four instances of figurative or metaphorical language are uttered per speaking minute in free discourse over a variety of settings ranging from political speeches to school instruction. Arter (1976) conducted an informal survey of school readers and found that figurative language occurred at the rate of about ten instances per thousand words. Pickens, Pollio, and Pollio (1985) estimated that high school students are generally required to deal with metaphorical and figurative usage at the rate of five or more figures per page. Lakoff and

Johnson (1980), Johnson (1987), and Lakoff (1987), have gone so far as to suggest that it is not only our language, but our conceptual systems themselves that are largely metaphoric in nature. According to this analysis, it is difficult to conceptualize any domain without using some figurative prototype which serves to structure and constrain what is thought about in that domain.

Assumption 2 *Metaphors are not conceptually useful, they are meant to deceive rational thought or to beautify prosaic ideas.*

Many philosophers and literary critics were of the opinion that metaphors and other forms of figurative language are deceitful, or at best merely served an ornamental purpose (Osborn & Ehninger, 1962; Sharpe, 1950). Since the time of the Early Greek civilization, the Western culture as a whole has generally viewed poetry, rhetoric, and other "fanciful" figurative forms of language as illusory and allied to the tradition of persuasive public oratory. Lakoff and Johnson (1980) traced the "characteristic distrust" of metaphor to as far back as the philosophers Plato, Thomas Hobbes and John Locke who had used figurative language freely in their own discourses, but believed that it helped sophists "make trifles seem important and important points trifles by the force of their language" (Plato, in *Phaedrus*). The rise of empirical science as a model for truth led to the continuation of the distrust and scorn for metaphorical and figurative devices. This ambivalence towards metaphor and rhetoric in the Empiricists' tradition fundamentally displays a contempt for subjectivism, which stems from a lack of faith in emotion and imagination. (Lakoff & Johnson, 1980). The works of many twentieth century positivist philosophers and others either state or imply that metaphors are frivolous and inessential, if not dangerous and logically perverse by denying to them a) any capacity to contain or transmit knowledge, b) any direct connection with facts or c) any genuine meaning (Cohen, 1978). Even recently, psycholinguists like R. N. Miller (1976) have decried the ambiguity and misleading nature of metaphors. However, it has to be recognized that like all language, metaphor and figurative language can be used to obscure as well as illuminate

reality (Pugh, 1989). Citing the example of "nukespeak", the terminology used by bureaucrats to euphemize nuclear war and weaponry, she mentions terminology like "peacekeeper" for the MX missile, "anticipatory retaliation" instead of "first strike" for dropping a bomb first, as being deliberate use (or misuse) of figurative language to affect and mislead the hearer.

Aristotle had recognized the positive role of metaphors in getting 'hold of something fresh' (Rhetoric, 1410). But although his view of how metaphors work was considered the classic view, it was never widely accepted in modern philosophical thought. The Empiricists' tradition, strengthened by the dehumanizing reality of the Industrial revolution, led to the development of the Romantic tradition as a reaction to the objectivistic views. The Romantics decried reason, science and objectivity for alienating man from himself and his environment and acknowledged imagination as a more humane means of achieving a higher truth, with emotion as a natural guide to self-understanding. The Romantic tradition thus embraced subjectivism and this further reinforced the dichotomy between truth and reason, on the one hand, and art and imagination on the other. This led to the development of a wide chasm between the two traditions which persists to the present day. The views of individuals like Vico (1725) an Italian philosopher and rhetorician, who analyzed a very large body of written works and concluded that the rules of logic and grammar that form Aristotelian rational thought and Cartesian clear and distinct ideas are merely abstracted and reified products of a more primary metaphorical process of cognition (Haskell, 1987) were, unfortunately, not given due recognition till recent times.

A change in perspective on the role played by metaphors has been seen due to the move away from classical positivism (Cohen, 1978). The view offered by Max Black (1962) is considered of pivotal importance in the acceptance of the idea of the cognitive status of metaphors. A similar perspective on the role of metaphor in conceptual change was offered by Schön (1963), who noted that the processes involved in figurative language are essential to the development of new scientific or philosophical theories. There has been a growing credence for this view (Boyd, 1979; Hoffman, 1985) and the importance of metaphor in scientific and

other forms of problem-solving are being scrutinized by researchers (Evans & Evans, 1989; Evans, 1988; Gentner, 1982, 1983, 1988; Ortony, 1975; Petrie, 1979; Pollio & Smith, 1980.)

Assumption 3 *Metaphors, anomaly, nonsense, and literal usage are psychologically distinct categories of language.*

While some philosophers of language have emphasized the role of metaphorical thinking in the origin of poetry and myth (for example - Cassirer, 1953) and in science (for example - Black, 1962), others have been bothered by the imprecision of its form and have attempted to show that metaphorical and figurative statements are deviant and anomalous (Beardsley, 1962). It is generally assumed that a person who is speaking, listening, reading, or writing will recognize metaphor as clearly distinct from instances of anomaly, nonsense or literal language (Beardsley, 1962). This view has appealed to those scholars who aimed at describing the structure of language as a coherent, logical system, or as Kroll, Kreisler and Berrian (1989) describe it, as a machine designed to match the world. They associate this approach with the componential analysis theory of meaning that is a part of Chomsky's transformational grammar and which is now characterised by the approach associated with Katz and Fodor (1963). Empirical research, however, has shown that linguistic categories do not always correspond to psychological categories (Pollio and Burns, 1977). Early psycholinguistic research assumed that sense and non-sense were clear categories and that metaphor could be distinguished from both (Miller & Isard, 1963; Steinberg, 1970). Empirical evidence has shown that individual perception needs to be taken into account in attempting to differentiate anomaly and deviant language from metaphor, since what is non-sense to one person may be sense to some others (Gibbs, 1986; Ortony, Schallert, Reynolds & Antos, 1978; Pollio, Fabrizi, Sills & Smith, 1981; Pollio & Smith, 1979).

The distinction between literal and figurative is another problematic area that has surfaced. Early analyses (Miller & Isard, 1963; Steinberg, 1970) did not view this distinction as problematic, but recent works of cognitive metaphor theorists like MacCormac (1985)

recognize the problems involved in defining what is meant by literal. The context-dependent aspect of metaphors and figurative language also makes it difficult to distinguish reliably the metaphorical from literal. Lakoff (1986) was of the opinion that the concept of literal is a bit like the concept of motherhood; it is sacred and characterized by an oversimplified set of conditions. The issues of literal and figurative distinctions implicitly invoke a number of assumptions concerning concepts, language and the world and theoreticians have been unsuccessful in resolving these issues.

Blasko and Connine (1993) refer to recent works which suggest that semantic domains are much less stable both between and within individuals than was originally thought. This leads them to contend that various additional factors have to be taken into account in any relatively comprehensive theory of metaphor. Some of the factors mentioned by them include individual-differences variables like analogic reasoning ability, an individual's knowledge base and the pragmatic and contextual factors such as political and social contexts. The familiarity and aptness of the metaphors being processed also act as constraints and need to be incorporated in any models of metaphor processing.

Assumption 4 The paraphrase of a metaphor has the same meaning as the original metaphor itself.

The substitution theory of metaphor (Black, 1979; Ricoeur, 1977) posits that a metaphor simply replaces a set of literal sentences or propositions. Such a view of metaphor makes them quite expendable since it implies that they do not provide any new information. Davidson (1979) suggested that metaphors have no special deeper meaning and what they mean depends on the ordinary meanings of their constituent words in much the same way as a sentence does. He distinguishes between what words mean and what they are used to do and it is his contention that metaphors belong exclusively to the domain of use. Metaphors are thus "brought off by the imaginative employment of words and sentences and depends entirely on the ordinary meanings of those words and hence on the ordinary meanings of the sentences

they comprise" (Davidson, 1979, p. 31). Bosch (1985) defends the thesis that the mechanisms involved in the interpretation of metaphors are nothing over and above the mechanisms needed in the interpretation of literal discourse. His aim was to study the conceptual possibilities of integrating the study of metaphor into a theory of natural language semantics.

Richards (1936) and Max Black (1962; 1979) interaction theory of metaphor disagrees with this view and they argue that the **topic** and **vehicle** of a metaphor interact to produce a new world view. A productive metaphor generates new knowledge and cannot be considered equivalently synonymous with any set of co-existing literal sentences. According to Turbayne (1962), the comprehension of the conceptual incompatibility which is presumed to be inherent in metaphors is dependent on finding new strategies. These strategies permit the regrouping of normal categories. Various studies (cited in Fraser, 1979) have found that different subjects paraphrase the same sentences differently and even the same individuals interpret and paraphrase metaphors in unique ways which may not be consistent over different occasions. A metaphor and its paraphrase do not say or mean the same thing and when it is alleged that metaphors obscure the true meaning of a sentence, it is assumed that there is a single true meaning that is decontextualized (i.e. it is independent of the producer or speaker and the situation) (Hoffman, 1983).

Assumption 5 *Metaphorical language depends upon, and/or is derived from, literal language.*

The idea of paraphrase equality assumes that the comprehension and production of figurative language is predictable from an analysis of its constituent literal meaning. This belief led to the assumption that figurative comprehension begins with the listener's attempt to make literal sense within the contemporary linguistic context of an utterance under consideration. The listener deals with it as non-literal only when the literal interpretation fails. Metaphoric comprehension, according to these studies (Kintsch, 1974; MacCormac, 1985; Miller, 1979; Searle, 1979) depends on a higher order cognitive act based on an initial logical evaluation of

elements in the figure. These assumptions implied that figurative understanding will take longer than literal understanding and that metaphoric meanings are an optional linguistic process. This view is congruent with the comparison view of metaphors (Black, 1979) which states that a metaphor is a condensed or elliptical simile and basically consists in the presentation of underlying analogy or similarity. It is a special case of the substitution view since it holds that the metaphorical statement can be replaced by an equivalent literal comparison.

The empirical literature concerned with metaphor comprehension is divided on this issue. Some studies (Gibbs, 1987; Glucksberg, Gildea & Bookin, 1982; Hoffman & Kemper, 1987; Ortony, Schallert, Reynolds & Antos, 1978) have reported processing time for metaphorical language to be the same as for ordinary or literal language. This led them to conclude that metaphor comprehension occurs through processes that operate in parallel. According to these researchers, listeners do not wait until a literal meaning has been discarded before processing for metaphoric meaning. Other researchers (Clark & Lucy, 1975; Janus & Bever, 1985; Searle, 1979) have provided different multi-stage models of metaphor comprehension. They found that metaphors require longer processing time than literal language and this was taken to suggest that the processes involved in metaphoric comprehension occur serially. However, Gregory and Mergler (1990) concluded that the models of metaphor comprehension that either assume that metaphors are automatically understood or are the product of the reinterpretation of the literal meaning, are mutually non exclusive. The multi-stage theories of metaphor, however, have been unable to explain the process of metaphor production successfully, and even the different time course for the comprehension of metaphors on the basis of familiarity and aptness of the metaphors cannot be accounted for under this model (cf. Blasko & Connine, 1993).

Assumption 6 *Children do not understand or use metaphors until they are at least 11 or 12 years of age.*

The "cognitive constraints view" (cf. Ortony, Turner & Larson-Shapiro, 1985) offers one view of the development of metaphorical language comprehension in children. It considers the ability to understand metaphorical uses of language as primarily constrained by the child's level of cognitive development. Proponents of this view believe that genuine metaphor comprehension does not emerge till early adolescence and that metaphor comprehension progresses to maturity through a series of developmentally determined stages. The belief that young children use metaphors inadvertently has had many supporters. A cognitive-developmental view of children and figurative language (Asch & Nerlove, 1960; Inhelder & Piaget, 1958) postulated that metaphor (and other figurative language) usage involves a complex form of reasoning that develops late in childhood. Any metaphoric creation is believed to be "accidental" and is presumed to reflect the child's impoverished vocabulary (Miller, 1976). Piaget (1969) and Cometa and Eson (1978) found that children could not provide adequate explanations for various figurative language tasks, but they could match paraphrased sentences to proverbs (Piaget, 1969) or successfully complete picture matching tasks (Kogan, 1980; Honeck, Sowry & Voegtle, 1978). Nine to eleven year olds often did not understand figurative language, but they thought they understood them. This led to the conclusion that metaphorical reasoning was associated with later arriving stages of development. Piaget (1969) introduced the concept of "verbal syncretism" to explain the possible 'accidental' matching which was found between proverb and paraphrase.

The alternative view, which is called the "language experience view", believes that a child's ability to understand metaphorical language depends on the extent to which the child has had exposure to such language. According to this view, (Reynolds & Ortony, 1980) cognitive constraints are relevant only so far as they affect the child's general language abilities. This view encompasses the more functional view taken by Pollio and Pickens (1980), who stated that if a figure serves a communicative purpose (either reflectedly or unreflectedly), it must be

considered a valid figure. The developmental studies conducted by Vosniadou and Ortony (1986), Gardner and Winner (1979), Pickens, Pollio, and Pollio (1985), Pollio and Pickens (1980), Billow (1975), have attempted to clarify the use and understanding of figurative language by children. It is now claimed that children appear to be able to produce and comprehend metaphors almost as soon as they are able to produce and comprehend language (Palermo, 1989; Keil, 1986;). The qualitative shift in children's ability to use and comprehend more "appropriate" or complex relational metaphors is being recognized by most researchers (Gentner, 1988; Winner, 1988). The specific course of this development has presently become the focus of many investigations.

Assumption 7 *There are metaphoric universals that exist across languages, historical eras and cultural groupings.*

Metaphorical processes are believed to be at the heart of cognition and language and represent universal aspects of human mental functioning (Lakoff & Johnson, 1980; Lakoff, 1987). This assumption of the all-pervasiveness of metaphorical language is in direct contrast to the first assumption which considered metaphors to be rare occurrences. The issue of universality is basically unresolvable except on the basis of definition and theoretical predilection.

A metaphor in its most fundamental sense refers to similarity in the midst of difference (Billow, 1977). Although this describes the essential elements of a metaphor, this depiction of metaphor is inadequate and needs to be further qualified. Metaphor entails a special kind of similarity, one that overrides conventional category boundaries and brings together objects or events that normally belong to different domains (Kogan et al., 1980). Four universal principles of metaphoric transfer were suggested by Ullmann (1962): anthropomorphisation, i.e. ascribing human characteristics and motivation to non-humans; from abstract to concrete; from animals to other objects, events and/or people; and synesthesia (cross-modality perceptual transfer). These principles were found in all language families examined by Ullmann and

similar 'rules' or principles have been reported by Smith, Pollio and Pitts (1982) and Gentner & Grudin (1985) in their investigations of metaphors over a prolonged historical period. The possibility of extensive cross-category matchings must be incorporated in the study of metaphors, even if such crossings "violate" the logical structure of thought then presumed to characterize existing concepts.

An Evolution in Empirical Evidence

The literature on metaphors and other forms of figurative language provides evidence that the empirical researchers who have attempted to study different aspects of figurative language have been constrained by the above assumptions and beliefs (Pollio, Smith & Pollio, 1990). The inconclusive evidence in the area of understanding the nature and functions of metaphors is probably due to the type of research which has been used. This problem is endemic in the history of this subject (Ortony, Reynolds, & Arter, 1978). The conceptual distinctions and theoretical concerns of the philosophers, linguists and literary critics was looked upon by psychologists (who saw themselves as fact-seekers) as speculation that would not lead to any decisive settlement. The humanist scholars believed that the experimental tests and laboratory apparatus of the psychologists were ill-conceived and superfluous to the study of metaphors since most discoveries were believed to be possible with the application of common sense (Gardner & Winner, 1980). An appraisal of some of the empirical research will help in understanding the status of the evidence in the study of metaphor.

Experiments on metaphors are difficult to conduct but researchers recognized that this difficulty was offset by the outstanding practical relevance of the topic. The first actual experiments on metaphors were conducted in the early part of this century (1908-1951) in the psychological laboratories of Bühler and in the Wurzburg school of thought. The physical and medical science orientation led to a focus on sensation and perception. Some of the experiments conducted required the comprehension and paraphrase of various forms of

sentences. The Gestalt psychologists such as Heinz Werner and Solomon Asch discussed metaphor with regard to development of language and cognition (cf. Hoffman, 1983). The study of double-function terms in which aspects of one sensory modality are used to describe experiences in another modality was the general approach used. The use of the Semantic Differential Task (Osgood, 1953) required people to rate different words and concepts on various affective and semantic dimensions. The 1970s saw a reaction to the Chomsky, Katz and Fodor approach to language and meaning which resulted in a spurt in interest in metaphor. Empirical evidence of the research that has been undertaken since then can be found in the data corroborating or dismissing the underlying assumptions on the subject of metaphors (presented earlier).

The growing interest on the topic in the field of Artificial Intelligence is also seen in the development of various theories such as the Structure Mapping Theory (Gentner, 1982, 1983, 1988), and the Approximate Semantic Transference theory (Indurkha, 1987). Computer programs to simulate metaphorical understanding are exemplified by the Structure Mapping Engine - SME (Falkenhainer, Forbus, & Gentner, 1986); the Approximate Transference - AT-MAPs (Indurkha, 1987), and MIDAS (Martin, 1992). All these models however deal with the comprehension or understanding of metaphors and have not attempted to include or develop separate models for the production or generation of metaphors. The focus of a major portion of the research on metaphors and figurative language has also been on the understanding or comprehension of such language, there is very limited research on the production of metaphors. This has resulted in a lack of empirical evidence on the creation or generation of metaphors.

One study, conducted by Pitts, Smith and Pollio (1982), was designed to evaluate three different theories of metaphor production. It suggested three different process operations as being of crucial importance:

1. Attribute matching approach based on the Katz and Fodor (1963) work, postulated that metaphors are understood in terms of a process of matching attributes shared by the

topic and vehicle. The production of a metaphor by this approach implies a multi-stage process, with the first phase involving the generation of a list of attributes for the topic of the metaphor and the second phase representing an attempt to find a vehicle sharing these characteristics.

2. Analogical reasoning approach derived from Aristotle's views of metaphors as comparisons based on analogies. Metaphors are understood when the particular analogical basis underlying it is recognized and the implication by contrast is completed. The production of metaphors in this case is said to begin with two empty cells in the frame of an analogy. A choice of vehicle category would be the first step followed by the selection of a particular exemplar that best reflected the relationship. The choice of the exemplar (or the vehicle) is said to be determined by the use of a single major attribute characteristic of either the vehicle or topic, or both.
3. Perceptual or Gestalt approach to the understanding of metaphors was derived from Werner and Kaplan's work (1963), in which metaphor is viewed as a physiognomic perception. According to this view metaphors are understood immediately without having to either resolve the nonliterality of the statement or of rearranging the elements to solve an implicit analogy. This view emphasizes the nonanalytic "seeing" of relationships between the subject and the vehicle of a metaphor where such relationships are of a holistic and semiperceptual nature.

In order to empirically evaluate these theories of metaphor production, Pitts, Smith and Pollio (1982) produced three tasks where the instructions given to the participants reflected the three different theoretical approaches. The responses and the explanations for the responses were recorded and the products were judged by 15 independent judges for their aptness on a five-point scale. Participants were also asked to rate the difficulty experienced for the tasks and the satisfaction felt for their own responses on a seven-point scale. The focus of the analysis was on the production of metaphors and the authors concluded that the conditions most conducive to the production of metaphors were the Gestalt or perceptual approach.

In a study on metaphor production Connor and Johnson (1985) developed an enriched context by providing perceptual information, and assigning a communicative purpose, and a target audience. Their aim was the development of a paradigm suitable for the study of figurative language production. The satisfaction and difficulty ratings of the participants were also collected. Results indicated that the perceptual information did help in the production of metaphors.

Rotherberg and Sobel (1980) examined the role of homospatial thinking, which involves the active conceiving of two or more discrete entities occupying the same space, a conception that leads to the articulation of new identities. The stimuli used for this purpose were two visual images that were superimposed and separated. Participants produced ten metaphors in either of the two conditions. The metaphors were judged by two literary experts. It was found that the metaphors stimulated by superimposed images were judged to be significantly more creative than those simulated by separated images.

Cognitive Processes and Metaphorical Thought

Another important factor that affected the early investigations on metaphor and figurative language has been the limited information provided by the psychometric methods that were generally utilized. Relying heavily on large scale statistical methods and the analysis of aggregated data, such analyses generally proceeded under the assumption that patterns of data gathered from large numbers of people provide more reliable information than data gathered from any particular individual. The results of some studies (Gibbs, 1987; Hoffman & Kemper, 1987) have led to an understanding of what does not occur when subjects are exposed to metaphorical expressions, but there is a lack of data on what does occur in such a situation. In a review article on figurative language research in cognitive psychology, Pollio, Smith and Pollio (1990), who have been closely associated with the research in the field of figurative language for about twenty years, have commented on the lack of available

information on the mechanisms that underlie the usage of metaphors. There is, therefore, a need for a viable conceptual framework and methodology to study the cognitive processes and structures involved in metaphorical thought and language.

Most of the assumptions that were presented earlier have formed the basis of innumerable philosophical discussions and many empirical research projects. However, an attempt to discard many of these 'misconceptions' and to characterize metaphors as representing two diverse domains that "interact" to create multiple interpretations has been assumed for the present study. The assumptions that underlie the depiction of metaphors for the present investigation have been adapted from Indurkha (1987) and they are:

1. Metaphors use terms belonging to one domain, called the source domain, to refer to objects, other than their conventional referents, belonging to a possibly different domain, called the target domain.
2. The source and target domain need not be different or disjoint, they may be the same or may partially overlap.
3. There is no basic unit of metaphors in discourse. This implies that a word, a phrase, a sentence, a passage or a whole book can be metaphorical. Recognizing the broad implications of this categorisation, the present study has limited its focus to phrases and sentences.
4. A metaphor works by transferring a set of structural relationships from the source domain to the target domain coherently.
5. Aptness of a metaphor is determined, at least in part, by how much of the structure of the source domain can be coherently carried across to the target domain.
6. A metaphor can be subject to several interpretations and therefore a metaphor can miscommunicate.
7. Metaphors may highlight certain parts of the target domain whereas they may downplay certain others.

8. Metaphors redescribe the target domain in terms of the source domain. Different metaphors may yield different descriptions of the same target domain.
9. Both source and target domains participate in generating an interpretation of metaphors.
10. Metaphors can often create new insights and perspectives.

Metaphors have been generally recognized as having similarity, relation and integration as core concepts in the analysis of metaphor processing (Paivio, 1986). They have been called the "omnipresent principle" of language by Richards (1936), who recognized the need to "translate more of our skill into discussable science"(p. 94). An awareness of these aspects of thought which are generally implicitly recognized, needs to be explicitly distinguished in order that they can be taught as generalized skills in the classroom.

Metaphors in the Classroom

The role played by metaphorical thinking in the classroom has become the focus of many studies and many aspects of its influence have been researched (Evans & Evans, 1989; Evans, 1988; Gentner, 1982,1983, 1988). Metaphors essentially serve two purposes in the classroom: the creative and the heuristic purpose. The insights gained by the use of "imaginative rationality," which is how Lakoff and Johnson (1980) depict metaphor, further strengthens the case for the use of metaphors in the classroom.

Polya (1954; 1957) advocated an inquiry approach to learning and problem-solving in which the heuristic strategies are vehicles for making sense of problem situations. Heuristic strategies are depicted as a means to an end; focussing on the approach or process of the inquiry (the solution process) rather than on the end product (the solved "answer"). An aspect of metaphorical thinking that has remained relatively obscure has been the role it can play in the teaching process. Metaphors can be used as a heuristic in teaching different content matter. A heuristic can be described as a method for discovery or a procedure for solving a problem. It is

any sophisticated and directed procedure that functions by reducing the range of possible solutions to a problem or the number of possible answers to a question (Reber, 1985). It relies on guesses, intuition, practical strategies and ways of organizing to discover or prove something. They are general strategies independent of a particular topic, and are often in the form of suggestions that an individual can follow to help approach, understand and attempt to solve problems.

Duit (1991) comments on the significant explanatory and heuristic functions of metaphors and analogies in the development of science. Munby and Russell (1990) claim that as a heuristic, metaphors influence both teaching and research and as such, they suggest that the power of metaphors should be invoked by teachers and administrators to reflect, and possibly improve, on their own practices. The ability to think metaphorically is promoted by Gamlin (1989) for the generalization of knowledge. Vosniadou and Brewer (1987) suggest that there are two different mechanisms that are needed for helping restructure the acquisition of domain specific knowledge in children. They advocate the use of Socratic dialogues and analogies, metaphors and physical models by teachers.

Pugh (1989) has documented different instructional programs where metaphor has been used as an instructional instrument in various contexts. She cites a program where students' ability to use metaphors was fostered by New Jersey teachers working with Montclair State College. The strategies taught included: (a) exploring the meaning of metaphors in everyday use, (b) analyzing formal metaphors from different subject areas, (c) creating metaphors for increasingly abstract concepts, (d) creating metaphors for subject-related concepts and (e) evaluating metaphors through discussion. These strategies were found to enhance students' learning and critical thinking skills. Other programs also teach students to use metaphors in different contexts and promote using metaphor analysis as a means towards increased semantic accuracy, awareness of the deep importance of metaphor in human understanding and the ability to transcend disciplinary boundaries.

The success of these programs and the recognition of the importance of metaphor in cognition make the inclusion of metaphor processing a key issue for all instructional programs. Implementation of such programs would necessitate the identification of the components that underlie metaphorical thought.

Investigating the Descriptive Metaphor

Schön (1979) refers to the central role played by metaphor in accounting for a perspective of the world (or about a particular concept, issue or word) by influencing how individuals think about things, how they make sense of reality and set the problems that need to be solved later. This role involves referring to metaphor both as a "product," which provides a perspective or frame, and also as a process by which new perspectives on the world come into existence. The importance of the process aspect lies in the generative nature of the metaphor that is created. Gordon (1961) however advocates the strength of the descriptive metaphor also. This mystery and excitement generated for the generative metaphor, could be applicable in the case of the descriptive metaphor also, particularly when the listener (a student in the classroom) is exposed to it for the first time, making it, for all practical purposes, equivalent to a generative metaphor .

Generative metaphors take their inception in a process of which we are not thoroughly conscious at the moment of its occurrence. Thus we tend to slide past the moment of inception, to regard it as mysterious and sacrosanct, to call it inspiration, and to overlook the possible effects of training and discipline on the metaphor making potential. However, even a good descriptive metaphor has a quality of mystery about it as it postulates similarities between apparently unlike things, and as it illuminates and excites in the "confusion" of our impressions by simultaneously suggesting an identity (a similarity) and a separateness (a dissimilarity). This quality of mystery then is present in both descriptive and generative metaphors, though to different degrees.

(Gordon, 1961. p. 114)

The empirical and theoretical evidence pertaining to metaphors that has been reviewed here is by no means exhaustive, but it is a representative section of the research and interest that permeates the field. The limited information on the processes and structures that underlie metaphor processing is particularly acute in the case of the more creative and abstract task of production or generation of metaphors. The need to redress this has been expressed by some researchers, but the limited evidence is an indication of the difficulties inherent in the operationalization of a viable methodology to tap what can be depicted as abstract, creative and intuitive form of thought that is pervasive in human thought and language.

CHAPTER 3

CONCEPTUAL FRAMEWORK AND RESEARCH OBJECTIVES

The ubiquitous nature of metaphors demonstrates the necessity of a flexible approach that accommodates some of the multi-faceted features of metaphors. An appraisal of the prevalent conceptual frameworks that have influenced the empirical research on metaphors will help provide an indication of a feasible approach.

General Approaches to Metaphor Processing

Theoretical formulations of metaphor processing differ in the way they conceptualize the representational elements, structures and processes that are presumed to be the basis of similarity, relational and integrative reactions to a metaphor. There are some very different approaches and explanations to metaphor processing.

Perception-Based Explanations

The perception-imagery approaches generally assume that topic-vehicle similarity is perceptually based, entailing a transfer of sensory experiences as in synesthetic metaphors or they assume that the resulting holistic meaning of metaphors is based on some kind of "abstractive seeing" as represented in imagery. Imagery as a variable in human cognition is said to focus on the functions that it serves together with the representation underlying semantic and perceptual knowledge. The role that imagery plays in metaphor processing is said to be similar to the role of imagery in human cognition in general (Walsh, 1990).

Multidimensional Space Models

Metaphors are often regarded as analogies and some analogies are metaphorical in nature (Tourangeau & Sternberg, 1981; 1982). One view of metaphor is that it constitutes a

mapping of the elements of one set on to another, and it is the use of a given relation in a group of things to facilitate the discrimination of an analogous relation in another group (Ogden & Richards, 1960). Simple or sentential metaphors are assumed to be represented by simple proportional analogies (A:B::C:D), whereas extended metaphors or models require more complex analogical representation. Tourangeau and Sternberg (1981) extended the model of analogy based on multidimensional space models of similarity developed by Rumelhart and Abrahamson (1973). The model is based on the notion of constructing parallel vectors in a multi-dimensional space.

Analogical Processing

Miller (1979) argued the analogy view of metaphor more explicitly than others. He adapted the notation for conceptual functions and arguments developed by Miller & Johnson-Laird (1976) to account for metaphors and introduced a function called SIM to represent the relation of similitude between concepts. Analogical thinking is conceptualized as beginning with recognition of the similarity that exists between the first and second terms, and between the third and fourth terms. Miller proposed two possible methods by which comprehension may occur: (a) Memory images and (b) Semantic models. The former involves the construction of a memory image which contains not only those attributes normally associated with mental imagery but all the mental processes that can construct a record of a passage of text and the information extracted from it. A semantic model, on the other hand, requires that the reader uses the information provided to systematically narrow the variety of possible states of affairs that can be regarded as true. As each item is understood it is added to the model, where it further reduces possible states of affairs compatible with the model. The main difference between the two is that memory images are constructive, whereas semantic models are selective. The constructive process results in a single representation of a scene whereas the selective process results in a collection of possible states. The difficulty in maintaining the various images for all the possible states led to the conclusion that semantic models are more

abstract than images. Imagery was thus given a prominent role in Miller's (1979) analysis of metaphor.

Analogies as Conceptual Graph

It has been claimed that the purpose of the reader in considering a metaphor as an analogy is partly to assist in the generation of a mental image (Sternberg & Nigro, 1983). The "conceptual graph" theories of analogy do not emphasize the role of imagery in analogy. Gentner (1983) and Gick and Holyoak (1980) proposed that mental representations may be modelled by conceptual hierarchies or graphs; and that analogies are static properties of conceptual graphs. Analogical thinking, in the general propositional view, is a means of recording similarities between elements that already exist in the knowledge base, and whose properties are static, subject to a set of constraints. The view of metaphor in which comprehension is seen to proceed by a) a retrieval of sets of semantic features that are propositional in nature, and b) a selection from these features of an appropriate common "ground" for the metaphor.

The central idea in structure mapping is that an analogy is a mapping of knowledge from one domain (the base) to another (the target). An analogy is therefore, a way of focussing on relational commonalities independent of the objects in which those relations are embedded (Gentner, 1983). Certain forms of metaphors also fall into this categorisation. In interpreting these metaphors, people seek to put objects of the base in one-to-one correspondence with the objects in the target so as to obtain the maximum structural match. Objects are placed in correspondence by virtue of their like roles in the common relational structure; there does not need to be any resemblance between the target objects and their corresponding base objects. Central to the mapping process is the principle of systematicity, people prefer to map connected systems of relations governed by higher-order relations with inferential import, rather than isolated predicates. Gentner (1988) states that the systematicity

principle is a structural expression of our tacit preference for coherence and deductive power in interpreting analogy.

Conceptual Framework

Empirical investigations have led to belief that analogies can underlie metaphorical statements (Billow, 1975; Gentner, 1977; Miller 1979; Tourangeau & Sternberg 1981; 1982; Sternberg & Nigro, 1983). The view of metaphors as abridged analogies has, however, been criticised for missing the essence of metaphors. A metaphor involves the interaction between two terms that signify different modes of thought so that the resulting meaning involves a blending of the two terms. This view of metaphor has been called the interaction view and was advocated by I.A. Richards (1936) and further elaborated by Max Black (1962, 1979, 1990). Black (1990) acknowledges the widespread acceptance that has been gained by the interaction approach but believes that it needs to be understood more clearly before its power and limitations could be appreciated.

The information-processing approach to human cognition that is used by cognitive scientists, provides a dynamic measure to study human abilities as information-processing capabilities. This approach assumes that mental structures and cognitive processes (which are the 'things' that take place in the head) are extremely rich and complex and that structures can be understood; and understanding them will yield significant insights into the ways that thinking and learning take place (Schoenfeld, 1987). Holland, Holyoak, Nisbett and Thagard (1986) utilize this approach to present a unified framework for Induction, which specifies an integrated and inductive approach to problem solving. Induction, according to Holland et al. (1986) refers to "all inferential processes that expand knowledge in the face of uncertainty." It is described as the study of knowledge modification through its use and accommodates all forms of thought processing, the collection and analysis of information, drawing of inferences and the forming of conclusions. These activities that involve problem finding, defining,

refining etc. involve the generation of new possibilities from previous knowledge through the construction of mental models (Holyoak, 1984). The role played by imagery, analogies, attribute matching and other "key" components or aspects of a metaphor can be examined by utilizing the flexible conceptual framework that provides the scope for various levels of interpretation and that accepts variations and exceptional occurrences as central or core issues.

The mental models framework proposes that people represent the world with which they interact in the form of mental models. According to this approach, people do not have direct access to the "things in themselves." Concepts and conceptualizations mediate between the person and the world. Norman (1983) found empirical evidence that people do differ in the conceptualizations that they form. The nature of the problem and the problem solver affects and influences the construction of the model. Thus, the psychological representation of the environment and its expected behaviour is used to form a mental model (Holyoak, 1984). An internal representation is a model if its symbolic objects (which encode the world into categories) behave similarly to the objects in situations that are represented, and uses these categories to define an internal transition function that mimics the state changes that unfold in the world (Greeno, 1989; Holyoak, Koh & Nisbett, 1989). This implies that operations on the objects in the model have effects like those of corresponding operations in the real situations. The mental models framework assumes that models can be constructed on the basis of either verbal or perceptual information (Johnson-Laird, 1980). Images correspond to those components of models that are directly perceptible in the equivalent real world. Conversely, models may underlie thought processes without necessarily emerging into consciousness in the form of images. Mental models of this kind thus incorporate features of the situation that can go beyond the knowledge that the individual can state in propositions or other explicit forms, and the representations of situations formed as mental models can be constrained by principles that are either known or considered as hypotheses (Greeno, 1989). They are, thus, dynamic and transient representations of unique situations and provide a flexible framework for explaining human cognition. The flexibility, and high organizational ability of this approach

together with the role assigned to experience make mental models a suitable framework to investigate the aspects of cognitive structures and processes that form the core of metaphoric production.

The role of analogical thinking in problem-solving has been studied within the mental models framework (Holland et al., 1986). Utilizing a pragmatic and functional approach, the interaction view of metaphor can be extended within the framework of mental models by adopting the approach used for analogical problem-solving as it can be said that both analogies and metaphors involve the mappings between two mental models. In the case of an analogy, the mental model of the source domain has to be mapped onto the mental model of the target domain. On the other hand, the mental model of the topic of a metaphor forms the "source" or unfamiliar domain while the mental model of the vehicle forms the "target" or familiar domain. A model encompassing all the possible mappings of the two domains will be a metaphor. There are many constraints that affect the mapping process. While Holland et al. (1986) postulate that pragmatic and semantic constraints play an important role in the mapping process, Holyoak and Thagard (1990; 1989) included structural constraints as another important variable that are found to recur in theoretical treatments of analogy. A structural constraint is defined when a source model can serve as a model for the target if the objects in the two models can be placed into correspondence so that relations also correspond (Holyoak & Thagard, 1990). Semantic constraints that affect the mapping process are based on the evidence (Gentner & Toupin, 1986; Holyoak & Koh, 1987) that high semantic similarity lead to greater ease in the mapping. The pragmatic importance of the elements of the two models, which provides the assessment of relevance to the goals of the analogist (Holyoak, 1985) serves as the pragmatic constraint according to this model.

Research Objectives and Questions

The conceptual framework elaborated here together with a focused review of the literature led to the identification of the following issues that can be addressed as the research questions guiding this exploratory study.

Studies on adults to examine the role of metaphor production or invention (Edwards & Clevenger, 1990; Clevenger & Edwards, 1988; Boswell, 1979) have investigated the different conditions and factors affecting metaphor production but have generally not attempted to study the cognitive processes that are utilized by the individual for doing the task. The importance of identifying these processes is of particular relevance to educators since it helps in providing the procedural knowledge (the information dealing with "how to" do a task) that can lead to the development of better programs and techniques for teaching metaphorical thinking. The solution patterns for metaphor processing obtained from teachers could provide an enriched data base that would be particularly useful for describing possible strategies for dealing with both the teaching and learning of metaphor processing. A knowledge of the cognitive processes, patterns and strategies used by teachers will help in devising curricula that would lead to the children's acquisition of the sort of thinking skills required for metaphorical thinking. This expectation led to limiting the present exploratory investigation to a population of school teachers. The target population was further narrowed to include only teachers having at least two years of teaching experience. This limitation was imposed to ascertain that the population of teachers targeted for the present investigation reflected the general population of teachers working in the school systems and it provided the dimension of a general level of "expertise" in teaching.

Flynn (1989) contends that metaphors are an effective instructional device for individuals at the formal operations stage of cognitive development ; while they are not effective in promoting concept acquisition in pre-operational individuals and have a confounding effect for individuals who are concrete-operational (Flynn, 1989; Gentner, 1988).

Empirical evidence suggests that the successful use of metaphors as a cognitive tool cannot be taught to children who have not entered the formal operations stage, which, according to Piaget (1969), is usually attained by age 11 and is consolidated during the adolescent years. The focus of the present study was therefore further narrowed to include teachers of children who had attained the formal operations stage of cognitive development. It is for this reason that Intermediate and Secondary school teachers were chosen as the target population for this study.

There are many references to gender-related differences in the literature dealing with language processing, but few empirical investigations have explicitly dealt with gender differences in adults. It is suggested by Kimura (1992) that major gender-related differences in intellectual functioning may lie in patterns of ability rather than in overall levels of intelligence. The monitoring of the gender variable was of interest in the present investigation because it would provide data to study possible gender related differences in processing patterns. In the case of an exploratory study it is important that the methodology should be sensitive to possible gender-related differences that may exist, not just the quantity of metaphors produced but the type or quality also. The observation of any striking patterns can then lead to the generation of pertinent hypotheses that can be the subject of further research.

The Sciences and Humanities essentially represent different ways of knowing. Bruner (1985) differentiates two modes of knowing, the Paradigmatic (in which he included the Sciences, Mathematics, Logic etc.) and the Narrative (various Social Sciences). Eisner (1985) also mentioned the different approaches of the Sciences and Social Sciences. It is expected that different patterns of processing may be observed across the two domains of specialization. The "expertise" of teachers and their familiarity with a particular content domain (subject taught) can influence their patterns of processing. The academic specialization variable may yield different patterns of processing and lead to the production of different types of metaphors (Kogan, Connor, Gross & Fava, 1980). The domains of specialization was the other criteria that was used for the selection of the sample and it was divided into Science and Social Science

groups and the possibility of the observation of any patterns would lead to the generation of a hypothesis that could be examined in future research.

The initial focus of this investigation involves understanding the general characteristics of the descriptions provided by the participants when they are given specific instructions to produce metaphorical descriptions. The primary objective underlying this focus is to obtain some criteria for comparing and talking about the diverse range of descriptions that will be provided by the participants. This objective can be stated in the form of the following research question (R.Q.):

R.Q.1 What are the characteristics of the statements that are produced as metaphorical descriptions by Secondary and Intermediate school teachers?

The establishment of some criteria to characterize the descriptive statements produced leads to the possibility of exploring the differentiating characteristics between and across the groups of participants. This leads to the research question:

R.Q.2 What are the differentiating characteristics of the statements that discriminate between the Secondary and Intermediate school teachers across gender and specialization?

One of the central issues that led to the investigation of metaphor processing involves the identification of the underlying cognitive processes. The research question raised is:

R.Q.3 What are the cognitive processes employed in the production of metaphors by groups of Secondary and Intermediate school teachers differentiated by gender and domain of specialization?

The identification of the cognitive processes utilized in the production of metaphors can be examined to extract the distribution of the episodes. The observation of these distributions serve to highlight strategies used by the individuals and groups. The research question that will be addressed will be:

R.Q.4 What is the distribution of episodes in the production of metaphorical descriptions that were observed for the groups of Secondary and Intermediate school teachers differentiated by gender and domain of specialization?

CHAPTER 4

METHODOLOGY

Before presenting the details of the methodology utilized, an overview of the trends that have influenced the prevalent views and approaches to the study of human thought will help in situating the present empirical study on metaphors, and as a corollary, metaphorical thinking in context. This in turn should provide an indication of the strengths and weaknesses of the approach undertaken.

Antecedent Methodologies for Studying Human Thought

As mentioned earlier in Chapter 2, the complex and varied nature of human thought has been the focus of much attention throughout recorded human history. Early speculations about the human mind were closely related to religious and philosophical questions about the nature of human beings. There was a widespread belief that the human mind was generally beyond understanding in scientific terms. Early philosophers did attempt to make inquiries about the mechanisms that are responsible for acquiring new knowledge and the correspondence between the external world and subjective experience. The basic source of information for these inquiries was observations made by philosophers of their own thoughts and cognitive processes, which was called introspection. The analyses were directed towards very general issues and questions about the mechanisms and structure of the human mind and were primarily speculative, with little concern for establishing empirical support for the proposed ideas (Ericsson & Simon, 1984). The early views about metaphors and metaphorical thinking fall into the same pattern of inquiry, being based on this mixture of speculation and self observation. Many of the proposals for mechanisms that underlie metaphors have become an integral part of the subsequent theorizing, but the introspective method gradually lost its appeal

The advent of psychology saw a reemergence of the direct observation of the mind in action as a primary method for obtaining indices on the working of the mind. It began with the use of introspection naturally and unselfconsciously as a major tool of investigation (James, 1890). However, this form of introspection was frowned upon as being unscientific and more rigorous and systematic methods were sought. The Structuralists, under E.B. Titchner and Wilhelm Wundt, tried to gather facts about consciousness (the content of the mind) and in the process attempted to uncover its structure by advocating an analytic approach to introspection through laboratory studies of perceptual processes. The extensive practice and training that was required for "the description of experienced conscious content while ignoring the inferential processes of causation, dependence and development" was criticised in this form of introspection. Wundt objected to the use of introspection to study thinking since he believed that there was a qualitative difference between thoughts and perceptions (Ericsson & Cruthers, 1991). The Würzburg psychologists, however, disagreed with this form of differentiation since they believed that many aspects of consciousness could not be reduced to sensory and imaginal components. Karl Bühler replaced analytic introspection with phenomenal reports on thinking. A controversy raged between Wundt and Bühler during the early part of this century and the central issue was regarding the introspective analysis of thinking. The issue of using verbal reports on thinking was not considered problematic by either. However, some of the widespread negative connotations attached to all forms of verbal reports can be traced to these controversies.

Verbal Reports as Data

The "cognitive revolution" of the 1950s saw the legitimization of the study of various mental phenomena. The goal of specifying explicit models of how subjects could generate the correct solution to a problem by using their available knowledge, has helped the information processing approach gain wider acceptance. The most prominent methods that are currently

used to gather information about the contents of the mind within the information processing framework are "think-aloud" or concurrent protocols and retrospective data collection or interviews (Ericsson & Crutcher, 1991; Garner, 1988). These can be classified as "verbal-report methods" in which participants tell receptive listeners (usually the experimenter) what they have thought and done, what they might think or do in a hypothetical situation or what they are thinking and doing while doing a task. Ericsson and Simon (1984) have described a verbal report as a subject's account of his/her own mental processing. Verbal protocols can be taken as being "documents" of mental problem solving in a problem space, breaking down of problems in sequences of sub-problems revealing means-end analyses and other procedures. What counts in these protocols is what is being verbalized, not so much how this is being done (Dechert, 1987). The Structuralists view in using analytic introspection had stressed the content of the self observation or introspection as being the data or the facts, whereas the information-processing view merely looks at the presence of elements in the reports as being indices about what goes on in the mind (Ericsson & Simon, 1984).

Concurrent and Retrospective Reports

A think-aloud protocol is a moment-by-moment description which an individual gives of his or her own thoughts and behaviours during the performance of a particular task (Gerloff, 1987). The think-aloud technique thus produces concurrent verbalizations about an activity while it is being performed. These verbal reports are elicited with instructions and probes that vary in generality from being undirected and self-initiated to being structured and other-initiated. On the other hand, retrospective reports and interview techniques generally consist of a set of questions that are answered by the individual recalling previously completed activities. These interviews produce retrospective verbalizations since they elicit reports of cognitive and metacognitive activity already completed. The concurrent protocols are related to retrospective interviews in that the participants report on their thoughts and actions, but in the case of the

former they do so while engaged in cognitive processing, unlike the latter situation where they recall previously performed activity.

The collection of concurrent verbal protocols requires the participants to simultaneously pursue two tasks: the verbalization of their thoughts and the execution of the task. Instructing participants to think-aloud and to verbalize their thoughts during the solution of the task provides a sequence of verbalizations that correspond to the sequence of generated thoughts. The rationale for using this form of "process observation" data (Ericsson & Simon, 1987) is based on some underlying assumptions of the information processing model of the mind (Ericsson & Simon, 1984; Newell & Simon, 1972):

1. A cognitive process can be identified by analyzing the information that is attended to in short term memory (STM) and in the stimulus;
2. The information vocalized is a verbal encoding of the information in STM;
3. The capacity of STM is limited;
4. The verbalization processes are initiated as a thought is heeded; and
5. The verbalization is a direct encoding of the heeded thought and reflects its structure.

Even when one accepts the assumption that the execution of a task cannot be simultaneously performed with the verbalization of the process, it is pertinent to note that the concurrent verbal protocols are made while the relevant information is still available from STM. Other forms of verbalization that are retrospective in nature, refer to information processed at an earlier point in time that must be retrieved from long-term memory (LTM) before being verbalized. Information retrieved from LTM is not recalled in its original form, it is altered by elaboration, abstraction, reduction, or evaluation (Norman & Rumelhart, 1975). Concurrent verbal protocols are collected as the participant goes through the process of actually doing the task and as such it demands minimal abstraction, selection or inferential processing on the part of the participant .

The use of retrospective reports alone has not been accepted as being a reliable source of data for tracing thoughts and cognitive processes (Ericsson & Simon, 1984; Byrne, 1983).

The critical issue that questions the validity of retrospective reports and interviews is the time lapse between the execution of the task and its reporting. The format of using retrospective reports and interviews to supplement the data collected through concurrent verbalizations is gradually gaining credence in research on cognitive processing (Haastrup, 1987; Ericsson & Simon, 1984; 1987). The general purpose of a retrospective interview session is often an attempt to obtain a broader range of data sources to enhance the validity of the data collected and also to enrich it (Haastrup, 1987).

The "post-process observations" obtained through the use of retrospective sessions that immediately follow the collection of think-aloud protocols generally provide information on memory for thought processes during the task, memory for presented information and recollection of strategies used (Ericsson & Simon, 1987). Ideally, the retrospective report is collected immediately after the task is completed while much of the information is still in STM or otherwise directly accessible and can be directly reported or used as a retrieval cue. The strength of an approach that uses retrospective protocols together with concurrent protocols as dual sources of information essentially lies in the fact that it serves to:

1. reduce the level of inference that the researcher needs to make,
2. confirm statements or issues elicited in the concurrent session, and
3. provide new cues related to the concurrent session.

The analysis of the retrospective sessions is prompted and guided by the information obtained in the concurrent verbal protocol data. This reliance and interconnectedness of the different sources of data reduces the level of inference that is involved in the interpretation of the concurrent protocols (Grotjahn, 1987; Poulisse, Bongaerts & Kellerman, 1987). In the context of the present study, the use of the complementary methodologies of Concurrent Verbal Protocols followed by a session of Retrospective reporting was chosen for data collection in order to meet the three criteria mentioned above. However, before elaborating on these data-collection techniques, it is important to critically evaluate the inherent weaknesses of verbal report data that have been the subject of continuous debate.

Critical Review of Verbal Reports

The accuracy of verbal reports about cognitive processes has been continuously challenged and the criticism and attack of the different forms of verbal-report data has been widespread (Dobrin, 1986; Wilson & Nisbett, 1978; Nisbett & Wilson, 1977). However, it is important to distinguish and differentiate the different kinds of verbal data in order to highlight the form and nature of the data collected.

Researchers in qualitative type of research rely extensively on structured and semi-structured interviews as a means of collecting data (Marshall & Rossman, 1989). The interview is recognized as a valid source of data when the kind of information sought deals with an understanding of the interviewee's perspective and requires the checking of description against fact. However, interviews generally have a large processing-reporting difference, i.e., a long time lapse between thinking-doing and providing the verbal report of what was thought and done, and this may account for memory failure to intrude as an explanation for skimpy reporting. Interviews are also criticised for eliciting responses to hypothetical states that often require reporting on potential activity rather than actual activity. The efficacy of using Retrospective report and interview protocols as a follow-up of collecting Concurrent Verbal Protocols in a careful and controlled manner leads to the minimisation of the problems inherent in verbal reports. A critical review of the issues that have been raised against verbal protocols provides some of the constraints that form basic guide-lines of concurrent and retrospective data collection to minimize the weaknesses .

Criticism 1: Inaccessibility of Thought

There are many significant concerns put forward about the reliability and validity of verbal data in the study of different aspects of human cognition. The most basic concern that is mentioned is the accessibility of cognitive and metacognitive processes for introspective analysis. Nisbett and Wilson (1977) commented sceptically on people's "ability to observe

directly the workings of their own minds." Their attempt to discredit verbal reports, however, can generally be attributed to a lack of distinction between thinking-aloud protocols, retrospective responses and interviews. Most of the empirical evidence that was gathered or commented on by them was retrospective reconstruction and can be described as being affected by the inferences made when recalling previously heeded activity.

Guidelines to minimize weakness

The concurrency of the verbal reports overcomes this objection since the participants are instructed to report their "actions" and thoughts as they perform them and it requires only minimal level of interencing.

Criticism 2: Verbalization Alters Performance

A serious criticism that has been levelled at think-aloud procedures is that the verbalization alters the normal course of the task performance. The generation of verbal reports is claimed to disrupt cognitive and metacognitive processes and to alter it in potentially nontrivial ways.

Guidelines to minimize weakness

Ericsson and Simon (1984) reviewed empirical studies of such verbalizations and concluded that when the assumptions of the information processing model are not violated, the studies showed no evidence that verbalization altered either the course or structure of the thought processes. Sinnott (1989) agrees that verbal concurrent and retrospective reports provide a nearly complete record of the sequence of information heeded during task performance and verbally reported data seem as regular and valid as other types of data .

Criticism 3: Incomplete Nature of Verbalizations

The incompleteness of the concurrent protocols to reflect all the thoughts is another objection raised to challenge the validity of concurrent protocols. Think-aloud protocols provide glimpses of a particular process that are cognitively controlled or are the focus of

attention while performing a particular task (Steinberg, 1986; Randall, Fairbanks, & Kennedy, 1986; Ericsson & Simon, 1984). The problem of informant capacity (the informants need to select what they verbalize because a complete verbalization would over charge their processing capacity) and of informant consciousness (because not all processes are conscious) are mentioned by Haastrup (1987) and Ericsson and Simon (1980). Automatization of certain tasks or some subroutines of tasks leads to difficulty in accessing the steps that were needed to arrive at the solution; Ericsson and Simon (1980) agree that recurrent processes that have become automated can be particularly problematic in this regard. It leads to incomplete data and raises the possibility of inappropriate inferences about cognitive processes.

Guidelines to minimize weakness

For this reason it is important to always treat protocols as incomplete records of thinking and to avoid the error of equating language with thought (Garner, 1988). This difficulty highlights the importance of task selection since the characteristics of the tasks influence performance and, consequently, the verbal reports produced during performance. Tasks which are too simple or familiar to the participants may be automatized and may not be easily accessible for verbalization. The level of difficulty of tasks should be optimally moderate so that it is likely to require deliberate and conscious processing which would maximize the validity of the data collected.

Criticism 4: Verbalizations Are Often Inconsistent With Actual Behaviour

Another criticism of the use of verbal report data is that participants, on occasion, tell more than they can know (Nisbett & Wilson, 1977). It is claimed that participants often produce verbalizations that are inconsistent with their actual behaviour. They sometimes report using cognitive and metacognitive processes that they do not demonstrate using. They report what they perceive they ought to know or do, not what they actually know or do.

Guidelines to minimize weakness

Ericsson and Simon (1980) agree that in such cases verbal reports may bear little relation to actual processes but contend that the effect of this phenomenon can be minimized when concurrent protocols are used. Participants are called on to report their thoughts while doing a task, which minimizes the possibility of reconstruction and closely reflects the aspects of the task actually being attended to. During the retrospective session some individuals may report complementary activities that were not demonstrated or verbalized in the concurrent protocol session. However, this discrepancy demonstrates the importance of triangulating data for corroborating the evidence obtained from different sources.

Criticism 5: Verbalizations Are Affected by Verbal Facility

Verbal facility is also a concern since individual differences in the ability to verbalize do exist (Miyake and Norman, 1979). This is particularly true for individuals with limited language skills, such as young children and also for some culturally variant or economically deprived individuals. Highly general questions or instructions can also be affected by verbal proficiency.

Guidelines to minimize weakness

The use of a "trial run" as a warm-up exercise eases some of the performance anxiety that is inherent in any externally imposed format due to the "artificial" setting of any experimental task. It also ensures that the various requirements for the task have been understood. Cohen (1987) noted the importance of a practice session since he believed that faulty data may be collected if there was an inadequate understanding on the part of the respondents as to how they are supposed to report.

Criticism 6: Verbalizations Are Affected by External Influences

Another problem that has been mentioned in the literature (Garner, 1988) is the role played by the "cuing" offered by instructions and probes. For instance, unintentional non-

verbal and verbal cues offered by the experimenter, and participant's sensitivity to certain forms of feedback. Any comments from the researcher can affect the performance and the verbalization process.

Guidelines to minimize weakness

This effect can be minimized by keeping probes to a minimal level and making them "neutral" as far as possible. Predetermined or "standardized" instructions and probes may also reduce the interference effects.

Theoretical and empirical support is now available for the careful and monitored use of verbal reports in cognitive process research within the information processing theory framework. The judicious use of verbal protocol data is possible after the critical appraisal of the main criticisms against verbal reports have been dealt with. An investigation of the cognitive processes and patterns that underlie metaphor production will be undertaken by utilizing the methodology of concurrent and retrospective verbal reports. As the methodology to investigate the cognitive mechanisms involved in metaphor processing is elaborated, an attempt will be made to focus on the steps and precautions taken to reduce various biases in the collection of verbal report data.

Maximization of the reliability and validity of the data that was collected for the present study was obtained by judiciously following established guide-lines as elaborated by Ericsson and Simon (1984) and making a conscious effort to adhere to the basic constraints imposed by the methodology. The dual methodology of collecting concurrent and retrospective data used to gather data on metaphor production minimized the weaknesses inherent in verbal reports by i) instructing the participants to report their thoughts and actions while they were performing the assigned task leading to low levels of abstraction, selection or inferencing, ii) selecting a task that required deliberate and conscious processing that helped maximize the validity of the data and minimized the possibility of automatized responses, iii) use a warm-up exercise as a trial run to facilitate the participant's task performance, iv) minimizing experimenter

interference by keeping comments neutral and using only standardized instructions and probes. These precautions served to minimize the inherent biases that are to be found when using verbal reports as data.

Design for Present Study

Population and Sample

Teachers with at least two years teaching experience at the Intermediate (Grades 7-9) or Secondary level (High school) form the target population for the present study. Twenty-four in-service teachers volunteered to participate in the study. The participants were equally balanced by gender and academic specialization (Science/ Math or Social Science/ Humanities). The final composition of the sample reflects the targeted population of Secondary and Intermediate school teachers.

The socio-cultural and linguistic context plays an important role in general (which includes figurative) language processing. The participants for the present study had diversified linguistic backgrounds. Thirteen of the participants were fluently bilingual, with five native French speakers and three with other native language backgrounds. They were all generally comfortable with spoken English, and had agreed to participate in the study knowing the general format of the investigation. Some demographic data pertaining to their teaching experiences was also collected at the beginning of the data collection session.

The Production Task

It is in the production of metaphors that its potential for creative synthesis becomes apparent (Connor & Ward, 1986) and this necessitated the use of a task that imposes minimal structure and provides the freedom to create and explore all possibilities that the participant considers as viable and justifiable. The meaning and comprehension of metaphors are generally considered to be highly sensitive to context effects (Pitts, Smith & Pollio, 1982) and therefore it is plausible to believe that the same would apply to the generation or production of

metaphors. Pitts, Smith and Pollio (1982) commented on the paucity of research on this whole subject, but suggest that the very process of making metaphors changes as a function of the type of larger task within which it is embedded. The format of the task was open-ended to reduce the constraints imposed by context on the participants and to maximize the creativity that generating or producing 'new' connections may induce in the participants.

The task of metaphor production was constructed to elicit metaphorical descriptions triggered by stimuli that were presented in both the visual (in the form of monochromatic sketches) and verbal (in the form of single words) modes. The decision to use two different modes of presentation was guided by various studies which reported that the perception of similarity across different stimulus fields may affect the apprehension of a metaphoric relation (Dent, 1984; Verbrugge, 1980). The role played by imagery, analogy construction, attribute matching and/or other such mechanisms in metaphor processing could be affected by the presentation of stimuli in the two different modes. The use of both visual and verbal stimuli should provide a wider range of productions than would be possible by using a single mode of presentation. The verbal stimuli were concrete-familiar or abstract forms of nouns or adjectives. Table 1 presents the different forms of the stimulus-topics that formed the task. The visual stimuli were monochromatic etchings (sketches) taken from the Metaphorical Triads Task (Kogan et al., 1980). The use of a single stimulus to elicit metaphorical associations is recommended in the studies by Stumberg (1928), Pollio and Smith (1975). The present study takes this a step further by attempting to elicit metaphorical statements on the presentation of the stimulus card.

The task of metaphor production was presented as a description task and the participants were instructed to depict the stimulus (word or picture) in terms that would not commonly be used to describe the given stimulus. The task can be described as being ill-structured in the terms discussed by Arlin (1989) since the specification of completeness of the task and the certainty with which a solution can be recognized as being either correct or optimal are both very low. The use of a single stimulus word or picture to elicit descriptions that are

metaphorical in nature can be categorized as being ill-defined since the task is not clearly defined. An important aspect of the task requires understanding exactly what is needed for the execution of this task. In terms of the challenge posed by the task, it can be said to fall into the creative problem category, where the challenge is to find the goal as well as the solution (Perkins, 1990).

Data collection

Concurrent verbal protocols of the participants, who were asked to think aloud while they were performing the given tasks were recorded. This methodology is based on the work of Ericsson and Simon (1984) who have argued that verbal protocols provide indices of thought and cognitive processes. A cognitive process is seen as a sequence of internal states successively transformed by a series of information processes (Ericsson & Crutcher, 1991). The think-aloud protocols involve the verbalization of new thoughts as they enter attention as part of the normal sequential thought processes in performing a task.

An extensive review of empirical studies led Ericsson and Simon (1984) to the conclusion that the concurrent nature of the verbal protocols and the controlled execution of the task would ascertain greater accuracy of the protocols. These protocols reflect underlying thought processes without changing the sequence of heeded information. Hayes and Flower (1983) believe that the incomplete nature of verbal protocols is a consequence of many important psychological processes being completely unconscious. However, they contend that verbal report data are still beneficial in that they provide direct evidence about processes that are otherwise invisible, yield rich data and promote exploration of cognitive processes .

Table 1
 Categories of Stimulus-Topics in the Metaphor Production Task

VISUAL Picture Stimulus	VERBAL Word Stimulus	
	Noun	Adjective
PATH	STAR (Concrete)	
CHILD	DEW (Concrete)	TRANSPARENT (Concrete)
CANDLE	COURAGE (Abstract)	TRAGIC (Abstract)

Procedure

Each participant met with the researcher in a private setting. A brief introduction informed the participants about the highlights of the study, including the methodology of collecting concurrent verbal protocols. Informed written consent of the participants was then obtained for using their verbalizations as data for the study and also to quote excerpts from their protocols (Appendix A). The confidentiality of the participants' identity was guaranteed. Demographic information pertinent to their teaching was obtained prior to each data collection session. The participants were then provided general instructions on the think-aloud technique and were also briefed about the nature and role of metaphors in human cognition. A trial task was administered as a warm up exercise to make the participants feel comfortable with the format of the data collection technique (verbalization of their thoughts) and to familiarize them with the format of the experimental task (Appendix B). A version of The Production Task was constructed and used for this purpose. Despite the training session however, it should be noted that some participants did lose track of the task or were unable to find ways of reaching the "goal". This can be ascribed to the abstract nature of the task; the difficulty experienced by some of the participants may have been reduced by providing more detailed information and examples about the nature of figurative descriptions and metaphors in particular. Since the context for the task was provided by the instructions, no specific instruction about how to concretize and deal with the abstract task may have hampered the processing by individuals (Mc Ghee Nelson, 1992).

The trial was immediately followed by the presentation of the Production Task. The participants were instructed (Appendix C) to describe each of the stimuli that was presented to them in metaphorical terms. One cue that was provided to all the participants as a possible suggestion for assisting in the process of generation or production of metaphors was to look for some associations to the presented stimulus, then to find or observe some inter connections or possible relationships between these different associations and finally attempting to depict

the stimulus by using complete statements that were considered metaphorical. The stimuli were individually printed on 4" x 6" cards and while the first two stimuli were presented in a fixed order (to monitor the possible influence of ease and comfort with the task), the six stimuli that followed were presented in a random order to the participants.

On completion of the task of generating metaphorical statements for eight stimulus-topics, each participant was asked to rank the difficulty experienced in doing the assigned task for each item (stimulus) on the task, giving the reasons for the assigned rankings. A brief description of the strategies or course of action employed in tackling the task was also provided by each participant. This retrospective session provided data on aspects of metacognitive thoughts of the participants and would be useful for triangulating the information obtained from the concurrent protocols.

The Categorisation Process

The recordings on the audio tapes were transcribed verbatim, replicating the verbalizations as closely as possible; the pauses, repetitions, hesitations, incomplete statements, humour, distractions were all scrupulously incorporated into the data files to reflect the verbalizations as accurately as possible. To ease the analysis process and also for easy access and reference to the data, the files were in the format of short lines which were numbered consecutively.

A content analysis of a sample of the protocols was then carried out. The low degree of structure that is found in the protocols necessitated the development of analytical categories which can be gradually refined to develop a coding grid (Krings, 1989). The decisions surrounding the categorisation and coding of verbal protocols should reflect the underlying theoretical and conceptual framework of the research.

The development of a categorisation scheme was a two-pronged process consisting of categories derived from the literature and also from the data collected. This led to a dual-level of categorisation of the problem-solving behaviours during metaphor production and which met the need to restrict the level of inference made about the data and observations found in the protocols (Rowe, 1985), while capitalizing on the theoretical perspective. The protocols were closely scrutinized and then partitioned (parsed) into macroscopic chunks of consistent behaviour called EPISODES. This provided a generic framework for macroscopic analysis as suggested by Schoenfeld (1985) and Ericsson and Simon (1984). The elaboration of all the ACTIVITIES that are presented as a part of the categorisation scheme, on the other hand, are directly derived from observations made in the protocol data itself.

Theory-Bound Categories

The global taxonomy of metacognitive components (read, analyze, explore, plan, implement and verify) suggested by Schoenfeld (1985) has provided a strong framework for the analysis of verbal protocols in mathematical problem-solving. An adaptation of this framework to the categorisation of cognitive processes in metaphor production yielded the basic categories of encoding, analysis, exploration, assessment and external influences. The generic nature of Schoenfeld's taxonomy allowed for its adaptation to a task that was essentially very different in nature. The broader activity of Encoding was used instead of the Read strategy found in Schoenfeld's categorisation to reflect the different nature of the task where the initial phase of attempting to understand the problem required more than just a reading of the problem. The Analyze and Explore categories were adopted since they play an important role in the context of the present study. However, the Plan, Implement and Verify categories were collapsed into Assessment comprising of evaluative and affective components to reflect the activities that were widely observed in the protocols. The category External or Experimenter Influences was also included in this list in order to monitor its possible effect.

Data-Driven Categories

Newell and Simon (1972) have stressed the important contribution of data itself on the development and elaboration of the coding grid. The specific activities that were developed from a random sample of eight protocols, obtained from an equal number of males and females, and Sciences and Social Sciences specializations. Operational definitions for each of these cognitive activities were elaborated. To keep the level of inference for the application of the coding grid to the data at a minimum, the operational definitions for the categories has to be highly descriptive. The definitions that were compiled for the two levels of categorisation together with prototypical examples of the categories led to the development of a coding grid which was then used for the categorisation of the complete data set (Appendix D). A condensed version of this grid with the operational definitions and the codes for all the categories is presented as Table 2.

The framework provided by the verbal protocols is open-ended in that data can be subjected to a very different level of reanalysis; a different perspective or frame of reference which is equally valid may be taken by another researcher. To establish an index of reliability for the selected categorisation scheme, the coding grid was presented to two independent coders to obtain intercoder reliability on the classifications. The two coders were familiar with the technique of Verbal Protocol Analysis. They were trained to apply the coding grid, developed for the present study, to the protocols through a long orientation session. After discussing all the categories, a complete protocol was coded by the two judges and the researcher. Initial agreement was 0.72 and 0.63 between two judges but only 0.46 between all three judges. This situation necessitated a further prolonged session with the judges and the researcher in order to reach consensus. This session resulted in the refinement of some of the definitions for the categories and it also led to the collapsing of two of the categories that were listed as different activities but were apparently causing confusion to the coders. Prototypical examples were also added to the categories that were perceived as ambiguous. Thus, semantic

problems particularly the meanings and connotations for some words used to name and, in some cases, to provide operational definitions for some of the activities played an important role in the incongruities that were observed. Besides this difficulty, the lack of relevant information about linguistic task analysis in general, and figurative and metaphorical language in particular also played a crucial role in the difficulty experienced in obtaining agreement between the judges. This observation pertaining to the "expertise" of the judges is congruent with the findings reported by Schael (1990) who observed that the level of task dependent expertise had more of an impact on agreement among judges than experience with the technique of protocol analysis.

Table 2
Coding Grid for Cognitive Processes

Episode	Activity	Code	Definition
Encoding			<u>During this phase, the participant's response to the stimulus is a natural attempt to understand and/or encode the initial and subsequently emerging reactions to the given stimulus.</u>
	Observes literal attributes	OLA	The individual's response demonstrates a literal or surface level of processing only and shows that only perceptual features are heeded. This includes the observance of certain distinctive features of the stimulus.
	Difficulty in specifying attributes	DSA	Exhibits difficulty in specifying particular attributes of the stimulus. This difficulty or inability to specify certain attributes leads the participant to conjecture and guess or express an opinion about them.
	Recalls previous usages	RPU	The participant recalls or refers to familiar usages. The stimulus triggers recall of a particular way the stimulus word was previously used or it leads the participant to connect the stimulus presented to some form of prior experience or knowledge (e.g. Quote or statement from a book or poem, idioms etc.)
	Observes figurative attributes	OFA	Participant observes an abstract or conceptual relationship and demonstrates a figurative understanding.
	Highlights functional aspect	HFA	The functional aspect of the stimulus is the criteria used to deal with the stimulus. The participant limits the observation made to an action related aspect of the stimulus.
	Affective reaction to stimulus	ARS	An emotional reaction which explicitly shows the involvement of the participant's feelings is observed.

(Table continues..)

Table 2 (continued..)

Episode	Activity	Code	Definition
Analysis	Focuses on word	FOW	<u>The analysis phase of the task consists of the attempts to understand the requirements of the task, to select an appropriate perspective and reformulate the problem in those terms. The participant usually makes use of convergent thoughts to work on the task, keeping its conditions and goals in mind</u>
	Sensory appeal criteria	SAC	A single word or idea forms the basis for further analysis or exploration. The participant focuses and sometimes fixates on a word or idea.
	Reiterates instructions for task	RIT	Sensory or aesthetic appeal is used as criteria for doing the task. The participant often refers to the "images" that he or she uses to depict or denote ideas.
	Refers to previous statements	RPS	Rereads or refers to instructions for the task in order to achieve a better understanding of what may be required to deal with the task.
Exploring			The participant refers to earlier tasks or some previous statement made while dealing with another stimulus to form new associations
	Associates different ideas	EDI	<u>The participant explores the given situation by moving away from merely working with the obvious literal and superficial aspects of the stimulus. It is characterized by the use of divergent ideas and thoughts.</u>
	Compares particular attributes	CPA	On observing a similarity, the participant associates two different ideas or objects. The similarities are generally at the surface or superficial level. Explicitly compares or relates particular elements and attributes of given stimulus to other aspects of the same stimulus or to other stimuli perceived to have similarities.

(Table continues..)

Table 2 (Continued..)

Episode	Activity	Code	Definition
	Constructs an analogy	CAN	The participant constructs an analogy to express the structural similarity between different elements or aspects of the stimulus. These similarities are explicitly elaborated in the form of a mathematical ratio a:b:: c:d.
	Comments on subjective aspects	CSA	Participant uses personal or subjective criteria to tackle the task.
	Provides examples of observations	PEO	Provides possible examples to explain or elaborate on particular observed attributes.
	Ancillary comments made	ACM	While analyzing and exploring the given stimulus, the participant makes statements or comments that are apparently unrelated to the task.
	Questions experimenter	QE	While exploring and analyzing the stimulus, the participant questions the experimenter for clarifications
Assessment			<u>The participant assesses the current state of knowledge utilized in doing the task and determines the value or worth of his/her statements. Assessment comprises of an evaluative and an affective component.</u>
<u>Evaluative component</u>			The assessment performed is evaluative in nature and comprises of verification activities.
	Monitors activity explicitly	MAE	Explicitly reviews own activity to monitor the observations made
	Makes changes in answer	MCA	The assessment of observations leads to the decision to change the answer or other aspect of observations.
	States inability to continue	SIC	States inability to continue or to add anything to the task
	Comments on ease or difficulty of task	CDT±	Explicitly comments on the ease or difficulty experienced while doing the task.

(Table continues..)

Table 2 (Continued..)

Episode	Activity	Code	Definition
<u>Affective influences</u>			Emotional factors influence the assessment that is done by the participant
	Expresses positive reaction to the task	ERT+	Participant reacts positively to an aspect of the task by expressing relief or pleasure for working with the given stimulus.
	Expresses negative reaction to the task	ERT-	Participant reacts negatively to an aspect of the task by expressing confusion or frustration for dealing with the given stimulus..
	Expresses positive feelings for the observations made	EFO+	Reacts positively to the observations or statements made while doing the given task.
	Expresses negative feelings for the observations made.	EFO-	Reacts negatively to the observations or statements made while doing the given task.
	Expresses uncertainty about observations	EUO	The participant explicitly exhibits or states ambivalence and uncertainty about the observations or statements made.
External influences			<u>All comments and statements made by the experimenter can influence and bias the participant's own thoughts and are scrupulously noted to acknowledge their possible role in the solution process.</u>
	Clarification provided	ECP	The experimenter explains or clarifies an aspect of the task when asked by the participant
	Prompts or suggests action	EPA	Experimenter prompts in as neutral a way as possible when there are long lapses into silence or when participant obviously experiences difficulties.
	Further elaborations requested	FER	Experimenter asks for further explanations or elaborations when participant does not provide enough details

The application of the coding grid to all protocols provides traces of the cognitive processes utilized by the participants performing the assigned tasks. An important aspect of the assigned task was to generate or produce metaphorical descriptions of the stimuli. In order to understand the cognitive processes that each individual used in attempting to "solve" the problem, it was important to scrutinize and fully appreciate the metaphorical descriptions that were produced by the individuals. Two aspects of the descriptive statements can be analyzed:

The categorisation of the referents that underlie intentional language (Bruner, Goodnow & Austin, 1956) was first considered. Waldron (1967) distinguished between metaphors of form, metaphors of function and metaphors of evaluative response. Matic and Wales (1982) adapted this typology to develop three categories of "grounds": Structural, Functional and Evaluative or Evocative forms of metaphors. These categories provided the initial format used to classify the produced statements:

1. Structural metaphors typically comprised specific material or perceptual properties inherent in the physical entity usually denoted by a particular word. They usually reflect linguistic generalization and/or respecialization (specification of the general) or are based on perceptual features which imply the mediation of imagery (Matic and Wales, 1982);
2. Functional metaphors on the other hand, emphasized the potential effects, actions or uses of entities;
3. Evaluative metaphors comprised of generalized properties associated with or evoked by a word or stimulus, but not intrinsic to the entity denoted by it.

For the second aspect, the type of "mapping" underlying the produced statements was applied. "At the core of analogical thinking lies the process of mapping, the construction of orderly correspondences between the elements of a source analog and those of a target " (Holyoak & Thagard, 1989). A metaphorical statement includes different kinds of comparisons, varying in their complexity and the nature of commonalities they convey (Lakoff

& Johnson, 1980). In the Structure Mapping Theory of Analogy, Gentner (1988, 1986, 1983, 1980) postulates that an analogy is a mapping of knowledge from one domain (the base) into another (the target) which conveys that a system of relations that holds among the basic objects also holds among the target objects. According to this framework an analogy is a way of noticing relational commonalities independently of the objects to which those relations apply. Gentner (1988) then makes use of her "influential" (Novick & Holyoak, 1991) Structure Mapping Theory to derive distinctions among kinds of metaphors. These distinction criteria for analogies and metaphors are adapted to develop five levels of mapping to differentiate the complexity and kinds of comparisons made in the produced statements :

1. **Level one:** The *Basic* or the *Literal* level of mapping was level 1 and it was marked by the absence of any transfer of elements across diverse domains. This form of similarity mapping was literal in nature and was incorporated into the five differentiating levels to monitor the basic forms of similarity statements that were made.
2. **Level Two:** The *Attributional* level of mapping involved mere appearance match or only the transfer of common object attributes. Vosniadou (1989) refers to this as "salient" features that are commonly associated with the particular concept or object. Ross (1989), while distinguishing between "superficial" and "structural" similarities by explaining that the former aspects are not involved in the solution while the latter are an integral part of the solution refers to the 'salience' and describes it as the superficial aspects that stand out as soon as the problem is read. He preferred the term distinctiveness as being a more apt term to describe the salient and superficial aspects that are accessed.
3. **Level Three:** The *Relational* level of mapping entails the transfer or mapping of the relational structure. The produced statements can be analyzed as analogies and

convey that the base and the target share common relational structure and have nothing to do with common object attributes.

4. **Level Four:** The *Double* mapping involved both appearance and relational matches and is a mixture of the level 2 and 3 mappings conveying both common attributes and common relational structure.

5. **Level Five:** *Complex* mappings were marked by intertwined mappings and cross-weavings across the different domains. The mapping of many attributes and relations to one particular.

A classification scheme based on these two criteria was developed (Table 3). All statements that were produced as descriptions of the given stimuli were extracted from the protocols of the participants and were then classified on the basis of the classification scheme.

Data Analysis

A variety of perspectives provide some insight about the product and the cognitive processes and patterns in metaphor production:

- (i) an examination of the different types of statements produced by the participants as a requirement for the assigned task,
- (ii) an analysis of the concurrent verbal protocols of the participants that were collected while they were doing the task, and
- (iii) the retrospective interview session data that was collected immediately following the completion of the task.

Table 3

Classification Scheme for Types of Metaphorical Statements Produced

Type of statement	Mapping	Symbol	Excerpts from protocols of participants
STRUCTURAL The size, shape, colour of subject or material properties that are easily visualized or conceptually described inherent within the nature of the thing form the basis for the statement made.	Basic (1)*	S(1)	Dew comes up from the ground, it does not fall from the sky. (S27, P3. Line 227-228)
	Attributional (2)	S(2)	The winding road is like a shoe lace. (S 19, P2. Line 699-670) Transparent is being able to see through glass or something like that.. (S 20, P7. Lines 230-231)
	Relational (3)	S(3)	Dew on the grass in the morning is like the stars. (S 5, P3. Lines 675-676)
	Double (4)	S(4)	A candle is like a person's life because one day it will end. There is no immortality, some candles burn faster, some candles burn longer, but some candles burn faster and brighter. (S 27, P6. Lines 526-530).
	Complex (5)	S(5)	The candle represents a person and (can be) likened to both behaviour and the physical being of the individual, the lighting is the physical environmental factor. (S28, P6. Lines 527-530)
FUNCTIONAL (F) The intention or purpose (often superimposed on structural properties) emphasizing utility forms the basis of the statement made. There is an implicit reference to action.	Basic (1)	F(1)	Courage is doing. (S 1, P5. Line 301) It is a word to describe the outcomes of human activity or action. (S 13, P8. Lines 163-164)
	Attributional (2)	F(2)	In life, the hard times represent the bends that you meet.(S 4, P 2).
	Relational (3)	F(3)	This is learning, this is a child learning in the most natural way and probably the most effective way. (S 9, P4. Lines 521-523).
	Double (4)	F(4)	Dew not only nourishes the ground and the trees, it starts everything off clean.(S 9, P3. Lines 191-193) A star is a benchmark because it demonstrates large distances and ,physical probability. (S18, P1. Lines 440-441)
	Complex (5)	F(5)	Stars are like road maps 'coz I use the position of the stars to help me understand what's occurring in my life. (S12, P1. Lines 34-36)

(Table continues...)

Table 3: (...Continued).

Type of statement	Mapping	Symbol	Excerpts from protocols of participants
EVALUATIVE Statements made show judgment in respect of qualities inherent within relationship that focus on abstracted and generalized impressions evoked by a particular subject.	Basic (1)*	E(1)	Courage is the lion from the Wizard of Oz. (S12, P5, Lines 128-129)
	Attributional (2)	E(2)	Tragic is things that are very senseless. (S9, P8, line 331)
	Relational (3)	E(3)	Babies are innocent, babies are curious and babies are the way all of us should be as often as possible in our lifetime. (S25, P4, Lines 348-350).
	Double (4)	E(4)	Stars are a part of the dark shadows, the evening or the night when we see them we are either sleeping or unconscious.. or almost there. (S6, P1, Lines 580-584)
	Complex (5)	E(5)	Experience can be very beneficial and we do things according to experience without really really realizing that (we) have the experience. (S30, P7, Lines 798-801)
			Stars represent life, because you have the analogy of.. you've got bright, you've got dim, you've got people making a difference in other people's lives in the same way that stars make a difference, you get people making patterns and hence stars are population. (S10, P1, Lines 31-39)
			There is a bit of romance involved in dew, its not as water because the droplets are separate, so little specks of light which go to the lights of the city with some mist involved, so it would be mysterious. (S14, P3, Lines 154-161)

* The number within parentheses depicts:

- 1 The mapping of elements is at a literal or basic level and the relationship is not across domains.
- 2 The mapping process takes place across domains, but it is merely an appearance match or common object attributes are highlighted
- 3 The base and the target share a common relational structure which forms the basis for the mapping.
- 4 A mixture of appearance and relation mappings or matches can be observed
- 5 The intertwined nature of the cross-weaving connections and mappings leads to a complex interconnected description.

The generic metaphor, according to the literature, comprises of three essential components: the topic, the vehicle, and the ground. An analysis of these components provides the different aspects that are the focus of attention during different phases. The perspective that forms the basis for the operationalization (metaphor instantiation) and the analysis phase (output) of the "product" is presented as Figure 1. It illustrates the three components and also the three phases (levels) comprising of the generic metaphor, its instantiation for the present investigation and the analysis of the output. The Figure provides a model of the components of a metaphorical statement:

Phase 1: At the generic level — with the topic and target and implicit ground.

Phase 2: At the instantiation level — with the implementation of the generic model for the investigation undertaken. The Topic was presented in the form of the Stimuli that were of verbal and visual form, while the target and the mapping process characterized the ground and were part of the descriptive statement produced.

Phase 3: At the output level — The metaphorical statement produced was componentially analyzed.

The mapping process was analyzed on the basis of the implicit "ground" or the underlying meaning of fifteen categories of statements, three types of categories and five mappings (Table 3). The target that was used for the mapping process was also analyzed with a syntactic **typology**. Frequency distributions of the classified statements (on the basis of the types and mappings elaborated in Table 3) were compiled for the four groups of participants and analyzed for patterns.

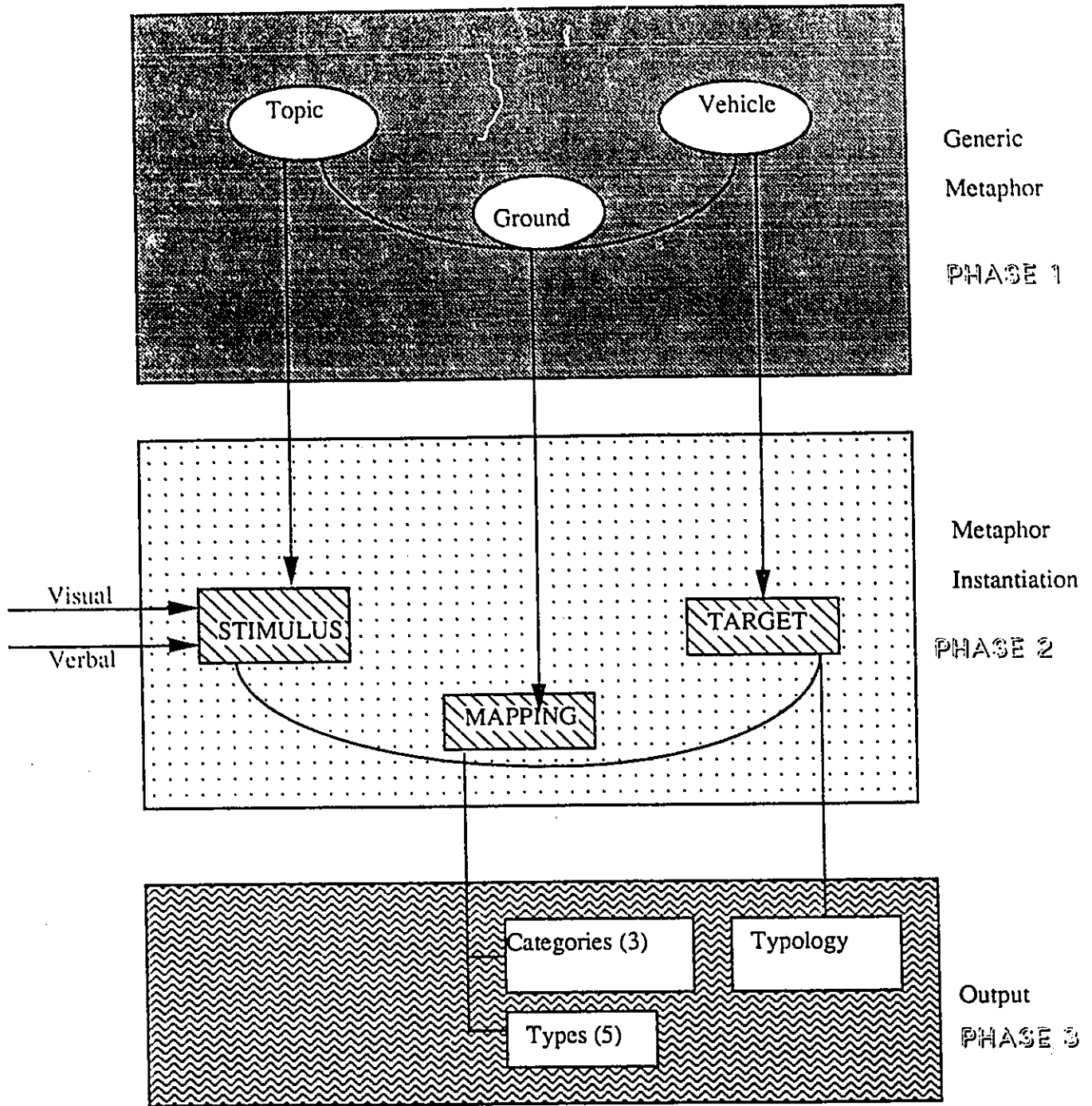


Figure 1: Phasal Model of the Components of a Metaphor

The process used by the participants to complete the assigned task was analyzed using verbal protocol analysis. Following the guide-lines of Ericsson and Simon (1984), the coding grid (Table 2) that was developed for the present study was used to obtain the sequential categorisation of the process undertaken. The distributions of behaviour focusing on the duration and frequency of observation were noted and links between the process and the "product" were also analyzed. The details pertaining to these analyses are presented in chapter five.

CHAPTER 5

ANALYSIS AND INTERPRETATION OF RESULTS

The research objectives for this exploratory study on metaphorical thought are primarily focussed on achieving a better understanding of the cognitive processes and patterns that underlie a task involving metaphor production. To succeed in the achievement of these objectives, the participants in the present study were assigned a task asking them to describe various stimulus words and pictures in metaphorical terms. The verbatim transcription of their verbalizations formed the data base. The density and richness of the data obtained provides various avenues for exploration. The data can be analyzed and interpreted at different levels of depth and complexity. This chapter reports on the analysis done on the data and provides some interpretations for the results that were obtained.

The decomposition of the verbal protocols of participants, to scrutinize the cognitive processes and patterns utilized in the production of metaphors, helps in tracing the underlying steps involved in the "solution process." A brief overview of the different stages that are involved in the analysis of the concurrent verbal protocols of the participants serves as a guide for the detailed analysis and interpretation that follows.

General Overview of the Analysis

The initial phase of the analysis focuses on the "product" that was obtained from the participants who had been instructed to describe the given stimulus words in metaphorical terms. Firstly, the frequency distributions of the metaphorical-descriptive statements were analyzed. A global perspective on the "product-oriented" data was followed by a more specific and detailed level of analysis by focussing on the elements (topic, target and ground) that comprise the metaphorical statements. This analysis of the metaphorical descriptions bridges

the two different approaches of looking at the product (the statements produced) by establishing the qualitative differences that are to be found in the descriptions and then quantifying the observations as frequency scores.

The next phase of the analysis involved the tracing of the cognitive processes underlying the task of metaphor production. The concurrent verbal protocols were categorized with the help of the coding grid that was developed for that purpose (Table 2) and focuses on the "process-oriented" aspect of the data. An analysis of processes leads to the observation of patterns of "problem-solving" behaviour, which in turn leads to the development of participant "profiles". Finally, the focus is directed to looking for possible links between the "product-oriented" statements and the "process-oriented" distributions of behaviour.

Metaphorical Statements as "Product"

The metaphorical statements generated by the participants can be described as the "product" of the task, and as such, are an integral part of the process which is the focus of the present study. These products were generated by the participants when they were instructed to describe and/or depict the given stimuli in different ways. The twenty-four participants generated metaphorical descriptions for eight stimuli and it was observed that for any given task, the number of statements produced by each individual varied from one to as many as eight. The 192 tasks (24 participants X eight tasks) produced a total of 764 descriptive statements, making the average number of productions for each task just under four per participant.

The descriptive statements produced by the participants were categorized on the basis of the two level Classification Scheme presented earlier (in chapter 4) in Table 3. The categories in this scheme are based on the speaker's intended meaning of the statements (i.e. it is analyzed and interpreted in the larger context, rather than just relying on a semantically determined analysis that just analyzed individual statements for literal meaning). A frequency distribution

of the categories of statements was then obtained for the four groups (Gender X Domain of Specialization): Males, Sciences (MS); Males, Social Sciences (MSS); Females, Sciences (FS); Females, Social Sciences (FSS), and these are reported in Table 4.

The frequency distributions of the metaphorical statements reported in Table 4 can be analyzed in two ways. First, within each category of statements, the frequencies can be compared across groups. An example of this inter-group level of comparison would be the comparison of the grand total number of statements produced by the four groups of participants. The Females Social Sciences (FSS) group of participants were the most prolific producers of metaphorical descriptions with a total of 218 statements. They were followed by the FS, MSS and MS groups with 200, 186 and 160 statements respectively. These inter-group patterns of observation could be in (a) the case of gender over domains of specialization or (b) for domains of specialization over gender.

Secondly, a comparison of the frequencies of different categories of statements produced within each group can be used to construct hierarchies of production for each group. To illustrate this type of analysis one can compare the frequencies of the different types of statements made by one group, for example, the Females Social Sciences (FSS) group. A breakdown of the 218 statements made by this group shows that 130 statements were Evaluative, 59 were Structural while 29 were Functional. This helps in establishing a hierarchy of statements produced. There is a marked inclination for Evaluative type of statements followed by Structural and Functional types. Similarly, within each type of statement that was produced, the five levels of mapping can also be monitored to compare and highlight possible differences in the kinds of statements made. A closer examination of the frequency scores presented in Table 4 will highlight these inter and intra-group variations.

Table 4
Frequency of All Metaphorical Statements Produced

Type	Mapping	FEMALE		MALE		Total	χ^2
		Soc. Science	Science	Soc. Science	Science		
S T R U C T U R A L	LITERAL	1	1	0	1	3	
	ATTRIBUTIONAL	21	19	32	9	81	7.03*
	RELATIONAL	8	8	6	5	27	
	DOUBLE	29	26	12	19	86	1.05
	COMPLEX	0	1	0	1	2	
	TOTAL	59	55	50	35	199	
F U N C T I O N A L	LITERAL	3	5	3	4	15	
	ATTRIBUTIONAL	0	1	4	3	8	
	RELATIONAL	23	28	25	30	106	0.054
	DOUBLE	3	7	3	2	15	
	COMPLEX	0	1	0	0	1	
	TOTAL	29	42	35	39	145	
E V A L U A T I V E	LITERAL	3	7	7	6	23	
	ATTRIBUTIONAL	6	6	3	0	15	
	RELATIONAL	98	71	71	66	306	.927
	DOUBLE	20	15	19	14	68	.0792
	COMPLEX	3	4	1	0	8	
	TOTAL	130	103	101	86	420	
GRAND TOTAL		218	200	186	160	764	

*p < 0.05

The comparison of frequency distributions across categories of statements and across groups leads to the identification of a different trend for the Structural type of statements compared to Functional and Evaluative types. The *Attributional* (81) and *Double* (86) mappings had the highest frequencies, followed by *Relational* (27) mappings for the Structural category. This pattern is displayed by all four groups but it differs from what is observed for the Functional and Evaluative types which displayed higher *Relational* mappings. An explanation for this observation may reside in the nature of the Structural category itself, since the material properties of the stimulus (its size, shape, colour and other visual or conceptually describable properties) form the basis of this class of statements. The mapping process in the production of metaphors then transfers these attributes, or material properties, to another domain, leading to *Attributional* level of mappings. However, even in the cases where conceptual relationships were also observed in the stimulus-topic, it generally would be incorporated with the appearance of *Attributional* matches also, thus leading to greater observation of *Double* mappings and fewer occurrences of just *Relational* mappings for the Structural type. The frequency of *Attributional* mappings for the Structural statements was higher for the MSS group (32) compared to the FSS group (21), the FS group (19), and the MS group (9). A chi-square test to determine the degree of association between the two variables (gender and domain of specialization) can be applied. The use of 2 X 2 contingency table (Siegel and Castellan, 1988) for the different categories of statements led to only one significant association ($\chi^2(1) = 7.03, p < 0.05$), namely the Structural-*Attributional* form of statements. The frequency of *Double* mappings for this category of statements suggest that females produced more metaphors than males. The FSS group had the highest frequency of 29, followed by FS group with 26, the MS group with 19 and MSS with 12 observations. However, the chi-square test of association found no significant differences in the observation of these frequency patterns across groups.

Of the three categories of statements, the Functional category had the lowest observed frequency (145). Within the Functional category, the *Relational* form of mapping was the

most frequently observed. The distribution of frequencies for Functional-*Relational* statements was essentially uniform across groups although it was highest for MS group (30), followed by Female Sciences group (28). It is possible that the science orientation of these two groups played a role in the higher production of Functional statements since the sciences as a domain of specialization are believed to be more functionalistically oriented. However, the chi-square test for degree of association found no significantly different patterns across the groups for this category.

The Evaluative category displays the highest number of metaphorical statements (420) with a vast majority of *Relational* mappings (306) and a significant number of *Double* mappings (68). The frequency of *Relational* mappings are at least four times larger than the *Double* mappings across the four groups. The FSS group showed a higher incidence of production, particularly for the Evaluative-*Relational* statements (98), when compared to the other groups. However, the discrepancy between groups was indicative of generalizable patterns.

A comparison of frequency patterns of the categories of statements (as opposed to mappings) can also be undertaken. Table 5 presents the frequencies and percentages across groups and categories of statements. The degree of association between groups and category of statements can also be done using a Chi-square test for a 4 X 3 contingency table. The Chi-square statistic for the 4 X 3 contingency table was 9.313 ($p > 0.05$). Thus no statistically significant difference was found across groups for the frequency patterns of statements. The extracted patterns suggest possible "preferences" for the different categories of statements for the various stimuli applied to the different groups of participants.

Table 5

Frequency and Proportion of Metaphorical Statements Produced

Statement Category	FEMALE		MALE		TOTAL
	Soc. Science	Science	Soc. Science	Science	
Structural	59 (27) ^a	55 (28)	50 (27)	35 (22)	199
Functional	29 (13)	42 (21)	35 (18)	39 (24)	145
Evaluative	130 (60)	103 (51)	101 (54)	86 (54)	420
GROUP TOTAL	218	200	186	160	764

Note:

^a. The figures in parentheses are the percentages of the statements produced within each group.

$\chi^2 (6) = 9.313$. ($p > 0.05$).

The frequency of use of specific categories varied within and across the four groups. This is seen particularly in the case of the FSS group which had a total of 59 Structural (27%), 29 Functional (13%) and 130 Evaluative (60%) statements, whereas the MS group had 35 Structural (22%), 39 Functional (24%) and 86 Evaluative (54%) statements. The hierarchy of statements produced by the FSS group had Evaluative, Structural and Functional categories in descending order, whereas the MS group had a hierarchy of Evaluative, Functional and Structural categories. This hierarchical variation displays the propensity of the MS group to produce more Functional statements. The proportion of Functional statements to the total number of statements made by each group showed that the participants with Science specialization produced relatively more statements (24% for MS and 21% for FS groups) than the participants with Social Sciences orientation (18% for MSS and 13% for FSS groups).

Patterns of Production for the Different "Topics"

The research literature shows that the commonly accepted way of talking about the parts and structure of metaphors generally makes reference to three key elements. These elements are (a) the "topic" (or Tenor) which is the "new" or less known way of describing a given word, (b) the "target" which is the familiar or already known word used as a "vehicle" to establish features (of similarity and/or difference), and (c) these two elements share a common "ground" which forms the basis for the similarity (or any other relationship) that is observed.

Shifting from the global level of analysis of the metaphorical statements produced, a more specific level of analysis can be undertaken that focuses on these elements that correspond to essential features. The different stimuli that were used in the present investigation of the task of producing metaphorical statements are the "Topic" (Black, 1960; 1990; Richards, 1960) or the "Source" (Gentner, 1982; 1983) that are to be described. There could be some influence from the visual or verbal presentation of the stimulus on the descriptive statements produced. Similarly, it is possible that the abstract or concrete natures of the verbal presentation (words that were nouns or adjectives) played a role in the observed

metaphorical descriptions produced. For each task stimulus, the frequency of occurrence of the statement produced by the four groups of participants is presented in Tables 6, 7, and 8.

Each of these Tables focuses on a specific type of statement that was produced and is derived from the global frequency scores presented in Table 4. This was achieved by refining the categories with the stimulus-topics. A criterion to reflect on the differences between the gender and domain of specialization variables was established to observe patterns of occurrences across gender (G), domain of specialization (S), and a form of interaction (G X S) pattern. The criterion of establishing patterns of observations facilitates the interpretation of the variation in occurrences that may emerge from the frequency of observations. It has to be sensitive to the variations that are observed in the data. It should not be too stringent since that would lead to the exclusion of too many observations, nor can it be too relaxed, because that would lead to the inclusion of too many observations. This criterion corresponds to the use of patterns identified by Taylor (1992). The notion of the patterns is not used in an inferential manner and they are only used to facilitate the interpretation of the differences that are observed. However, the observation of large differences are indicative of possible viable hypotheses or even some promising avenues of research for future consideration. For the purpose of the present study a pattern is identified when a difference in frequencies of at least three is observed between the different groups. The G X S pattern is similar in form to an interaction pattern and it reflects a difference in gender across domains of specialization. When such a difference exceeds three, then it is called a G X S pattern {for example [FS- FSS] - [MS-MSS] ≥ 3 }.

Table 6

Frequency of Structural Metaphorical Mappings for the eight Topics

Stimulus	Topic	Mapping	FEMALE		MALE		PATTERN ^a		
			Soc.Sc	.Sc.	Soc.Sc.	Sc.	G	S	GXS
Concrete Noun	STAR	Literal	0	0	0	0			
		Attributional	4	4	3	3			
		Relational	2	1	0	0	*		
		Double	5	8	4	3	*		*
		Complex	0	1	0	0			
Visual	PATH	Literal	1	0	0	0			
		Attributional	4	2	7	3	*	*	
		Relational	1	1	0	0			
		Double	5	8	3	9		*	*
		Complex	0	0	0	0			
Concrete Noun	DEW	Literal	0	0	0	1			
		Attributional	2	6	7	0		*	*
		Relational	1	1	3	0		*	
		Double	6	1	2	2	*	*	*
		Complex	0	0	0	0			
Visual	CHILD	Literal	0	0	0	0			
		Attributional	1	0	1	0			
		Relational	1	0	0	0			
		Double	1	0	0	0			
		Complex	0	0	0	0			

(Table Continues...)

Table 6 (..Continued)

Stimulus	Topic	Mapping	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Abstract Noun	COURAGE	Literal	0	0	0	0			
		Attributional	0	0	1	0			
		Relational	1	0	0	2			*
		Double	1	0	0	0			
		Complex	0	0	0	0			
Visual	CANDLE	Literal	0	0	0	0			
		Attributional	3	3	6	2		*	*
		Relational	0	2	0	1		*	
		Double	6	5	3	5	*		*
		Complex	0	0	0	0			
Concrete Adjective	TRANS- PARENT	Literal	0	0	0	0			
		Attributional	7	4	8	1		*	*
		Relational	2	2	2	2			
		Double	4	4	0	0	*		
		Complex	0	0	0	0			
Abstract Adjective	TRAGIC	Literal	0	1	0	0			
		Attributional	0	0	0	0			
		Relational	0	1	1	0			
		Double	1	0	0	0			
		Complex	0	0	0	0			

Note:

^a. A pattern is noted when a frequency difference of at least three is observed between the groups across gender (G), across domain of specialization (S), or across their interaction (GXS).

The frequency of Structural statements that were produced as descriptions for each topic (Table 6) by the four groups of participants reveal variable patterns across gender, domain of specialization and also across their interaction. An analysis of these patterns provides an indication of the possible effect that the nature of the stimulus, as the "topic" for the descriptive statement produced, had on the category of statement produced.

It is observed that the presentation of the stimuli CHILD, COURAGE and TRAGIC led to the production of very few Structural statements. In the case of the stimulus words COURAGE (Noun) and TRAGIC (Adjective), the abstract nature of the topics may have provided few opportunities for finding and exploring any concrete material properties that could then lead to the production of Structural statements. However, in the case of the CHILD, the visual presentation of the stimulus could have been a factor that led the participants to concentrate more on appraising the qualities and functions of the topic-stimulus rather than looking at its physical attributes. Teachers (and parents!) generally see a child as a dynamic, functioning individual with different qualities and attributes that are taken as the quintessential "properties" that define and distinguish one child from another. It may be an overgeneralization to state that this form of response may be expected from all adults when it comes to describing a child. However, it is possible to say that since all the participants were teachers, they may have downplayed the physical appearance of the child and stressed what they perceived as more "relevant" aspects of the stimulus.

The two other visual images PATH and CANDLE did elicit some Structural statements and this was probably because the physical attributes of the stimuli that were presented were used as the basis for making descriptive statements. For the visual image of the PATH, a pattern is noted across gender (Females $4 + 2 = 6$, Males $7 + 3 = 10$) and across specialization (Social Sciences $4 + 7 = 11$, Sciences $2 + 3 = 5$) for the *Attributional* form of mappings, whereas the *Double* mappings showed a pattern across specialization (Social Sciences $5 + 3 = 8$, Sciences $8 + 9 = 17$) and an interaction effect ($8 \text{ FS} - 5 \text{ FSS} = 3$ compared to $9 \text{ MS} - 3 \text{ MSS} = 6$ for a difference of 3). The other visual stimulus was the CANDLE and it showed a pattern

across specialization (Social Sciences $3 + 6 = 9$, Sciences $3 + 2 = 5$) and also an interaction effect ($3 \text{ FS} - 3 \text{ FSS} = 0$ which differs from $2 \text{ MS} - 6 \text{ MSS} = -4$ by 4) for *Attributional* mappings. The *Double* form of mapping for the CANDLE stimulus was seen to have patterns across gender (Females $6 + 5 = 11$, Males $3 + 5 = 8$) and an interaction effect was also seen ($5 \text{ FS} - 6 \text{ FSS} = -1$ which differs from $5 \text{ MS} - 3 \text{ MSS} = 2$ by 3).

The frequency distributions for the statements produced in the case of the three concrete words STAR, DEW and TRANSPARENT display a trend of having a pattern across gender for the *Double* form of mappings. In each of these cases it is duly noted that the frequency counts for the females was higher than it was for the males. The *Double* form of mapping also displayed interaction effects in the case of STAR and DEW and a pattern across specialization for the stimulus word DEW. The *Attributional* form of mapping of DEW displayed a similar pattern across specialization and an interaction effect . The same patterns across specialization and an interaction effect were repeated for the *Attributional* mapping of the stimulus TRANSPARENT. The *Relational* form of mapping of the stimulus STAR displayed a pattern across gender.

The patterns across the three dimensions are evenly dispersed (with 6 patterns observed across gender, 8 across specialization and 7 across their interaction) indicating similar patterns of influencing the mapping undertaken in the production of Structural statements.

An examination of the frequencies of Functional statements produced for the different stimuli (Table 7) shows that the topics that elicited a very limited number of statements of this form are the visual images of PATH (with a total of 7 observations),and CANDLE (with a total of 7 observations) and the adjective stimulus word TRANSPARENT (with a total of 6 observations. The nature of the stimuli-topics may have been responsible for the lack of attention to the functional aspects of these stimuli.

Table 7

Frequency of Functional Metaphorical Mappings for the eight Topics

Stimulus	Topic	Mapping	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Concrete Noun	STAR	Literal	1	0	0	1			
		Attributional	0	0	3	0	*	*	*
		Relational	3	2	5	6	*		
		Double	0	0	1	0			
		Complex	0	1	0	0			
Visual	PATH	Literal	0	0	0	0			
		Attributional	0	0	0	2			
		Relational	1	1	0	0			
		Double	1	0	1	1			
		Complex	0	0	0	0			
Concrete Noun	DEW	Literal	1	0	0	1			
		Attributional	0	1	0	0			
		Relational	4	2	0	3	*		*
		Double	1	3	1	0	*		
		Complex	0	0	0	0			
Visual	CHILD	Literal	0	0	0	0			
		Attributional	0	0	1	1			
		Relational	5	7	3	5	*	*	
		Double	0	1	0	0			
		Complex	0	0	0	0			

(Table Continues...)

Table 7 (..Continued)

Stimulus	Topic	Mapping	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Abstract Noun	COURAGE	Literal	0	2	2	1			*
		Attributional	0	0	0	0			
		Relational	1	12	15	2	*		*
		Double	0	0	0	0			
		Complex	0	0	0	0			
Visual	CANDLE	Literal	0	0	0	0			
		Attributional	0	0	0	0			
		Relational	1	0	0	5	*	*	*
		Double	0	1	0	1			
		Complex	0	0	0	0			
Concrete Adjective	TRANS- PARENT	Literal	0	0	1	0			
		Attributional	0	0	0	0			
		Relational	1	1	0	1			
		Double	1	2	0	0	*		
		Complex	0	0	0	0			
Abstract Adjective	TRAGIC	Literal	0	3	0	1			*
		Attributional	0	0	0	0			
		Relational	3	3	2	2			
		Double	0	0	0	0			
		Complex	0	0	0	0			

Note:

^a. A pattern is noted when a frequency difference of at least three is observed between the groups across gender (G), across domain of specialization (S), or across their interaction (GXS)

The physical attributes of the visual images and the appraisal of the qualities seen in all the stimuli were generally more regularly noted at the expense of a functionalistic role being assigned.

Despite the low frequencies, a pattern across gender (Females $1 + 0 = 1$, Males $0 + 5 = 5$), specialization (Social Sciences $1 + 0 = 0$, Sciences $0 + 5 = 5$) and their interaction ($0 \text{ FS} - 1 \text{ FSS} = -1$ compared to $5 \text{ MS} - 0 \text{ MSS} = 5$ for a difference of 6) was found for the *Relational* form of the visual stimulus CANDLE. A similar observation was made for the Concrete noun stimulus-word STAR which showed patterns across gender, specialization and an interaction effect. The *Double* form of mapping for the adjective TRANSPARENT displayed a pattern across gender (Females $1 + 2 = 3$, Males $0 + 0 = 0$). The abstract adjectival stimulus word TRAGIC did have some *Relational* form of mappings for the Functional statements, but no pattern was discernible, while a pattern across specialization was seen in the *Literal* form of mapping (Social Sciences $0 + 0 = 0$, Sciences $3 + 1 = 4$). The abstract noun COURAGE too had *Relational* form of mappings and these displayed a pattern across gender (Females $1 + 12 = 13$, and Males $15 + 2 = 17$) and an interaction effect between gender and specialization ($12 \text{ FS} - 1 \text{ FSS} = 11$ compared to $2 \text{ MS} - 15 \text{ MSS} = -13$ for a difference of 24). The *Literal* form of mapping for COURAGE also displayed an interaction effect ($2 \text{ FS} - 0 \text{ FSS} = 2$ compared to $1 \text{ MS} - 2 \text{ MSS} = -1$ for a difference of 3). The visual image of the CHILD displayed a pattern across gender (Females $5 + 7 = 12$, Males $3 + 5 = 8$) and specialization (Social Sciences $5 + 3 = 8$, Sciences $7 + 5 = 12$) for the *Relational* form of mappings. The concrete noun stimulus STAR shows a pattern across gender for the *Relational* form of mappings for the Functional statements (Females $3 + 2 = 5$, Males $5 + 6 = 11$) and the *Relational* form of mapping for the other concrete noun DEW too displayed patterns across gender (Females $4 + 2 = 6$, Males $0 + 3 = 3$) and an interaction effect ($2 \text{ FS} - 4 \text{ FSS} = -2$ compared to $3 \text{ MS} - 0 \text{ MSS} = 3$ for a difference of 5). The *Double* form of mapping for the stimulus word DEW also displayed a pattern across gender (Females $1 + 3 = 4$, Males $1 + 0 = 1$).

The Functional form of statements thus displayed few patterns of occurrence for the different stimuli and the frequency of observation of such statements was itself quite low. One exception to this was seen in the case of the abstract noun COURAGE which had a frequency count of 12 for the FS group and 15 for MSS group. These statements may indicate that the abstract (in the sense of being theoretical and lacking in concrete and practical examples) nature of the word led to many functionalistic descriptions of the word. However, the high frequencies observed for the FS and the MSS groups only would need to be explored further. The other abstract stimulus word was TRAGIC and it did have some observations for the *Relational* form of Functional statements, though no patterns across gender or specialization were found. Also, the *Literal* form of the mappings for the Functional statements for these two words (abstract stimuli COURAGE and TRAGIC) were observed more frequently than for the other stimuli and this can be ascribed to the abstract nature of the stimuli which may have led many individuals to deal with the descriptions in a very literal manner. Despite the low frequency of the Functional statements for the visual presentation of CANDLE, the number of observations of the *Relational* form of mapping for the MS group was relatively high (5), and this led to the observation of patterns across gender, specialization and their interaction.

The number of patterns observed across gender were higher than those observed for the other variables, which provides some indication that gender may have influenced the mapping undertaken for the production of Functional statements.

The frequency of Evaluative statements made for the given stimulus-topics (Table 8) show similar patterns of high *Relational* mappings for all the eight stimuli used in the present investigation. This provides an indication that the underlying *Relational* structure of all the stimuli was regularly noted by a large number of participants in the four groups. This is consistent with general discussions found in the literature (Gentner, 1988). A few occurrences of *Double* mappings (which mapped the salient or surface *Attributional* features and the deeper or *Relational* features also) were noted for the stimuli STAR, PATH, DEW, CHILD, CANDLE, and TRANSPARENT. All these stimuli-topics with *Double* mappings revealed

patterns across specialization, while DEW, CHILD and TRANSPARENT had patterns across gender. The stimuli PATH, CHILD and TRANSPARENT displayed an interaction effect. The *Relational* mappings for the Evaluative statements showed patterns of occurrence across specialization for most of the stimuli-topics - STAR, DEW, CHILD, COURAGE, TRANSPARENT and TRAGIC. Out of these six cases DEW, COURAGE and TRANSPARENT displayed patterns across gender. Other topics that had a discernible pattern across gender for the *Relational* form of mapping were the visual images of PATH and CANDLE. An interaction effect for the *Relational* mappings was found for the topics PATH, DEW, COURAGE, TRANSPARENT and TRAGIC.

The Concrete stimuli DEW (Noun) and TRANSPARENT (Adjective) displayed the most observation of patterns for this type of statement with over 69% *Relational* level mappings. The patterns of the mappings for the Evaluative statements were observed across gender and specialization more frequently than they were for the other statement types. This provides an indication of the gender and specialization effects on the mapping process utilized in the production of Evaluative statements.

Comparison of Metaphorical Statements for the Different Topic-Stimuli Used

The observation of the patterns of occurrence of metaphorical statements corresponding to the different topic-stimuli was characterized by their frequency of statements (Tables 6, 7, and 8). A comparison of the frequency distributions across the three Tables for each stimulus-topic should enhance the patterns of metaphorical statements that were observed.

Table 8

Frequency of Evaluative Metaphorical Mappings for the eight Topics

Stimulus	Topic	Mapping	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Concrete Noun	STAR	Literal	0	0	0	1			
		Attributional	1	1	1	0			
		Relational	9	10	7	10		*	
		Double	5	2	4	3		*	
		Complex	2	1	0	0	*		
Visual	PATH	Literal	1	0	0	0			
		Attributional	0	0	0	0			
		Relational	2	5	3	1	*		*
		Double	1	5	4	3		*	*
		Complex	0	0	1	0			
Concrete Noun	DEW	Literal	0	0	0	1			
		Attributional	1	2	0	0	*		
		Relational	7	7	7	11	*	*	*
		Double	5	1	3	0	*	*	
		Complex	0	1	0	0			
Visual	CHILD	Literal	0	0	1	2	*		
		Attributional	0	0	1	0			
		Relational	18	9	17	9		*	
		Double	0	4	1	0	*	*	*
		Complex	0	1	0	0			

(Table Continues...)

Table 8 (..Continued)

Stimulus	Topic	Mapping	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Abstract Noun	COURAGE	Literal	0	2	1	2		*	
		Attributional	0	0	1	0			
		Relational	25	14	17	9	*	*	*
		Double	1	0	1	0			
		Complex	0	0	0	0			
Visual	CANDLE	Literal	0	0	0	0			
		Attributional	1	1	1	0			
		Relational	6	6	2	2	*		
		Double	5	3	6	2		*	
		Complex	0	1	0	0			
Concrete Adjective	TRANS- PARENT	Literal	0	1	0	0			
		Attributional	3	2	0	0	*		
		Relational	12	6	8	7	*	*	*
		Double	2	0	1	6	*	*	*
		Complex	0	0	0	0			
Abstract Adjective	TRAGIC	Literal	2	4	4	1			*
		Attributional	0	0	0	0			
		Relational	19	14	15	16		*	*
		Double	1	0	0	0			
		Complex	1	0	0	0			

Note:

a. A pattern is noted when a frequency difference of at least three is observed between the groups across gender (G), across domain of specialization (S), or across their interaction (GXS).

The frequency distributions presented in the three Tables for the three visual stimuli PATH, CHILD, and CANDLE can be compared. The stimulus PATH led to Structural -*Attributional* statements that displayed patterns of occurrence across gender and specialization, while Structural -*Double* statements displayed a pattern across specialization. There were few observations of Functional statements for this stimulus. The Evaluative -*Relational* form of statements showed a pattern of occurrence across gender while the Evaluative -*Double* statements had a pattern across specialization. The visual stimulus CHILD on the other hand had a very few Structural statements and the Functional -*Relational* statements produced displayed a pattern across gender and specialization. A higher number of Functional -*Relational* statements were observed for females compared to the Males; this observation can be attributed to the fact that Females are generally more vocal than Males.

The pattern across specialization for the stimulus CHILD displays the lower frequencies for the Social Sciences compared to the Sciences which can be attributed to the specifically functionalistic orientation of the Sciences. The Evaluative -*Relational* statements showed a pattern across gender while the Evaluative -*Double* statements displayed patterns across gender and specialization. Despite the low frequency of observation (1 FSS and 5 MS) a pattern across gender and specialization was discerned for the visual stimulus CANDLE on Functional -*Relational* statements. The Structural -*Attributional* statements displayed a pattern across specialization while the Structural -*Double* form of statements displayed a pattern across gender. The Evaluative -*Relational* statements showed a pattern across gender while the Evaluative -*Double* statements had patterns across specialization.

The metaphorical statements produced as descriptions for the stimuli-topics STAR and DEW, that were Concrete form of Nouns, can also be compared. While the Structural -*Attributional* form of statements for STAR showed a consistent frequency of occurrence (although no pattern was discernible), the Structural -*Double* statements displayed a pattern across gender. A similar pattern (across gender) was observed for the Functional -*Relational* form of statements while the Evaluative -*Relational* and *Double* form of statements showed a

pattern across specialization. DEW, the other concrete noun stimulus used in the study, showed a pattern across specialization for the Structural form of *Attributional*, *Relational* and *Double* statements, with the *Double* statements also displaying a pattern across gender. Both, the Functional and Evaluative *-Relational* and *Double* form of statements displayed a pattern across gender with the Evaluative statements also showing a pattern across specialization. The other concrete topic TRANSPARENT was an adjective and the frequencies of the different statements made show patterns that are similar to those found for the other concrete word stimuli. The Structural *-Attributional* form of statements displayed a pattern across specialization while the Structural *-Double* form showed a pattern across gender. There were very few Functional form of statements while the Evaluative statements displayed patterns across gender for the *Attributional*, *Relational* and *Double* form of statements, with patterns across specialization for the *Relational* and *Double* formats.

The other adjective word that was used as a topic was TRAGIC and this stimulus word was abstract in nature. It displayed very rare occurrences of Structural statements, while the Functional *-Relational* form of statements displayed a consistent frequency of occurrence with no patterns being observed. A similar observation of consistent occurrence with no discernible patterns was made for the Evaluative *-Literal* form of statements. The Evaluative *-Relational* statements displayed a pattern across specialization. Another abstract topic was the noun COURAGE and it too had very rare occurrences of Structural statements. The Functional *-Relational* and the Evaluative *-Relational* form of statements showed patterns across gender with the latter form also displaying patterns across specialization. Altogether 26 patterns across gender, 25 across specialization and 21 interaction effects are observed.

The observation of patterns across gender and specialization to note possible effects of the stimuli-topics on the level or complexity of mapping displays a wide dispersion and indicates equal influences of the gender and specialization variables on the types of statements produced. The lack of "strong" patterns is attributable to the varied perspectives taken by the participants as was discerned through their retrospective session. While some were positive

about the role of visual stimulus on their task performance, others went to the other extreme and said that it detracted and distracted their attention. The words were also dealt with in very different ways. While some commented on the abstractness of the words making the task more difficult, others talked of enjoying the "creativity" provided by abstract words.

The "stronger" influence was the format of the stimulus-topic, with the visual format of presentation generally resulting in lower observation of statements, and the abstract stimuli also displaying lower productions. The adjectival word stimuli had fewer productions compared to the noun-words.

Patterns of Production for Different Types of "Targets"

The format of the "topic" was used as a stimulus to generate metaphorical statements and its analysis has led to the observation of patterns across gender, specialization and also for an interaction between gender and specialization. The "target" of the metaphorical statement which is the vehicle used to describe the new topic (stimulus), is the familiar word (or concept) used by an individual to map certain attributes or relationships to the "new" topic. It is an important element of a metaphorical statement and plays an important role in the product generated. The process of mapping that takes place between the "target", which is the individual or personal response used as descriptor for the given stimulus-topic, is the underlying mechanism (or process) that is theorised (Gentner, 1982; 1983; 1988; 1989) to play an important role in the processing of metaphors. An analysis of the different kinds of "targets" identified by the participants in the present study has the potential to yield categories of patterns of responses.

The objective underlying the assigned task was to provide descriptive, metaphorical statements, and the initial phase of the analysis is aimed at identifying possible patterns of response among these statements. The descriptors used in these statements were observed to be abstract or concrete concepts that can be syntactically analysed (by examining their role or function in the sentence) by classifying them as Nouns, Adjectives or Verbs. A noun is a

naming word, and its use in a concrete or abstract form as the "target" in the metaphorical statement serves to name the topic presented in a manner that the individual participant finds to be meaningful. An adjective, on the other hand, is a describing word and its use in the concrete or abstract form serves to describe the target by qualifying or modifying the word or concept that is being described. A verb is a "doing" word and it denotes activity, thus implying that its use as a target reflects the action-oriented depiction of the given topic. The description of the given topics in terms of naming (by using noun target descriptors), describing or qualifying (by using adjective target descriptors) or doing (by using Verb target words as descriptors), may, to a large extent, play an important role in the nature and diversity of the statements that were produced. A typology of the different descriptors used as "target" words consisting of concrete and abstract forms of nouns and adjectives and verbs was applied to all the descriptors used in the metaphorical statements that were produced.

The implementation of the next phase of analysis of the metaphorical statements thus examines the different types of targets that acted as "vehicles" (in terms used by Richards, 1936) to describe the assigned stimulus-topics. The statement categories that had the highest frequencies of occurrence (Structural category with *Attributional* and *Double* types of mapping; Functional category with *Relational* mapping and Evaluative category with *Relational* and *Double* mappings) were singled out for this specific level of analysis. The other categories had sporadic and isolated occurrences only and the low frequency counts obtained for them would not lead to any viable display of patterns. The frequency distributions of the metaphorical statements produced (as products of the assigned task) by the four groups of participants are presented in Tables 9 to 13. The observation of patterns of occurrence across gender, domain of specialization and their interaction are also noted in order to highlight the observed trends

The frequency distributions of the Structural-*Attributional* statements for the different types of targets (Table 9) reveal patterns across gender and specialization for the topic STAR, PATH and TRANSPARENT for the Concrete Noun type of target. The topic PATH displayed

a pattern for the interaction effect with the Concrete Noun target type and another pattern across gender for the Concrete Adjective target. The interaction effect patterns were discerned for the Topic DEW with the Concrete Noun target, and for the topic CANDLE with the Verb target type. Thus most of the occurrences of Structural-*Attributional* statements used Concrete Nouns as the descriptors of the targets

The breakdown of the patterns observed for the types of targets used to produce the Structural -*Attributional* category of statements displayed 8 patterns that used Concrete Nouns as targets, while there were one pattern each for Concrete Adjective and Verb targets. These ten patterns were almost evenly distributed across gender, domain of specialization and the interaction effect, with four patterns being found across gender and three across the domain of specialization and three interaction effects. The patterns for the different targets used for the production of Structural-*Attributional* statements show that, out of the 10 patterns observed, 9 were associated with the use of concrete words.

Table 9

**Frequency of Structural-Attributional Statements using
Different Types of Targets**

Stimulus	Topic	Type of Target	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Con. Noun	STAR	Con.Noun	1	4	0	2	*	*	
		Abs.Noun	0	0	0	1			
		Con.Adject.	1	0	0	0			
		Abs.Adject.	3	0	1	0			
		Verb	0	0	2	0			
Visual	PATH	Con.Noun	0	1	6	0	*	*	*
		Abs.Noun	2	0	0	0			
		Con.Adject.	0	1	2	2	*		
		Abs.Adject.	0	0	0	0			
		Verb	1	0	0	0			
Con. Noun	DEV!	Con.Noun	1	5	5	0			*
		Abs.Noun	0	0	0	0			
		Con.Adject.	0	1	1	0			
		Abs.Adject.	0	0	1	0			
		Verb	1	0	0	0			
Visual	CHILD	Con.Noun	1	0	1	0			
		Abs.Noun	0	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	1	0	0	0			
		Verb	0	0	0	0			
Abs. Noun	COURAGE	Con.Noun	0	0	0	0			
		Abs.Noun	0	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	0	0	0			
Visual	CANDLE	Con.Noun	0	1	0	0			
		Abs.Noun	0	0	1	1			
		Con.Adject.	0	0	2	0			
		Abs.Adject.	1	1	0	0			
		Verb	1	1	4	0			*
Concrete Adjective	TRANS- PARENT	Con.Noun	7	2	5	0	*	*	
		Abs.Noun	1	0	1	0			
		Con.Adject.	0	1	2	0			
		Abs.Adject.	1	1	0	0			
		Verb	0	0	0	0			
Abstract Adjective	TRAGIC	Con.Noun	0	0	0	0			
		Abs.Noun	0	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	0	0	0			

Legend: Con. = Concrete; Abs. = Abstract

a. A pattern is noted when there is a difference of at least three frequency counts between the groups across gender (G), across domain of specialization (S), or across their interaction (GXS).

The frequency distribution of Structural-*Double* statements produced with different types of targets (Table 10) displays only a limited number of observations across the four groups. Out of a total of 80 statements, 46 (58%) were Concrete Nouns, and 17 (21%) were Abstract Nouns. The patterns of occurrence that are discerned are across gender for the topics STAR, PATH, TRANSPARENT and CANDLE. The first three stimuli displayed the use of Concrete Noun type of Targets. PATH also shows the use of Abstract Noun targets for patterns across gender, specialization and the interactional effect. The topic CANDLE, on the other hand, displayed a pattern across gender for the Abstract Noun type of target and an interaction effect for the Concrete Noun type of target. The other types of targets were used in isolated cases with the exception of the use of the Abstract Adjective for the topic CANDLE for which three of the four groups showed a regular frequency count of 2 statements each.

The patterns for the Structural-*Double* category of statements are all related to Nouns as targets, with an equal number of patterns for Concrete (4) and Abstract (4) forms. The patterns of occurrence were higher across gender (5), followed by (2) patterns across the interaction while there was only a single pattern across domain of specialization. The patterns of observation noted for the *Attributional* and *Double* categories of Structural statements showed some variation. The use of Abstract form of Noun was observed in the case of *Double* level of mappings(4) while it was not used at all in the *Attributional* level of statements. The *Attributional* statements showed the use of other targets also: Concrete Adjective (1), and Verb (1), whereas the *Double* statements did not have any other targets used.

Table 10

Frequency of Structural-Double Statements using Different Types of Targets

Stimulus	Topic	Type of Target	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Con. Noun	STAR	Con.Noun	4	5	3	1	*		*
		Abs.Noun	0	1	0	0			
		Con.Adject.	0	1	0	1			
		Abs.Adject.	1	1	0	0			
		Verb	1	0	1	1			
Visual	PATH	Con.Noun	4	5	2	3	*		
		Abs.Noun	1	0	0	4	*	*	*
		Con.Adject.	0	1	0	1			
		Abs.Adject.	0	1	1	0			
		Verb	0	1	0	2			
Con. Noun	DEW	Con.Noun	3	1	1	1			
		Abs.Noun	0	0	1	1			
		Con.Adject.	1	0	0	0			
		Abs.Adject.	1	0	0	0			
		Verb	0	0	0	0			
Visual	CHILD	Con.Noun	1	0	0	0			
		Abs.Noun	1	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	0	0	0			
Abs. Noun	COURAGE	Con.Noun	0	0	0	0			
		Abs.Noun	0	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	0	0	0			
Visual	CANDLE	Con.Noun	2	0	0	4			*
		Abs.Noun	2	2	0	1	*		
		Con.Adject.	0	0	0	0			
		Abs.Adject.	2	2	2	0			
		Verb	0	1	1	0			
Concrete Adjective	TRANSPARENT	Con.Noun	3	3	0	0	*		
		Abs.Noun	1	1	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	0	0	0			
Abstract Adjective	TRAGIC	Con.Noun	0	0	0	0			
		Abs.Noun	1	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	0	0	0			

Legend: Con. = Concrete; Abs. = Abstract

a. A pattern is noted when there is a difference of at least three frequency counts between the groups across gender (G), across domain of specialization (S), or across their interaction (GXS).

The *Functional-Relational* statements that were produced using the different types of targets are reported in Table 11. The patterns across gender are found for the topic CHILD and COURAGE using the targets that were Verbs (for both the topics) and Concrete and Abstract Nouns in the case of the latter topic-stimulus. A few patterns across specialization were also noted (4) but there were many more dispersed patterns for the interaction effect (6).

The topic-stimulus COURAGE displayed many patterns (8 out of a total of 14) for the *Functional-Relational* category of statements. These patterns showed a high level of use of Abstract Noun (3) and Verb (3) targets. Observing the number of productions, out of a total of 105, 34 (32%) used Verb targets, and 38 (36%) used Abstract Noun targets. The frequencies in Table 11 lead to an interesting observation: the MSS group had a much higher frequency of use of Abstract Noun (9) and Verb (7) targets to describe the Abstract Noun topic-stimulus COURAGE than any other group. This challenges the observation made earlier about the Functionalistic orientation of the Science groups.

There was a high number of Verb targets (7) to produce the *Functional-Relational* statement patterns. This trend varies from the observations made for the other categories of statements which showed very limited usage of Verb targets. This observation can be attributed to the nature of the Functional category, which emphasizes the role or action-related aspect of the stimulus. Abstract Noun targets were also associated with 5 patterns.

The Evaluative category of statements were the most prolific production generated by the participants. The *Relational* and *Double* mappings were both utilized frequently; the frequency distributions of metaphors with the different types of targets are summarized in Tables 12 and 13 respectively. The patterns of occurrence are observed to be widely and evenly dispersed, particularly for the *Evaluative-Relational* statements (Table 12) which displays 11 patterns across gender, 11 across domains of specialization and 12 for the interaction of the two.

Table 11
 Frequency of Functional-Relational Statements using
 Different Types of Targets

Stimulus	Topic	Type of Target	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Con. Noun	STAR	Con.Noun	1	1	2	2			
		Abs.Noun	0	0	1	2			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	1	2	1			
		Verb	2	0	0	1			*
Visual	PATH	Con.Noun	0	0	0	0			
		Abs.Noun	1	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	1	0	0			
Con. Noun	DEW	Con.Noun	1	0	0	0			
		Abs.Noun	3	1	0	2			*
		Con.Adject.	0	1	0	0			
		Abs.Adject.	0	0	0	1			
		Verb	0	0	0	0			
Visual	CHILD	Con.Noun	0	0	2	0			
		Abs.Noun	3	0	0	2			*
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	1	0	0			
		Verb	1	7	1	3	*	*	*
Abs. Noun	COURAGE	Con.Noun	2	1	0	0	*		
		Abs.Noun	1	3	9	3	*	*	*
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	4	1	3		*	
		Verb	2	2	7	2	*	*	*
Visual	CANDLE	Con.Noun	0	0	0	0			
		Abs.Noun	1	0	0	1			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	2			
		Verb	0	0	0	1			
Concrete Adjective	TRANSPARENT	Con.Noun	0	0	0	0			
		Abs.Noun	0	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	1	1	0	1			
Abstract Adjective	TRAGIC	Con.Noun	0	1	0	0			
		Abs.Noun	1	1	2	1			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	2	1	0	0			
		Verb	0	0	0	1			

Legend: Con. = Concrete; Abs. = Abstract

a. A pattern is noted when there is a difference of at least three frequency counts between the groups across gender (G), across domain of specialization (S), or across their interaction (GXS).

There is a higher level of use of Abstract criteria as targets and this is revealed in the patterns of occurrence. The use of Abstract Noun targets led to the observation of 10 patterns, while the use of Abstract Adjective targets led to 11 patterns being observed. Compared to the 21 patterns for the Abstract form of targets, there were 9 patterns observed for the Concrete forms of target, with (8) Concrete Noun and (1) Concrete Adjective pattern. This phenomenon can largely be attributed to the nature of the Evaluative category which often needs abstract criteria to appraise and judge the stimulus-topics. The number of patterns was also high for the Abstract form of the stimulus -topics; with COURAGE, the Abstract Noun topic displaying 7 patterns and with TRAGIC, the Abstract Adjective topic displaying 8 patterns of occurrence.

The Evaluative-*Double* category of statements had a limited number of observations (Table 13). The use of Abstract criteria as target predominated, with (4) patterns across Abstract Noun targets and (5) patterns across Abstract Adjective targets and one pattern with Concrete Noun target. These patterns were observed across gender (4); domain of specialization (2), and the interaction of the two (4). Even when the observations were not "strong" enough to display a pattern, the regular frequency counts were observed to be in the case of Abstract forms of targets. An example of this can be found in the case of the stimulus-topic STAR which shows regular use of Abstract noun and Abstract Adjective targets.

The use of Abstract criteria as targets was repeated for the Evaluative-Double statements, with 47% use of Abstract Noun and 26% use of Abstract Adjective. The Concrete Noun target was used 21%, and Verb target only 6%.

Table 12
 Frequency of Evaluative-Relational statements using
 Different Types of Targets

Stimulus	Topic	Type of Target	FEMALE		MALE		PATTERNS ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Con. Noun	STAR	Con.Noun	2	0	0	2			*
		Abs.Noun	4	8	4	7		*	
		Con.Adject.	0	0	0	0			
		Abs.Adject.	3	2	2	2			
		Verb	0	0	0	0			
Visual	PATH	Con.Noun	0	2	1	0			*
		Abs.Noun	0	1	0	1			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	1	2	2	0			*
		Verb	1	0	0	0			
Con. Noun	DEW	Con.Noun	1	0	1	0			
		Abs.Noun	1	4	5	4	*		*
		Con.Adject.	0	0	0	1			
		Abs.Adject.	4	3	1	6		*	*
		Verb	1	0	0	0			
Visual	CHILD	Con.Noun	3	0	2	0			
		Abs.Noun	11	3	10	0	*	*	
		Con.Adject.	0	0	1	0			
		Abs.Adject.	3	3	5	6	*		
		Verb	3	2	1	3			*
Abs. Noun	COURAGE	Con.Noun	9	5	5	3	*	*	
		Abs.Noun	9	3	0	4	*		*
		Con.Adject.	0	0	0	0			
		Abs.Adject.	3	5	3	2	*		*
		Verb	4	0	4	2		*	
Visual	CANDLE	Con.Noun	0	0	0	0			
		Abs.Noun	3	2	1	2			
		Con.Adject.	0	0	1	0			
		Abs.Adject.	3	3	0	1	*		
		Verb	0	1	0	0			
Concrete Adjective	TRANS- PARENT	Con.Noun	1	0	4	1	*	*	
		Abs.Noun	3	2	4	2		*	
		Con.Adject.	2	0	1	0		*	
		Abs.Adject.	5	4	3	2	*		
		Verb	0	0	2	1			
Abstract Adjective	TRAGIC	Con.Noun	3	1	1	5			*
		Abs.Noun	12	2	5	7		*	*
		Con.Adject.	0	0	0	0			
		Abs.Adject.	3	10	2	4	*	*	*
		Verb	3	1	0	1	*		*

Legend: Con. = Concrete; Abs. = Abstract

a. A pattern is noted when there is a difference of atleast 3 frequency counts between the groups across gender or across domain of specialization.

Table 13
 Frequency of Evaluative-Double Statements using Different Types of Targets

Stimulus	Topic	Type of Target	FEMALE		MALE		PATTERN ^a		
			Soc.Sc.	Sc.	Soc.Sc.	Sc.	G	S	GXS
Con. Noun	STAR	Con.Noun	1	0	1	0			
		Abs.Noun	2	1	2	1			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	2	1	1	1			
		Verb	0	0	0	0			
Visual	PATH	Con.Noun	0	2	1	0			
		Abs.Noun	1	1	3	3	*		
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	2	1	0			*
		Verb	0	0	0	0			
Con. Noun	DEW	Con.Noun	0	1	0	0			
		Abs.Noun	4	0	1	0	*		*
		Con.Adject.	0	0	0	0			
		Abs.Adject.	1	0	1	0			
		Verb	0	0	1	0			
Visual	CHILD	Con.Noun	0	1	1	0			
		Abs.Noun	0	1	1	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	1	0	0			
Abs. Noun	COURAGE	Con.Noun	1	0	0	0			
		Abs.Noun	0	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	0	0	0			
Visual	CANDLE	Con.Noun	3	0	1	0			*
		Abs.Noun	1	3	2	0			*
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	3	2	*		
		Verb	1	0	0	0			
Concrete Adjective	TRANS-PARENT	Con.Noun	0	0	0	1			
		Abs.Noun	1	0	1	2			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	3	*	*	*
		Verb	1	0	0	0			
Abstract Adjective	TRAGIC	Con.Noun	0	0	0	0			
		Abs.Noun	1	0	0	0			
		Con.Adject.	0	0	0	0			
		Abs.Adject.	0	0	0	0			
		Verb	0	0	0	0			

Legend: Con. = Concrete; Abs. = Abstract

^a. A pattern is noted when there is a difference of at least three frequency counts between the groups across gender (G), across domain of specialization (S), or across their interaction (GXS).

Highlights of the Metaphorical Descriptions

The analysis of the statements that were produced as metaphorical descriptions has so far yielded frequency counts and patterns of occurrence of the diverse categories of statements. To complement this information, a qualitative analysis of the verbal protocols shall enhance the understanding of the similarities and differences in the statements produced. Representative samples of excerpts from protocols are provided in Tables 14, 15, and 16. They are meant to capture some of the richness that is inherently to be found in the verbalizations of the participants. The excerpts are extracts from the concurrent verbal protocols of participants and highlight the distinguishing features of the descriptions that led to their classification as Structural, Functional or Evaluative statements. These examples help in focussing attention on the similarities and differences of topics and types of targets that were used by the participants.

The excerpts are episodes extracted from the protocols of different individuals (subjects) identified by group to which they belong and by S followed by a number. These excerpts are presented as examples to highlight the different ways in which the participants described the given eight stimuli-topics (identified at the end of each excerpt by the letter P followed by a number from 1 to 8). The excerpt serves to contextualize the metaphorical descriptive statement produced (the underlined portion of the excerpt) with some of the text that precedes and follows it in the protocol. The target or the "vehicle" used by the individual as descriptors for the given topic is identified also at the end of each episode (Abstract [A] or Concrete [C] forms of Noun [N] or Adjective [A], or Verb [V]). The last identification for each excerpt provides the classification of the underlined metaphor (based on Classification Scheme presented in Table 3). The examples from the protocols, discussed individually, facilitate in focussing attention on the elements or components of a metaphor. Furthermore, they serve to highlight some outstanding or unique features and aspects that are to be observed in each metaphorical descriptive statement.

Features Highlighting Structural Statements

The statements that were classified as being Structural focused on the physical attributes, or what can be generally described as the commonly observed "salient features" (Vosniadou, 1989) of the stimulus-topic that was being described. An enhanced level of appreciation of the distinctive features found in the statements is provided by the cross-section of Structural statements (Table 14). In example 1, Participant S5's attention is drawn to the burning CANDLE which looks as if it were "almost to be guttered", focussing on a physical attribute of the presented stimulus. This leads to its being classified as a Structural statement. Then S5 continues by stating

"The end of life is like a dying candle, slowly melting away as the body systems break down and.. you begin with a potential of a big, strong candle".

The physical attributes of the burning candle which had begun in a form that was big and strong, are used as the basis for the depiction and comparison with life, with the last phase of the candle being similar to the end of life. The target that was used was thus an abstract form of Noun (End of life) and the mapping of attributes (big and strong to begin with and now melting) and relations (dying) from the Topic CANDLE to the target that has to be retrieved from memory. The choice of the "ending of life" as the target leads to the common "ground" of "the break-down of systems".

Commenting on STARS as famous people mainly on the screen (Example 2, Table 14), Participant S27 proceeds by "mapping" the silver screen on to the blanket of the night (where stars that are suns are found) and mentions that the common ground between the two forms of stars is that they shine on their respective screens. The description provided here thus maps only the attributes or what are described as "salient" similarities of the Target and is therefore classified as a *Structural-Attributional* statement which made use of a Concrete Noun as its target.

Table 14
Excerpts from Protocols of participants to illustrate a cross section of
Structural statements

Ex. 1 O.K. I give up, is this a candle? (Experimenter affirms).o.k. a burning out candle, almost to be guttered. The end of life is like a dying candle, slowly melting away as a body, systems break down and uhh.. you begin with a potential of a big, strong candle. I'm thinking must be as you get older and older and your systems break down, life is like a .. the end of life is like a burned out candle.

Social Sciences, Female (S5), Topic (P6). Lines 725-731. Target - AN, S(4).

Ex. 2 *Stars in reality are suns just like our sun.* Stars are also a word used to describe very famous people mainly on the screen.. uhh.. may be silver screen can be associated to the blanket of night; that's why they call them stars.. because they shine on the screen. Umm.. stars.. umm.. football stars.. they shine on the football field. Uhh.. these are very, very good, better than the average people in the.. in their league.

Sciences, Male (S27), Topic (P1). Lines 16-23. Target - CN, S(2).

Ex. 3 Umm.. I'm thinking of the lens of a camera, kind of water in a uh.. clear lake, a pond and the quality again is seeing through, having the spaciousness.. so its clear, see through and spacious. They also some.. I don't .. somehow the transparent seems to have a quality of distortion in it.

Sciences, Female (S12), Topic (P7). Lines 203-208. Target - CN, S(2).

Ex. 4 I'm feeling.. admiring the fact that it is going to be able to burn to its completion. I like the drop of wax, it just reminds me that tears.. I like that picture, I like the shape and curve of the flame.. and I again.. I'm feeling that the candle is enduring and lasting, and its being allowed to finish, its not being snuffed out before its time.

Social Sciences, Female (S3), Topic (P6). Lines 68-74. Target - AA, S(4).

Ex. 5 ..dew.. beautiful, uhh.. I think of, picture in my mind of a magnified flower with drops of dew on it. Umm.. the dew on a rose is like a tear on a child's cheek, both very beautiful, the rose and the child and the de .. very, very much being a one dew drop as opposed to dew.

Social Sciences, Female (S5), Topic (P3). Lines 670-675. Target - CN, S(4).

Ex. 6 ..its a.. as I said, time is running out whatever you have to do you'd better do now while the light is there. Umm.. let's see what else I can think of.. the using up of resources.. that's again a tragedy on the planet that's irreversible..

Sciences, Female (S14), Topic (P6). Lines 398-403. Target - V, S(4).

Ex. 7 Its.. its.. it seems to be winding its way off into the distance and I guess its just a matter of perception whether you see that as something coming up or something going down. But it snakes.. its like a snake.. it snakes its way across the.. the countryside or whatever it is.. whatever this is. uhh.. its meandering.. it doesn't have any great uh.. purpose, its just going wherever it is going .. kind of.. kind of aimlessly. So its just wandering uhh.. whatever it is, its wandering aimlessly like the.. like river going across in a meander or an animal just burrowing around in the ground looking for.. looking for who.. its not going in any particular.. its not going.. its.. its.. its not going anywhere in particular.

Sciences, Male (S30), Topic (P2). Lines 598-610. Target V, S(4).

Example 3 presents another *Attributional* level of mapping for the description of the topic TRANSPARENT. After providing some examples of TRANSPARENT (lens of a camera, water in a clear lake), Participant S12 uses descriptors such as "clear, see through and spacious" as common features for these examples. These qualities are considered to be the salient similarities of the topics and the target (the Concrete Nouns that were produced as examples) and lead to the classification of the statement as being *Structural-Attributional*.

Participant S3's description of the topic CANDLE (Example 4) is based on the quality that it is "able to burn to its completion". The CANDLE is thus depicted as having the qualities of being enduring and lasting and being allowed to finish, thus the targets used are Abstract Adjectives. Another noticeable feature of the description is the aesthetic appeal of the stimulus as referred to in "I like the drop of wax....I like that picture, I like the shape and the curve of the flame" is seen to transfer to (be mapped on to) the positive feelings "admiring the fact that it is going to burn to its completion" that are used to describe the CANDLE.

Participant S5 describes the topic DEW (Example 5) as being beautiful, which leads to the picturing of a "magnified flower with dew on it". This is compared to a tear on a child's cheek, and the physical attributes that form the basis of this comparison lead to the categorisation of this statement as Structural with Double level of mapping (since the appearance and relationships are uncommon) with a Concrete Noun (tears) as its target. The underlying beauty of the dew acted as the "trigger" that led to the comparison that followed. Examples 6 and 7 both present the use of targets that are Verbs to describe different visual topics. While Participant S14 describes the burning CANDLE as the "using up of resources" which is similar to the running out of time in that both are a "tragedy on the planet that's irreversible", S30 describes the image of the PATH as "it snakes its way across the countryside". Both descriptions are action-oriented and depict the topics by using Verbs as targets to map both physical attributes and relations.

Features Highlighting Functional Statements

The Functional category of statements are marked by an emphasis towards the functional role or action-related aspect of the stimulus. This is often manifested in a manner which is superimposed on the physical or Structural attributes. To understand the distinguishing features of this category of statements, a sample of illustrative excerpts for the diverse forms of Functional statements that were produced is presented in Table 15.

Describing the Topic DEW in example 1, Participant S3 views it as a revitalization that acts as an equalizer of nature. The function or role assigned to dew is the focus of this statement, which is then mapped to transfer the relational feature of being an equalizer. The target word that is used to depict this feature (revitalization) is an Abstract form of Noun. The analogy created to describe this role of the stimulus helps to distinguish between metaphors and analogies. Metaphors can be described as being evocative depictions of a given stimulus (they evoke images, similarities, distinctions...), whereas analogies are generally descriptive in nature and they help in clarifying the features that are being focussed on. Thus while the notion of revitalization being linked to dew leads to a myriad of possibilities, the analogy that follows helps in clarifying the strong relationship seen between dew in nature and man's early morning cup of coffee.

Example 2 has similar features as Example 1; it serves to highlight the very different orientation of the statements despite their similarities. The role of Dew as seen by Participant S29 is as a focus that helps in the evaluation of children's understanding about change. Although the two descriptions of Dew (a) as a revitalization and (b) as a focus for change, both serve to highlight the Functional role and the deeper Relational level of mapping using Abstract Nouns as targets, the two statements were drawn from very different experiential situations.

Table 15

Excerpts from Protocols of Participants to illustrate a Cross section of the
Functional Statements

Ex. 1 ..dew is an equalizer.. yeah the morning dew is an equalizer of nature. Although it doesn't rain.. I'm thinking if it doesn't rain at least there's the morning dew to refresh the plant life. So I'm thinking of the morning dew as.. a revitalization.. Morning dew.. is.. like a man's early cup of coffee (laughs).. revitaliser. So the morning dew to nature is like man's early morning cup of coffee. Ta..da..o.k.

Social Sciences, Female (S3), Topic (P3). Lines 635-642. Target - AN, F(3).

Ex. 2 Of course, for me.. uhh.. the first thing that comes to mind because I always used.. umm.. I used.. always used dew.. for many years I used dew as a uhh.. as a focus for uhh.. evaluating children's understanding about change that uhh.. I always encourage children uhh.. in my teaching and so on to umm.. of course move towards being a creative problem solver in their own right in.. in science education and so more often than not I would uh.. I would use dew as.. as one of my problems that I would give children because it was relevant to the children and it was something that children are in contact with..

Sciences, Male (S29), Topic (P3). Lines 367-378. Target- AN, F(3).

Ex. 3 O.K. Stars.. an association would be probably in sports because a star.. if you see hockey night in Canada there are always three stars at the end of hockey... I see it as high performance, I see it as.. as.. probably money, but it mostly is being outstanding.

Sciences, Male (S26), Topic (P1). Lines 528-533. Target- CN, F(3).

Ex. 4 Courage is the..(laughs) I laugh because I think courage has got man into hell of predicaments at times.. so courage is the.. instigator of man.. courage is the instigator of man.. No..o.. or the foundation.. Courage is the foundation of man. Uhh.. I like that. Courage and foundation.. yes I like that one. Courage is the foundation of men.

Social Sciences, Female (S2), Topic (P5). Lines 618-624. Target - CN, F(3).

Ex. 5 Ah, Dew. Uh.. dew is.. this is.. this is probably about as metaphorical as I can.. dew is a washing of the earth.. in the morning. Almost like a cleansing for the day ahead.. a way of getting rid of what was there yesterday, its like a fresh start everyday.. and.. not only does it nourish the ground and.. and the trees and what you have, but it starts everything off clean.. in nature, obviously not in the city.. but in nature..

Sciences, Female (S9), Topic (P3). Lines 187-194. Target - V, F(4)

Ex. 6. courage is.. is not.. courage is doing what you have to do courage is.. is.. courage is doing what you don't want to do.. uhh.. or you might not want to do or.. or.. but something which has to be done. uhh.. its a blank. Its like getting up in the morning when you're going to work sometimes.. and you don't want to do it, but you know you have to do it. So you.. you just go ahead and do it. So courage is.. may be you can say (laughs self consciously) courage is just doing. sometimes that's what courage is all about. Uhh.. having a strength to.. uhh.. its having the strength to survive or having the strength to carry on.

Sciences, Male (S30), Topic (P5). Lines 689-698. Target- V, F(3).

Table continues...

Table 15 (..Continued)

Ex. 7 Stars... uh... its kind of the link to the spiritual and others. I guess stars as ... uh... noble. I'm thinking man's connectedness or aspirations...

Social Sciences, Female (S3), Topic (P1), Lines 90-92. Target- V, F(3)

Ex. 8 The child is an enthusiastic explorer of every world that it encounters. And I say that because my daughter is excited about every single thing, and it doesn't matter what it is...

Social Sciences, Male (S18), Topic (P4), Lines 730-732. Target - CN, F(3)

Ex. 9 Umm.. Back to process, process is often the end, and it could be in terms of teaching, should be in terms.. in terms of teaching. The pathway is more important than where the end goes, because what we should be doing and not all of us do this.. umm.. but there is going to be a strong push is that we should be teaching process rather than end product, So in this terms I really like the path (laughs).

Social Sciences, Female (S1), Topic (P2), Lines 36-43. Target - AN, F(3).

While Participant S3 reflected on the daily ritual of morning coffee being seen as the revitalizing element, Participant S29 resorted to his experiences as a Science teacher to focus on the concept of "change" which, for him, is epitomized in the formation of dew.

Participant S26 finds a Functionalistic description for Topic STAR when he depicts it as being "high performance" and "outstanding" with the added corollary of "(Stars) as money." (Example 3). The nature of the Target chosen to depict the stimulus is of the Concrete form where Nouns are most commonly used. Another description that made use of a Concrete Noun as its Target is provided by Participant S2 (Example 4). Her statement that "Courage is the foundation of man" assigns a fundamental role (as a foundation) to the abstract Topic COURAGE.

The description of DEW as a "washing of the earth" and "a cleansing for the day ahead" again focuses on the Functional aspects of the Topic (Example 5). DEW is described as being this washing and cleansing. The target that is used in the production of the statement is in the form of a Verb and Participant S9 goes on to add that dew "nourishes" (another Verb). Unlike the other statements presented in Table 15, this statement is a Double metaphor since it has mapped both salient features (morning and wetness) and deeper Relational features (clean, pervasive, nourishing) in its depiction of the given Topic. These functions of DEW are seen as being an inherent part of it and are used to denote activity generally associated with other things (washing, cleansing and nourishing are more commonly associated with water and rainfall). Participant S30's description of COURAGE (Example 6) as "just doing" and "having the strength to survive or having the strength to carry on" also makes use of a Verb as a Source in the Functional metaphorical statement. The depiction of a STAR as a "link to the spiritual" (example 7) is again another Functional description that has made use of a Verb (link) as its Target.

The description of the CHILD by Participant S18 (Example 8) as an "enthusiastic explorer of every world that it encounters" highlights the role or activity associated with the given topic CHILD. It is therefore classified as a Functional statement with a Concrete Noun

as its target. Example 9, on the other hand, has made use of the Abstract Noun as its target to describe topic PATH as "the process is often the end [...] the pathway is more important than where the end goes". Participant S1 depicts the pathway as the "process", which makes the target word an Abstract Noun. In elaborating further, an analogy is created which again reinforces the explanatory function or role of analogies. While depicting the pathway as the "process is often the end" S1 goes on to state that "it could be in terms of teaching, should be in terms of teaching" thus creating the proportional analogy Pathway is to End as Process is to Product.

The different focus that underlies the Structural and the Functional statements becomes apparent if a comparison is made between excerpts taken from Table 14 and 15. Ex.2, Table 14 and Ex. 3, Table 15 are both describing the topic STAR and their orientation is found to differ at the semantic levels.

Features Highlighting Evaluative Statements

The categorisation of metaphorical statements as Evaluative was based on the judgement that focuses on the conceptual and generalized qualities of the observed relationship. The excerpts of Evaluative statements listed in Table 16 serve to highlight the distinctive features (Evaluation or appraisal of the observed relationships) of the metaphorical statements.

Examples 1 to 6 are excerpts corresponding to the visual presentation of the topics. In Example 1, Participant S1 describes the burning CANDLE as "the end of the candle is sadness for what is finished". The excerpt shows how S1 progresses from depicting the burning candle stimulus which evoked images of candle-lit dinners that are associated with thoughts of intimacy and contentment, to feelings of not wanting it to end and that led to sadness for what is finished.

Table 16

Excerpts from protocols of participants to illustrate a Cross-section of
Evaluative-Relational statements

Ex. 1. Yeah, I just think of my table.. umm.. I'm thinking of dinner dishes, uhh.. again I'm thinking of my home. Umm.. I'm thinking of intimacy, I'm thinking of contentment.. umm.. the end of a romantic evening. Umm.. not wanting it to end. Uhh.. I'm not.. I'm not.. I'm not getting any oth.. uh.. metaphors.. sadness. Yeah, I guess I would say the candle.. the end of the candle is sadness.. for what is finished..

(Social Sciences, Female (S1) Topic (P6), Lines 258-265. Target - AN)

Ex. 2. A child is oh what did I read somewhere that I thought was just a beautiful analogy. Child is God's promise that the world will go on. Another one that comes to my mind is ch.. uhh.. I've thought of this looking at my own baby as a child is.. is God's promise that there.. that there is good in life and will always be good in life, miracle in life. And child is a like a miracle. The day.. where there was no life there is life. umm. the continuing on of generations.

(Social Sciences, Female (S5), Topic (P4). Lines 778-788. Target - AN)

Ex. 3. Uhh.. think of new life, spring, a metaphor for children, guess the metaphor for children is. is a belief in.. there's optimism. You believe its worth bringing somebody into the work'. So children.. having children is a metaphor for optimism..

(Social Sciences, Male (S22) Topic (P4), Lines 732-736. Target - AN).

Ex. 4. O.K. Well, road, journey.. umm.. life is like a uhh.. a road that we take on our journey through life umm.. with many bends and places to stop under a shady tree, things can help us out in our life but many turns and forks etcetera in life. Umm.. the pathway is like a root system on a tree that bends and goes around the rocks, in formations that are impeding its progress..

(Social Sciences, Female (S5), Topic (P2). Lines 600-606. Target - CN).

Ex. 5. This picture is a beautiful one, I like it. Umm.. what I've seen here is a winding, rugged road. And the impression it gives me right now, is a representation of the realities of life. Umm.. Life in my opinion, it is.. as a matter of fact in my own experience has been that its never a straight road. Its winding, its rugged, too many corners, too many surprises because uhh.. if you've travelled on a winding road you would know that there are so many surprises for you.

(Sciences, Male (S28), Topic (P2), Lines 78-85. Target - AN. E(4))

Ex. 6. See, you assume.. you're soon going to get darkness, right.. 'coz there's not much life left in the candle. so its kind of like the candle is blind.. so I mean by ominous it just seems like.. yeah, like the candle is dying. 'Coz all that negative .. all the negative connotations to it.

(Sciences, Female (S9), Topic (P6). Lines 313-318. Target - V)

Ex. 7. People aren't courageous, they are lacking in fear or they understand their fear and they can put their fear in place. But.. so I'm not sure that courage exists. So walking in the rain without a hat is my metaphor for courage. That's.. that's.. smiles, suppose or it takes an understanding of your own fears. So smiles are courageous, smiles are courage. Yep, that's it!

(Social Sciences, Male (S22), Topic (P5). Lines 607-615. Target - V)

Table continues...

Table 16 (..continued)

Ex. 8 .. it was a struggle. So umm.. again tragic for me means struggle and disempowering and not being able to effect change in your life, whatever is affected you, you add effect. You are the effect rather than being able make for.. relationship.. to oil spills umm.. to James Bay.. power dam project, to umm.. cutting down the tropical rain forests in uh.. in Brazil.

(Sciences, Female (S12) Topic (P8), Lines 249-254. Target - AA).

Ex. 9 Tragic is.. uhh.. unfairness, tragic is.. is something bad happening that's going to change a person's life from relatively comfortable to inconvenient and painful and suffering. Uhh.. tragic is a word that I don't like.. uhh.. to have in my vocabulary, and I don't.. when I say something is tragic, its usually something that is hurting me down deep because I can't explain why it happened. I associate tragic with trying to explain to my own children when things would happen.. umm.. that didn't seem to have any rhyme or reason.

(Sciences, Male (S25), Topic (P8). Lines 264-273. Target - AN)

Ex. 10 Transparent is.. first thing I was thinking was, you know, whether the.. whether the properties of transparency o.k. the.. you know, the clarity, there is no distortion. You can see right into it. o.k. so transparency is liberating. Transparency is liberating because being able to see clearly.. is a freedom. Transparency is a freedom. I like that one.

(Social Sciences, Female (S2) Topic (P7), Lines 710-717. Target - AN)

Ex. 11. .. looking at stars as.. as again it is.. it is.. stars represent uh.. the wide unknown, it is one of the areas that uh.. mankind on earth has as yet to really exercise any degree of familiarity with, the whole concept of star..

(Sciences, Male (S29), Topic (P1), Lines 26-30. Target - AA)

Ex. 12 ..Could be morning yoga (laughs softly). Dew is morning yoga, absolutely fresh and early morning like in that you are not quite awake but you can feel , when.. when you're.. when you're out walking when the dew is around you can feel the freshness of the skin almost, and when you're doing yoga you can feel that as well..its all the energy around, its the same kind of tingling..

(Sciences, Female (S12), Topic (P3), lines 92-98. Target - CN. E(4))

The target descriptor is thus the Abstract Noun "sadness" which maps the common relationship of being close to the end and evokes feelings of sadness for what is finished and not wanting it to end for both the candle and the romantic evening.

Example 2 represents another description of the visual stimulus CHILD by using an Abstract Noun target. Participant S5 initially recalls what she considers to be a "beautiful analogy" which depicts a child as "God's promise that the world will go on" and also "that there is good in life and will always be good in life". This leads to the statement that a "child is like a miracle". The target word "miracle" (which is an Abstract Noun) maps the qualities of being God's creation, life giving (seen in the statement "where there was no life, there is life") and continuity on to the topic CHILD. Another description of the same Topic by using another Concrete Noun Target word (Example 3), is noted when Participant S22 "Think(s) of new life, Spring (as) a metaphor for children". The connotation that can be derived from Spring is newness, budding, anticipation, hope (and many other positive notions!) and these are mapped on to the topic CHILD. This leads to another statement that describes children as "optimism" and this metaphorical depiction uses an Abstract Noun as a target word.

Example 4 is an excerpt showing how the visual presentation of the topic PATH was described by Participant S 5. The target word used as descriptor was in the form of a Concrete Noun. The path or the road is immediately associated with "journey" and the road is then described as being a "journey through life with many bends and places to stop under a shady tree". This description is immediately followed by another metaphorical statement which uses the Concrete Noun target of "a root system on a tree" to map the qualities of "bending, and going around the rocks in formations that are impeding its progress". S28's description of the stimulus PATH (example 5) as "the winding rugged road (that) is a representation of the realities of life" makes use of an Abstract Noun as a target that maps the qualities of winding, rugged, too many corners and too many surprises on to the topic stimulus.

The use of Verbs or "Doing" words as the source to describe the topics is seen for many of the stimuli that were presented to all the participants. In the case of the visual

presentation of CANDLE, Participant S9 (Example 6) describes the candle as being "blind" and also depicts it as "the candle (is) dying". The description of the candle in terms that relate to what it is doing serve to highlight a very different aspect of the topic also. In Example 7, the topic word COURAGE is described in terms of a Verb target. The depiction of courage as "walking in the rain without a hat" reveals the notion of smiles or the understanding of one's fears as being considered pertinent descriptors by Participant S22.

The evaluative nature of the descriptions for the stimulus word TRAGIC which is an Abstract Adjective can be seen in the excerpts of different participants. Participant S12 depicts the stimulus word TRAGIC (Example 8) as a struggle and denotes the disempowering feeling of not being able to effect change in one's life by citing various examples : the oil spills, James Bay power dam project, and the cutting of the tropical rain forests in Brazil. These events and the word TRAGIC share the same quality of generating feelings of disempowerment, emphasizing the Abstract nature of the Adjective that was used as a target. The statement made by participant S28 to describe the word TRAGIC (Example 9) similarly deals with the notion of unfairness. The occurrence of events that don't seem to have any rhyme or reason and that change life from relatively comfortable to inconvenient and painful is explained as being tragic and both share the relationship of being "unfair".

Participant S2 saw the topic TRANSPARENT (Example 10) as possessing the qualities of clarity and having no distortion, which was described as a liberating experience. This led to the depiction of transparent as a freedom. The target that is used for the production of the metaphorical statement is thus the Abstract Noun "freedom" that is juxtaposed on to the Concrete Adjective topic TRANSPARENT. The Concrete Noun topic STAR (Example 11) and DEW (Example 12) are described by focussing on different target domains. While Participant S29 depicts the topic by using the target type of an Abstract Adjective "the wide unknown", Participant S12 uses a Concrete Noun "morning yoga" to depict the notion of DEW.

Tracing the Process of Metaphor Production

The detailed analysis of different metaphorical statements serves to highlight the rich and diversified descriptions that were produced by the participants. An important aspect of metaphorical thought that needs to be understood is the process that is involved in successful metaphor generation or production. The next phase of analysis proceeds to the identification of this process.

The think-aloud protocols obtained from the participants while they performed the task of producing metaphorical descriptions provided information that was both rich and complex in nature. It necessitated the development of a categorisation scheme to reduce the complexity of the data and facilitate the content analysis. The symbolic transcription of these verbal protocols using the vocabulary introduced in Table 2 yielded traces of the cognitive processes that were displayed by the participants in the performance of the assigned tasks. The total number of protocols that were symbolically transcribed was 192 (24 participants X 8 tasks).

The Process Strip

The processes that were evidenced in the protocols were depicted on strips that graphically represented the activities undertaken by each participant in an ordered sequence (See Figure 1). The number of lines in the protocols were used to express an approximation of the duration of each category of processes. Each strip reflected the complete coded protocol of an individual doing one task. The strips were then colour coded to differentiate the six general categories of processes (episodes) as defined in Table 3. This broad categorisation of the cognitive processes was based on a modified version of the Schoenfeld (1985) approach to analyze verbal protocols on problem-solving tasks. The coloured strips of process information provided visual representation of the patterns of episodes observed for each participant. The 192 process strips that were colour coded then reflected the entire corpus of concurrent

observations. These patterns of episodes were then classified as "strategies" which can be described as sequences of activities employed by the participants for tackling the task.

The coloured process strips were used to analyse the distributions of episodes or behaviours. During this phase, the analysis and exploration episodes were collapsed into one since the categorisation of the data had shown that the analysis related activities (Focussing on word; Sensory appeal criteria; Reiterates instructions for task; or Refers to previous statements) were used only infrequently. This could be attributed to the nature of the task which was generally perceived as being divergent and exploratory rather than being analytical. The colour-coded strips simplified the complexity inherent in the data obtained through concurrent verbal protocols by making the task of identification of strategies used in each protocol visually transparent.

Distribution Of Episodes

The colour-coded Process Strips provided visual evidence of the distribution of cognitive behaviour. The categorisation scheme of the distribution of the episodes is presented in Table 17. The distribution of general cognitive behaviour that was analyzed through the Process Strips was based on the criteria of duration and frequency of the episodes. The strategies progress from no observation of the episode in the protocol to increased levels of frequency and duration. In the following sections the patterns of episodes displayed in Table 17 and identified in the verbal protocols are described.

Distributions of Encoding

The encoding episode consisted of several activities (Observes literal attributes, Difficulty in specifying attributes, Recalls previous usage, Observes figurative attributes, Highlights functional attributes, and Affective reaction to stimulus- Refer Table 2) that were defined as being a natural response to the stimulus while attempting to understand and/or

encode the reactions to the given stimulus. Five different patterns of encoding were identified from the colour strips (Table 17).

The No Explicit Encoding (NE) distribution was observed when none of the activities that were included in the encoding episode were observed in the protocol of a participant, whereas Low Observance of Encoding (LE) was noted when fewer than three occurrences of brief encoding activities (with at least a duration of two lines of the protocol) were observed. The Repeated encoding distribution (RE) was characterized by activities related to encoding being observed at frequent intervals throughout the protocol. The observation of more than three episodes of encoding (duration of at least two lines) dispersed over a protocol was classified as RE pattern.

When the protocol began with an episode of encoding that was at least three lines long and no other occurrence of encoding activity for the remainder of the protocol was observed, it was taken as a separate distribution of encoding and called Early or initial encoding (EE). This observation overlaps with the LE distribution but can be differentiated from it since it possesses the characteristic of having only one episode of encoding at the very beginning of the protocol. On the other hand, when a protocol had an initial or early phase of encoding followed by other regular occurrences of encoding, it was considered as a different distribution and was called Initial and repeated encoding (IRE) was assigned to it. It differed from the RE distribution since it was observed to have the initial encoding episode followed by the observation of episodes similar to the RE pattern.

Table 17
Distribution of Episodes in the Production of Metaphorical Statements

Episode category	Distribution of Episodes	Symbol
Encoding	No explicit encoding	NE
	Low observance of encoding	LE
	Repeated encoding	RE
	Early or Initial encoding	EE
	Initial and repeated encoding	IRE
Analysis and Exploration	No analysis	NA
	Limited analysis	LA
	Periodic episodes	PA
	Prolonged episodes	PRA
	Periodic and prolonged episodes	PPA
Monitoring	No monitoring observed	NM
	Minimal monitoring	MM
	Brief, regular episodes of monitoring	BM
	Regular and prolonged episodes of monitoring	RM
	Irregular monitoring	IM
Affective component	Absent affective component	AA
	Very limited observance of affect	VA
	Sporadic observation of affect	SA
	Long affective episode	LF
External influences	External intervention not observed	XI
	Brief intervention	BI
	Frequent prompting	XR
	Intervention episode prolonged	IP

The need to differentiate the episodes of encoding that were characterized by an early observation of encoding was guided by the expectation that the early phase of encoding may be a distinguishing characteristic that needed to be monitored.

Distributions of Analysis and Exploration

The activities included in the Analysis episode were general attempts that made use of convergent thoughts to work on the task, while keeping its conditions and goals in mind. The exploration episode, on the other hand, is characterised by the use of divergent thoughts and involves a move away from the obvious and salient features (aspects that are inherently associated with the given stimulus). The analysis and exploration episodes were combined for the purpose of "strategy extraction". One factor that led to the combination of the two episodes was the limited number of analysis episodes observed in the protocols. The other factor was the apparently higher level of inference needed to differentiate between the convergent and divergent criteria.

Five types of distributions were observed for the enlarged Analysis episode (Table 17): The no analysis (NA) distribution was noted when there was no explicit activity related to the analysis and exploration episodes found in the protocol. The distribution of limited analysis (LA) is observed when the complete protocol has at most three brief episodes from one to three lines each devoted to analysis and exploration. Periodic episodes (PA) of analysis and exploration are characterized by activities at frequent intervals. This entailed the observation of at least four episodes of analysis and exploration (from one to three lines each) distributed over the protocol. Prolonged episodes (PRA), on the other hand, are observed when the analysis and exploration activities are prolonged episodes with a duration of over ten lines in the protocol that may occur once or up to three times. A fifth distribution of Analysis and exploration incorporated the last two distributions of PA and PRA. It was reflected in prolonged episodes of analysis (over ten lines) that were periodically used throughout the

protocol (at least three episodes) and it was called Periodic and prolonged episodes (PPA) of analysis and exploration.

Distributions of Monitoring

The five distributions of Monitoring extracted from the Process Strips were also based on the length and frequency of occurrence of the corresponding activities (Table 17). The distribution of no monitoring (NM) is identified by the absence of any explicit monitoring activity throughout the protocol. The distribution of minimal monitoring (MM) is observed when less than three occurrences of monitoring activity with a duration of less than six lines altogether occur in the complete protocol. The brief monitoring distribution (BM) is characterised by brief (less than six lines of the protocol) episodes of regular monitoring. Another distribution of Monitoring that was extracted from the protocols was Irregular monitoring (IM), characterized by at least three occurrences of monitoring activity that were unequally distributed throughout the protocol. The regular monitoring (RM) distribution is characterized by regular (four or more occurrences of monitoring, periodically distributed over the protocol) and prolonged episodes (more than six lines of the protocol for the episode) of monitoring.

Distribution of Affective component

Four different distributions of affective components were identified from the episodes that explicitly mentioned emotions and feelings of the participants. The absence of any identifiable affective component in the complete protocol is the distinguishing characteristic of Absent Affective component (AA). The distribution of Very Limited observance of affect (VA) was noted when one or two brief (with a duration of less than three lines) occurrences of affective component were found in the protocol. Sporadic observance of affect (SA) was characterized by the observation of three or more occurrences of affective activities distributed

at different points in the protocol. The Long Affective episode (LF) corresponds to an affective component which lasted over more than five lines.

Distributions of External influences

A concurrent verbal protocol consists of verbalizations made by an individual while attempting to execute a task or solve a problem. It is assumed that the verbalizations provide direct indices of the problem-solver's thoughts and these verbalizations can therefore be used to trace the cognitive processes that are utilized for the solution process. It is also assumed that there are minimal external influences that affect the verbalizations during the solution process. To achieve this "ideal" of no interference, as far as possible only neutral prompts and interventions are used, i.e. interventions which are unlikely to be perceived as influencing the solution path chosen by the problem-solvers. Four distinct distributions of external influences related to the experimenter's comments were identified (Table 17). The absence of external intervention (XI) was taken as a distinct observation. A distribution of Brief Intervention (BI) was characterized by at the most two occurrences of external influences that were not more than four lines each. Frequent prompting (XR) was noted when three or more occurrences of experimenter's comments were noted during the protocol. A prolonged intervention episode (IP) was a distribution that was characterized by occurrences of one long intervention of more than six lines.

Distribution of strategies used

These distributions of activities were then used to develop a "participant profile" for each individual. These profiles displayed the sequence of episodes used by the individual to tackle each task. To each protocol corresponds a profile on five dimensions of cognitive episodes, e.g. it could be LE, PA, IM, AA, IP.

The different distributions of global strategies that were observed provide an indication of the cognitive processes utilised in task performance. An examination of the distributions of

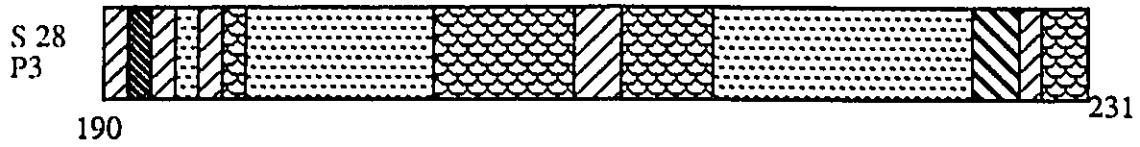
general or global strategies used and the kinds of statements that were produced as a "product" of the task may provide links between the **process** and **product** of the metaphor production task.

During the data collection stage, the participants had been encouraged to provide as many metaphorical descriptions as they could, for each of the stimuli that were presented to them. An analysis of frequency distributions of the different categories of statements has already been presented. This analysis was based on a classification scheme. The five levels of mapping can be described on a continuum of complexity with level one, Basic or literal transfer, at the lower end and level five, Complex mapping, being at the higher end of the continuum. To investigate any possible links between these "products" and the underlying cognitive processing patterns, the "dominant category of metaphor" is identified. This "dominant category of metaphor" corresponds to the category with the highest frequency of occurrence for any given stimulus. In case of ambiguity, the more complex metaphor was chosen as the dominant metaphor.

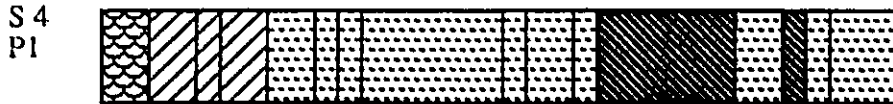
The frequency of dominant categories of metaphors (structural, functional and evaluative) for the patterns of global activity for all eight tasks are appended (Appendices F to J). Out of the five levels of complexity of mapping, the two extreme levels (Literal and Complex) were deleted since their occurrence was observed to be minimal. The three remaining levels were *Attributional* (A), *Relational* (R), and *Double* (D) .

From the frequency distribution of statements, presented in Table 5, there were an equal proportion of *Attributional* and *Double* mappings for the Structural statements. However, when the dominant metaphors were extracted for each task it was observed that the *Double* mappings for the Structural statements had a higher frequency of occurrence than the *Attributional* mappings.

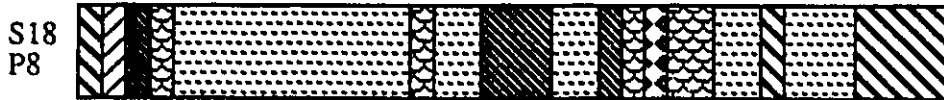
Process Strips



Profile: (RE, PPA , IM , VA , XI)



Profile : (EE , PRA , MM , AA , XI)



Profile: (LE , PA, RM ,SA , BI)

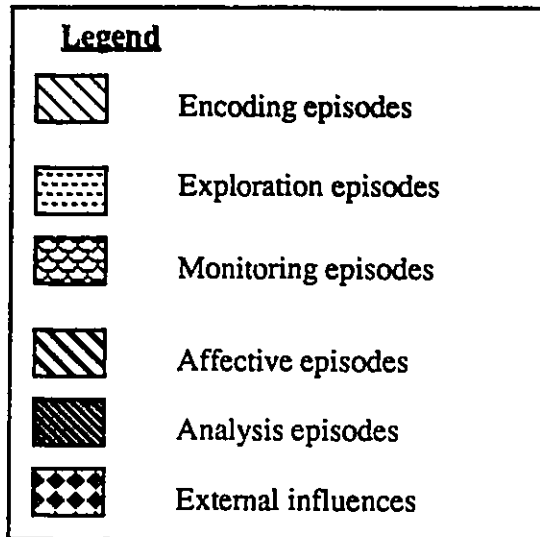


Figure 2: A visual presentation of the frequency and duration of cognitive processes

Table 18
 Chi-square Test of Association for Dominant Categories of Metaphors
 Produced by the different groups.

Group	Structural (Double)	Functional (Relational)	Evaluative (Relational)	Evaluative (Double)
FSS	8	6	23	5
FS	8	6	16	6
MSS	3	9	10	11
MS	10	7	22	4
χ^2	3.021	0.506	4.37*	3.43

* p < 0.05

A Chi-square test of hypothesis for the degree of association between the dominant categories and the grouping of subjects (Table 18) showed that the only significant association was observed for the *Relational* form of Evaluative statements (at the .05 level of significance).

Table 19 presents a composite view of all the distributions of episodes that were observed for the dominant category of metaphors for the different groups. This information can be used to compare the different distributions of cognitive activity. The low encoding (LE) distribution was the most frequently observed pattern for all the four groups of participants. The need for very limited encoding is directly attributable to the nature of the ill-defined task. The instructions that were provided with the task (Appendix C) were open-ended and since they provided the context for the task, they required only a limited amount of encoding activity. There were few observations of the no explicit encoding (NE) distribution. The Repeated encoding (RE) distribution was more frequent with isolated incidences of the early encoding (EE) or the Initial and Repeated encoding distribution.

The distributions of activity for the analysis and exploration episode show the most frequently used distribution to be periodic analysis (PA). The Females Social Sciences (FSS) group in particular displayed the predominant use of PA distribution across different categories of dominant metaphors. Regular use of analysis and exploration is understandable particularly when the nature of the assigned task is taken into consideration. The combination of frequency and duration of analysis, discerned in the PPA (Periodic and Prolonged Analysis) distribution, was also found to have regular occurrence.

The distributions of monitoring linked to the Dominant metaphors showed a variety of distributions of occurrence across groups. The observation of Regular monitoring (RM) was systematically found in all the groups but the number of dominant metaphors linked to this distribution was inordinately lower for the FS group with 6 cases altogether, compared to the other groups with 19 cases for the FSS, 13 for the MSS and 14 for the MS groups.

Table 19

Frequency of dominant category of metaphors for global patterns of cognitive processing

PATTERN	Structural(Double)			Functional(Relational)			Evaluative(Relational)			Evaluative(Double)			
	FSS	FS	MS	FSS	FS	MS	FSS	FS	MS	FSS	FS	MS	
No encoding	1	1	0	0	1	0	4	2	3	5	1	1	0
Low encoding	3	3	1	5	4	7	17	9	6	8	1	1	7
Repeated encoding	2	0	0	1	1	2	2	4	0	7	2	3	1
Early encoding	2	1	0	0	0	0	0	0	1	2	0	1	4
Initial and repeated E	0	3	1	0	0	0	0	1	0	0	1	0	0
No analysis	1	0	0	0	0	0	0	0	0	0	0	0	0
Limited analysis	1	0	0	0	0	0	1	1	1	1	1	1	0
Periodic analysis	5	5	2	6	3	5	19	11	3	10	3	4	8
Prolonged analysis	1	0	0	0	1	1	1	1	3	3	0	1	0
Periodic and prolonged A	0	3	1	0	2	3	2	4	3	8	1	0	3
No monitoring	0	0	0	0	0	0	1	0	0	0	0	0	0
Minimal monitoring	2	2	0	1	0	1	4	3	1	4	0	3	1
Brief monitoring	1	4	1	1	2	1	8	7	4	8	1	0	5
Regular monitoring	4	0	2	3	1	3	8	2	2	6	3	3	5
Irregular monitoring	1	2	0	1	3	4	2	4	3	3	1	0	2
Absent Affect	5	3	2	0	2	1	6	2	5	11	0	3	2
Very limited affect	2	3	1	1	1	0	8	7	3	5	2	1	7
Sporadic affect	1	2	0	5	3	4	9	7	2	5	3	2	2
Long episode of affect	0	0	0	0	0	0	0	0	0	1	0	0	0
No external intervention	4	1	0	4	1	0	8	2	7	7	0	2	3
Brief intervention	1	4	0	2	4	7	10	8	2	10	3	3	4
Regular prompting	3	2	3	0	0	2	3	1	1	2	2	1	4
Prolonged intervention	0	1	0	0	1	0	2	5	0	3	0	0	0

Note: Size of samples - FSS (n=43), FS (n=42), MSS (n=43), and MS (n=44).

The distribution of Brief Monitoring (BM) was observed more frequently for the Evaluative-Relational type of metaphors. The Irregular Monitoring (IM) distribution was displayed consistently across the groups, but the incidence of dominant metaphors for the FSS group was lower (5 cases) compared to the frequency observed for the other three groups. The Minimal Monitoring (MM) distribution was also consistently, although somewhat sporadically, observed for all groups. The observation of No Monitoring (NM) distribution was isolated to single occurrences for the FSS and the MS groups, with for the Evaluative-Relational forms of metaphors.

The distribution of Affective components displayed some trends for the different Dominant metaphors that were extracted. The Absence of Affective component (AA) had a count of 21 occurrences for the two groups of Female participants. However, the Frequency count for AA for the males was higher (27). The Sporadic observation of Affect (SA) displayed a reverse trend from the AA pattern since the Females groups had higher frequency counts for the patterns (32) compared to the Males groups (18). The distribution of Very Limited observation of Affect (VA) was seen to have very similar frequencies for all the four groups of participants while the Long Affective episodes appeared only for the MS group.

The analysis of the different distributions of cognitive activity across the various categories of dominant metaphors produced by the four groups of participants leads to the identification of a composite "profile" of Low encoding (LE), Periodic analysis (PA), Regular and Brief monitoring (RM and BM). The frequent observation of these distributions make them more probable cognitive activities that are conducive to the production of different categories of metaphors, while the patterns for affective and external intervention episodes were more idiosyncratic and varied.

The observation of other distributions of the episodes may reflect limited or deficient cognitive activity and the individual profiles can be studied and "diagnosed" for strengths and weaknesses which can then lead to possible remedial measures being suggested to help improve or overcome observed deficiencies.

Ranking the Difficulty of the Tasks across groups

The collection of concurrent verbal protocols of participants, as they described different stimuli to produce or create metaphorical statements, was followed by a retrospective session during which the participants ranked the difficulty experienced by them in doing the tasks. The rankings range from 1 for the easiest task to 8 for the most difficult task. A wide variation in the rankings was noted and this is directly attributable to the different aspects of the stimuli that were probably being attended to by different individuals.

Table 20 reports the mean ranking score that was given to each task by each group of participants. The information contained here (in Table 20 and in the excerpts of the participants protocols) is gleaned from the retrospective protocols and it complements the data collected as concurrent verbal protocols. It taps the participants own memory for thought processes during the task (their cognitive and metacognitive processes), their memory for the information that was presented (the instructions and the stimuli), and their recollections of the strategies used in doing the task.

It is observed that the Females Sciences group gave consistently low ranking to the visual presentations. PATH has a mean score of 3, CHILD has a score of 3.83 and CANDLE has a score of 2.5. These low rankings may indicate that the individuals found the topics in their visual format more evocative. This is articulated in participant S14's retrospective comments:

"I think umm.. first of all I found that the pictures were easier than the words because they evoked some kind of emotional response in me and the words didn't. I had to then associate.. and because they were words I had to associate.. they were more concr.. I don't know.. they were not.. they didn't engender anything creative in me to see these words, whereas the picture because its a creation and art and I'm quite artistic, evoked some kind of emotion to me, so I could go to a more divergent thinking than when I just looked at the words.

(S 14, 1 426-438)

Table 20

Mean Score for Ranking of Difficulty for Tasks Across Groups

TOPIC	FEMALE		MALE	
	Social Science	Science	Social Science	Science
STAR	3.17	5	4.33	3.5
PATH*	3.4	3	4.5	4
DEW	4	4.5	3.8	4.33
CHILD*	4.5	3.83	4.17	3.33
COURAGE	4.5	4.67	5.67	4.67
CANDLE*	4.83	2.5	5	5.17
TRANSPARENT	6	6	5.33	4.67
TRAGIC	5.33	5.67	3.67	6.33

Note:

- * The topics with the asterisk indicate visual presentation of stimulus.
- Rank 1 assigned to the easiest task and 8 to the most difficult task.

This sentiment was not shared by all the individuals in this group, but they had very different reasons for having found the visual stimuli to be easier to handle. Another ranking that needs to be scrutinized is that given to the stimulus STAR by the two groups of Female participants. The Social Sciences group had a mean score of 3.17, which implied that the group consistently found the stimulus to be easy to deal with. The Sciences group, on the other hand had a mean score of 5, which was at the upper end of the mean scores obtained and implied that the sciences group found the stimulus to be more difficult. The two groups of Males had lower mean scores for STAR compared to the Females Sciences group.

While commenting on the difficulty experienced in dealing with some of the stimuli, S29 mentioned that he found TRAGIC to be the most difficult "because its a more abstract concept, because it being a descriptor..." (Lines 569-570). S30 found "words more difficult" while S4 described her experience to be "...I was just so stuck on what it was a picture of.. that that was preventing me from describing it" (Lines 534-536).

When any mention of the criteria used to rank the difficulties were verbalized, it was noted that they were also very diverse. S22 talked of "the criteria I'm using is the amount of excitement I experienced when I first glimpsed a metaphor because I think I sort of have this faith that the amount of excitement I have is an indication of the amount of strength and association that lies behind that initial excitement." (Lines 716-722). However, for S27 the criteria was "... output.. its volume of output.. how freely my ideas flowed from this concept and a little bit having to do with the depth of my ideas..." (Lines 618-621).

When specifically asked to describe the "strategies" they had chosen for dealing with the task, many comments were made about the emotions or the feelings involved. S2 talked of how "...I was trying to connect it to a feeling" (Line 711), and S1 also talked in similar terms "...I sort of went with that feeling in terms of trying to describe that feeling rather than go back to the actual..." (Lines 520-523). In a similar vein S22 described "...the most vivid image that came to my mind, and there was a real emotional reaction to uhh.. having that image.." (Lines 768-772).

The role played by visual imagery was often brought out in the comments made by different participants. S18 talked of.. "I just tried to put an image of.. a mental picture in my mind.. and then.. if possible give a verbal description of that image..". S30 described his strategy for dealing with the task as being "I was waiting for assoc.. I was waiting for things to come into my mind.. and I.. that's how sometimes ideas or words or.. or.associations or whatever they .. they just sort of (Lines 995-999). S29 characterized his course of action as being.. "In order to determine the metaphor, .. well, I'd create a visualization. In each case I try.." (lines 610-612).

The ranking of the difficulty experienced in dealing with the assigned task of producing metaphorical descriptions provided some information that directly reflected the participant's metacognitive knowledge related to the task. The different aspects of the task, the solution process or the solution itself that were mentioned as the factors responsible for the difficulty experienced, display the wide range of perspectives that may have affected the way in which the different participants tackled the task. One reason the mean score for the ranks showed very low range of ranking variation may be related to this diversity of perspectives that were brought to bear on the task.

Summary of Highlights

The perspectives gained on the data through process and product analysis lead to an understanding of the metaphorical statements and the process that underlay its production. The analysis that was undertaken utilized both concurrent and retrospective protocols as data sources to obtain the information for the investigation. The application of a classification scheme to the descriptive statements provides a characterization that showed the frequency of the three type of statements and the five levels of complexity of the mapping involved. The frequency distributions of the different statements produced together with the patterns of observations related to the different topic-stimuli and the targets used provide some indications of the different criteria that influenced metaphor production. The influence of the gender and

domain of specialization variables was noted but other "stronger" influences that were observed were:

- * the level of abstractness - concreteness of the given stimulus-topic and the target word or concept.
- * the syntactic role of the stimulus-word and the target-word (Nouns were preferred, with some use of verbs and adjectives also being noted).
- * the role of analytical - exploratory processes like associating, comparing, constructing analogies, using images and imagery to describe and denote stimuli.
- * the role of regular monitoring and limited encoding in the process of producing metaphorical statements.

Some global features of the multi-faceted phenomenon of metaphor production can be derived from this analysis and these are discussed in the following chapter.

CHAPTER 6

DISCUSSION OF RESULTS AND THEIR IMPLICATIONS

The primary objectives of the present investigation were to identify and understand the nature of the cognitive processes and patterns that are involved in the production of metaphors. According to Black (1962), empirical researchers have shied away from investigations into the creative and abstract nature of metaphorical thought itself. The most deterring factor that may in some ways be responsible for this lack of empirical information about metaphor creation (or production) has been the lack of an adequate methodology to identify and observe indices of human thought processes without altering them significantly. This was one of the central issues that was addressed in the present study.

The present exploratory study relied on a qualitative approach for data collection and analysis. The approach entailed lengthy, time consuming activities for each participant, which resulted in limiting the size of the targeted sample ($n = 24$); the sample size is considered large when compared to other studies of this type. To gather empirical evidence on cognitive processes underlying metaphor production, the sample of twenty-four (balanced for gender and domain of specialization) Secondary and Intermediate school teachers were asked to perform a task that instructed them to describe assigned stimulus-topics in metaphorical terms; they were required to think-aloud while executing the task. The concurrent verbal protocols were recorded and transcribed. Together with other observations from a retrospective session, they form the corpus of data for the study.

In the first phase of analysis, the metaphorical descriptions of the stimulus-topics that were produced by the participants were classified on the basis of two criteria (Table 3). The classification was based on the categorisation of the referents that underlie intentional language (three categories were established — Structural, Functional and Evaluative); and the different levels of mapping that formed the core of the process that was used (five levels of complexity

— from basic to complex). The classified statements were then analyzed for patterns across gender, domain of specialization and their interaction.

For the second phase of analysis, based on the research literature and a content analysis of the protocols, a coding grid (vocabulary for categorisation) was developed. The categorisation provides an approach for identifying the sequences of cognitive processes used in task performance.

The results emerging from the data analysis will be discussed in the light of the following four research objectives:

1. To examine the characteristics of the statements produced as metaphorical descriptions by Secondary and Intermediate school teachers .
2. To explore the differentiating characteristics of the statements that discriminate between the Secondary and Intermediate school teachers across gender and specialization.
3. To identify the cognitive processes employed in the production of metaphors by groups of Secondary and Intermediate school teachers, differentiated by gender and domain of specialization.
4. To identify the distribution patterns of the cognitive activity or global strategies in the production of metaphorical descriptions that were observed for the groups of Secondary and Intermediate school teachers, differentiated by gender and domain of specialization.

These objectives necessitated a broad and comprehensive examination of the data to obtain information about the characteristics and nature of the given task and the cognitive processes and patterns used in the execution of a task requiring the production of metaphorical statements. The results that were obtained from this investigation are presented in chapter five, and are discussed in the present chapter within the context of the research objectives and the conceptual framework. The implications of these results for future research and the impact on the educational milieu will also be addressed.

General Characteristics of Metaphorical Statements

To analyze and understand the task of metaphor production, an important feature of the task that has to be analyzed is the "end product" of the production process. The descriptions that were provided as metaphorical statements can be qualitatively analyzed by answering the following question:

Research Question 1 What are the characteristics of the statements that are produced as metaphorical descriptions by Secondary and Intermediate school teachers?

This question was addressed by initially focusing on one aspect of the data gathered from the teachers' concurrent verbal protocols. The transcribed verbalizations were examined and all the statements that were descriptions of the stimulus-topic were extracted from the protocols. The compiled list included all the descriptions that were verbalized by the participants other than the most simplistic statements which were interpreted as being categorizations. For example, Participant S11, while describing the stimulus-topic STAR, makes the statement: "So first we'll do stars as in stars in the sky..." (lines 16-17) was one such statement that was considered as a simple categorization and not included in the list of descriptions. A scrutiny of the list of statements and a survey of the research literature led to the development of a classification scheme (Table 3).

Guided by the conceptual framework that was established for the present investigation, two criteria were established for the classification. The first criterion is based on the "pragmatic constraints" (Holyoak & Thagard, 1990), and refers to the assessment of the relevance assigned to the goals of the assigned task. The pragmatic constraints are "satisfied" through the intention or perceived function of the description that was provided by the participants, and this led to the use of the criteria established for the referents that underlie

intentional language (Bruner, Goodnow & Austin, 1956; Matic & Wales, 1982). Three types of statements were differentiated, characterized by distinct observation of three forms of metaphorical descriptions. These are Structural, Functional and Evaluative types of statements. The second criteria is based on the "structural constraints" that are imposed by looking for correspondences, so that not only the objects, but the relations also correspond (Gentner, 1988, 1983; Holyoak & Thagard, 1989). This process of looking for correspondences imposes constraints which can be monitored by observing the "mapping process". The mapping process being observed also takes into account the level of complexity of the mapping that is undertaken to monitor the "semantic constraint". The five levels of mapping that were monitored were Basic, Attributional, Relational, Double and Complex. The two criteria for the statements and mapping yielded fifteen different categories, which established the Classification Scheme (Table 3) for the categorisation of all the metaphorical descriptive statements. The fifteen category Scheme incorporates the analysis and examination of the three constraints that are theorized (Holyoak & Thagard, 1989; Holland et al., 1986) to affect mapping and which would also affect the metaphor production task.

The criteria established in the classification scheme can then be used to attempt to find an answer to the next question.

Research Question 2 What are the differentiating characteristics of the statements that discriminate between the Secondary and Intermediate school teachers across gender and specialization?

The application of the classification scheme (discussed in R.Q. 1 above) to the large quantity of descriptive statements (764) produced by the four groups of participants provided a data base for comparisons. This phase of the analysis was focused on frequency distributions obtained from the categorized statements that were produced by the different groups of participants (Table 5).

A comparison of the frequency distributions of the different categories of statements led to the identification of a different trend of observations for the Structural category when compared to the Functional and Evaluative categories. The level of complexity of the mapping process showed a high incidence of *Attributional* (Total = 81) and *Double* (Total = 86) mappings for the Structural statements, whereas the Functional and Evaluative statements displayed more *Relational* (Total = 106 and 306, respectively) mappings. This trend can be explained by the nature of the Structural category which relies on the specific physical properties forming the basis of the statement produced. The lack of depth of processing while examining physical properties seems to generate a general limitation. The observation of various underlying **relationships** (also called structural mappings) between the "elements" in the stimulus-topic and the elements in the target is an important ingredient for success in producing metaphorical statements which have a high level of complexity. Burton (1989) observed that a rich "repertoire of relations" possessed by individuals who successfully interpreted proverbs enabled the participants to identify a relation between elements in the proverb and elements in the general interpretation provided. Access to a rich and varied "repertoire of relations" could thus be a key factor in the success and ease of handling figurative language.

The key elements or components that characterize a metaphor (based on a general consensus in the literature), the topic-stimulus, vehicle-target and the implicit ground were examined in order to monitor the characteristics of the statements produced as metaphorical descriptions. This led to the observation of patterns of occurrence across gender and domain of specialization for the groups of participants. Both the topic-stimulus and the target were monitored across two dimensions: **abstraction**, displaying two levels of concrete and abstract; and the **syntactical** role of the word as noun or adjective (and also verb in the case of target).

The observation of patterns for the use of the topic-stimulus (which was the assigned "input" provided for the task), were too diffuse and widespread to lead to interesting

conclusions about their nature. The size of the sample may be a factor that affected the ability to observe any trends in the observations made. The only comments that can be made are with regard to the general patterns that are observed. There were limited observations of the Structural type of statements for the abstract form of the topic-stimuli (COURAGE and TRAGIC) and also for the visual presentation of the stimulus CHILD. This shows the possible restricted nature of the stimuli (it is generally acknowledged that for many people abstract concepts are more difficult and complex than concrete concepts). The low frequencies may also be a result of an inability on the part of the participants to find any perceptual or material properties in these topic-stimuli, most likely due to their abstract nature. The production of Functional form of statements too were limited in their occurrences for the visual stimulus PATH and for the adjectival topics TRANSPARENT and TRAGIC. The Evaluative form of statements were regularly produced for all the different topic-stimuli and the evocative nature of these statements (i.e.- making judgments that focus on generalized properties that are not inherent to the entity denoted by it, but are "evoked" by the stimulus, often in the form of images) highlights the inherent qualities that are commonly heeded.

In observing and analyzing the target (as part of the output produced by each participant), it was noted that the Concrete forms of stimuli-topics were more prone to be described by using Concrete forms of targets in the case of the Structural form of statements produced, while the other forms of statements displayed more diverse patterns of target use. The Functional statements had a high frequency of occurrence of verbs (32%) and Abstract Nouns (36%) as targets, while the Evaluative statements displayed higher frequencies of Abstract forms of targets used (Nouns and Adjectives). Highlights of the different categories of statements that help in capturing the nuances and the rich variance observed in the descriptions are presented as excerpts (Tables 14, 15 and 16).

The patterns of occurrence of statements across gender and domains of specialization were found to be diffuse and spread out, showing some indication of differences across gender and also between the domains of specialization of the Sciences and the Social Sciences.

"Stronger" patterns were noted in the case of the influence of the format of the topic-stimulus and also for the types of targets used. In the case of the topic, it was observed that the visual stimuli had lower frequencies of statements produced, while the Concrete words led to more productions than the Abstract words did. Within the Concrete format, nouns were found to be more conducive to production of descriptive statements than adjectives.

It can be said that the analysis of the constraints that influence metaphor processing has provided some indications of the characteristics of the descriptive productions and has also provided some characteristics that distinguish the groups involved in the production task. Other factors influencing the production of metaphorical statements were found in the analysis of the retrospective protocols and helped to develop a composite picture of the effect of these factors on the types and frequencies of the statements produced. This analysis of the metaphorical statements bridges two different approaches of looking at the **qualitative** differences that are to be found in the productions (three types of statements and five levels of mapping), and then **quantifying** the observations as frequency scores. The approach consolidates our understanding of the characteristics of the descriptions produced.

Tracing the Cognitive Processes Utilized in Metaphor Production

A shift in focus to study the underlying processes that lead to (or follow) metaphor production will provide some additional information on metaphors and metaphor production and will help in answering the next question.

Research Question 3 What were the cognitive processes employed in the production of metaphors by groups of Secondary and Intermediate school teachers, differentiated by gender and domain of specialization.

The identification of the cognitive processes that were utilized in the production of metaphorical statements was made possible by the application of the coding grid (Table 2) that was developed through a content analysis of a sample (n = 8) of the concurrent verbal protocols that formed the data base. Altogether, twenty-nine different categories of activities were identified. A complete coding grid, together with examples taken from the protocols of the participants to illustrate the variety of activities, is presented in Appendix D .

The Analysis and Exploration phases are of particular relevance for understanding the process of metaphor production, since different vital activities of associating, comparing, constructing analogies, using sensory or aesthetic appeal as criteria, which are all mentioned in the literature as being key elements in the processing of metaphors, are observed in this phase of processing.

The highest frequency of exploratory activity undertaken was that of Associating different ideas, closely followed by Comparing particular attributes. The instructions for the task (Refer Appendix C) suggest that associating the given stimulus with other things that come to mind would help the participants start the process of looking for any relationships that acted as linkages and helped in the creation of a metaphorical statement.. Participant S11, while recalling the strategies she had used to tackle the assigned task, made a comment during her retrospective session that helps in illustrating the role of this activity for her:

...again... listing in my mind, listing the... listing the associations, try to find the... you know, doing all that listing and then trying to come to a consensus with it. I guess I'm... I'm searching in my mind with each one of them, trying to find all.. you know, quickly do a ... what do we call... brainstorming... quickly brainstorm the concept in my mind, come up with a list... (Lines 754-762).

In a similar vein, Participant S22 also comments on the strategies he found to be most helpful in doing the task to be:

Mostly the old... uhh... the word association type things... first thing that popped into my mind, that's what I'd work from and then just sort of see where that took me. (Lines 823-826).

The activity of providing examples from observations was noted and observed for long episodes regularly, with some subjective aspects being commented on quite frequently. The experiential basis of metaphorical descriptions has been regularly mentioned in the literature surveyed (Lakoff & Johnson, 1980; William, 1984). The frequency and duration of the activities of providing examples and/or commenting on subjective aspects used by the participants serves to highlight the successful incorporation of these activities for the production of different metaphorical statements. Generally, the construction of an analogy was explicitly noted only when the participant was attempting to explain or elaborate on an already verbalized metaphor. However, implicit analogy construction was often implied from the level of mapping noted in the production of more complex metaphors.

However, the Encoding (Observation of literal attributes, Difficulty in specifying attributes, Recalls previous usages, Observes figurative attributes, Highlights functional aspects, and Affective reaction to the stimulus) and Assessment (with the evaluative and affective components) specify aspects that are also crucial to the process of metaphor production and their role in the metaphor production needs to be better understood. This was partially achieved by investigating the distributions of the episodes of cognitive activity

Distribution of Episodes or Strategies Used

Research Question 4 What are the distributions of episodes or global strategies in the production of metaphorical descriptions that were observed for the groups of Secondary and Intermediate school teachers, differentiated by gender and domain of specialization.?

The cognitive processes employed by the participants were displayed in process strips that graphically represented the activities performed by each participant in an ordered sequence. The duration and frequency of the episodes were the two criteria used to develop the distributions of the episodes (Refer to Table 17). The twenty-three patterns of activity that resulted were then used to develop a participant profile on five dimensions reflecting the sequence of patterns used by the individual to tackle the task. By linking these profiles to the categories of statements made (Table 19), relationships between the process and the product of metaphor production were uncovered. Participants most frequently employed the low encoding pattern (with less than three occurrences that lasted not more than three lines each), Periodic analysis (characterized by regular observation of more than three occurrences in a protocol having a duration of four to five lines), Brief and Regular monitoring (representing more than three occurrences of evaluative activities that were either brief, with less than three lines or long episodes, having more than four lines of evaluative activity), very limited or sporadic affect pattern and brief external interventions.

These patterns of frequently occurring cognitive activity lead to the development of cognitive profiles for individual and also for groups. These profiles can play an important role in the educational milieu which will be briefly discussed in the section highlighting the educational implications of the present investigation.

Contributions to the Conceptual Framework

The conceptual framework presented in chapter 3 postulated that the mental models framework, utilizing an Induction approach (which refers to all inferential processes that expand knowledge in the face of uncertainty), was an appropriate framework to study the cognitive processes underlying metaphorical thought. The framework provides a comprehensive and dynamic approach to explore and identify the cognitive processes that may underlie any cognitive task. The functional model of the interaction view of metaphors

highlights the mapping between two mental models as being the key activity underlying metaphor processing. This approach is similar to the structural approach presented by Gentner whose Structure Mapping Theory (1983, 1988) highlights what has been described as the structural (or relational) underpinnings of the metaphorical statements. It focuses attention on the mapping of the relationships that are considered inherent features of the stimulus. This theory has been depicted as playing an influential role in the quest for understanding the mapping process that leads to the successful construction of mental models of an analogy and some forms of metaphor. The structure mapping theory has been criticised for its limited concern for the possible pragmatic constraints that affect, or even limit, the mapping of structural elements. The framework suggested by Holland et al. (1986) incorporates the satisfaction of different constraints for the mapping process. They postulate that besides focussing on structural constraints to explain the construction of mental models, pragmatic and semantic constraints have to be incorporated in the framework.

The classification scheme developed for the present study has attempted to overcome an important limitation of the Structure Mapping theory which does not explicitly deal with the pragmatic constraints that affect the mapping process. The present study incorporates the pragmatic constraints by focusing on the type of statements produced, and it also monitors the structural and semantic constraints by including the level of mapping as a criteria in the classification scheme. This application of the Induction model of constraint-satisfaction represents an important contribution of the present study to the mapping theory that is widely used to understand and explain metaphor processing.

Methodological Implications

Any attempts to investigate the cognitive processes which may be involved in performing a task have to take into account the fact that human thought is a covert or implicit process that is not directly observable (Reber, 1985). The existence of a thought process has

to be inferred from the reports of someone who was doing the thinking or by observing behavioural acts that suggest that thinking was going on (as in the case of problem solving). The need for a viable approach that would facilitate in the identification of the generative processes involved in the production of metaphors was one of the key methodological issues that had to be addressed in the present investigation.

The use of the participants concurrent verbal protocols followed by retrospective interview sessions was found to be a promising approach. The verbal protocols of the teachers were obtained by asking them to think aloud while they "solved" a given task and this was immediately followed by a brief retrospective session. The highlight of this methodology that taps the dual verbal protocols is seen in the corroborating information obtained from different sources and also the complementary nature of the data gathered. It provides an indication of the strength of this methodology for tapping cognitive processes and patterns for analyzing even ill-defined and creative (or generative) tasks.

Some Limitations of the Study

The exploratory nature of the present investigation has some inherent limitations that need to be acknowledged in order to provide a contextual framework that helps situate these issues within the context of other research in similar or related areas. The sample size and the nature of the task presented limit the generalizability of the results obtained in this study. The use of concurrent and retrospective verbal protocols as data and the analysis of this data also has some inherent limitations. The verbal protocols provided an enriched data-base that was overwhelming in its magnitude and diversity, but it is important to stress that the contents of the protocols, by their very nature, are restricted to what was verbalized during the task. Consequently, the protocols are reliable for all that they do contain, but not for what is omitted. The limited level of inter-coder agreement obtained for the coding grid that was

developed for the categorisation of the verbal protocol data also shows the limited generalizability of the results.

The exploratory study has led to some tentative interpretations of the results that were obtained, but it does represent a useful contribution to the conceptualization and design for research investigating the cognitive processes and patterns involved in the production of metaphors and other figurative language. The on-going analysis and interpretation of the results that will be obtained from the complete investigation of metaphorical thought processes, will serve to further consolidate the theoretical contributions of the study.

Contributions of the Study and Its Implications for Education

The empirical evidence obtained in the present investigation contributes to our understanding of some of the aspects of the phenomena mentioned and discussed in the review of the literature. The nature and characteristics of metaphors, the role played by metaphors in human cognition and its influence on the study of the human mind (under the cognitive science umbrella using the problem-solving approach as support) are some of the key areas that have been explored through this study.

Some of the basic assumptions that have influenced much of the theoretical and empirical evidence found in the literature and research on metaphors can now be critically examined by looking at the results obtained from the present investigation.

The prolific number of metaphorical productions provided by the participants (who were only given some basic instructions) demonstrate the fallacy of the assumption that metaphors are special linguistic events that occur only rarely. As suggested by Lakoff and Johnson (1980), Johnson (1987), and Lakoff (1987), the metaphorical nature of our conceptual systems make the use of metaphors a frequent and basic occurrence in everyday speech. It is not only the quantity (764 statements) of the metaphorical descriptions produced,

but also the nature or quality of the descriptions that demonstrate their experiential and personal basis and helps in reducing the expectation of it being a special linguistic event.

The metaphorical descriptions essentially serve a basic, conceptual purpose that leads to the depiction of given stimuli in somewhat unique, but personally meaningful ways. The purpose or function that these descriptions may serve could be to beautify prosaic ideas or even to mislead the listener, but that is generally not the intention of the speaker or producer of the metaphorical description. The subjective nature of human experience often leads to similar concepts and words denoting very different things for different individuals. The view of language as a coherent and logical system that has been designed to match the world has come under attack due to some inherent limitations and weaknesses. The intention of a producer of metaphor is believed to help differentiate between sense and nonsense, literal and non-literal, and metaphors and anomaly and it is important to realize that they are not distinct categories of language usage but are affected by the contextual influences. In the case of the empirical evidence gathered for the present study, the statements produced were analyzed on the basis of the **type** of statement (referring to the intentions which were divided into the three forms of structural, functional and evaluative) and the **level** of mapping involved (the complexity of the elements that are transferred) in order to understand and categorise the metaphorical statements produced.

The assumption that metaphorical language depends on literal language implies that metaphor processing should take longer than literal language processing. The present study did not monitor the real time involved in doing the assigned task but a scrutiny of the data gathered shows that the production of metaphors was spontaneous and showed no signs of being dependent on literal language processing. The different phases of the protocol during which the participants produced metaphors also serve as an indication of the mutually exclusive nature of metaphor and literal language production. The exploratory study on metaphor production also shows the universality of metaphors as a mode of cognition and language through the vast collection of metaphorical descriptions generated.

The importance of competence in dealing with figurative language has been documented in many research findings (Arter, 1976; Pollio, Smith & Pollio, 1980). The creative synthesis that underlies the process of metaphor production is a skill that needs to be consciously enhanced. Its use as a heuristic for various forms of creative problem solving necessitates a better understanding of the processes that underlie the product. A comprehensive model of the cognitive processes that are utilized in the production of metaphorical statements will provide detailed information on the phases and steps that are necessary for the teaching and learning of metaphorical thought .

The role of personal experience that was seen in the long and frequent observations of the activities of "Provides examples of observation" and "Comments on subjective criteria" is rarely recognized in the traditional classroom and its role is generally downplayed in the traditional classroom. Students are rarely allowed to bring their personal experiences into the formal setting of the classroom, which creates a rift between book-knowledge gained in the school and their everyday experiences. The incorporation of metaphorical thinking in the classroom setting provides an approach which invites students to explore their experiences and make "connections" under the guidance of more stimulating interactions. The metaphoric activity undertaken can lead to creativity at a more conscious level. Metaphors establish a relationship of likeness, the comparison of one object or idea with another object or idea by using one in place of the other. They introduce conceptual distance between the student and the object or subject matter and prompt original thought.

The diversity of perspectives which were explored and utilized by the participants (structural, functional and evaluative) led to a wide variety of descriptions being provided for the given subject matter. The freedom to explore different avenues should be provided in the classroom and the students can be guided and challenged to explore the different aspects of various phenomena using different levels of "mapping". To create an atmosphere that allows for creative and constructive questioning, the classroom has to be a challenging but non-threatening place where evaluation of the process highlights its strengths and weaknesses and

possible improvements can be suggested in a positive and matter of fact way. A teacher would need to have a lot of confidence under such circumstances since what is required is not just being an explainer, task setter and manager in the classroom, but an ability to "leap" into the unknown, without knowledge of all the possible answers which would set up a group dynamic that allowed the teacher to work **with** the students to optimize their learning. To do justice to such an approach more pre and in-service training for teachers will have to be focused on providing opportunities to experience and gain confidence in the problem-solving framework which stresses the need for process instruction.

The participant profile that was developed by tracing the processing patterns can be described as a solution path followed by the individual. An analysis of solutions can lead to the development of profiles which can be used as diagnostic tools to identify the sources of difficulty and misconceptions. The profiles can serve the function of a diagnostic tool in the classroom. Students think-aloud protocols can be collected as they "solve" an assigned metaphor production task. By studying the nature of statements made, and the cognitive processes used, the profile of the student can be analyzed and "diagnosed" for weaknesses and possible handicaps and strengths. The limited use of analytical or synthesis skills can be diagnosed or noted from these profiles and intervention techniques to overcome the drawbacks can be suggested.

Recommendations for further research

It is quite natural for an exploratory study of this nature to succeed in raising more questions than it is able to answer. The understanding and insight about the process of metaphor production that has been gained through the present investigation leads to the possibility of further research utilizing this approach in order to achieve a more comprehensive understanding of the nature of metaphorical thought. The conceptual framework of mental models, together with the methodology of using the concurrent and retrospective protocols, has

provided a viable approach for accessing some of the underlying thought processes that form an integral part of metaphorical thought. The promising nature of this approach can be useful to study and investigate different aspects of metaphor processing. As mentioned in the introduction, the present investigation forms a part of a larger study that primarily aims at exploring and understanding the cognitive processes that are used in metaphor processing. Besides metaphor production, the comprehension and interpretation of metaphors are important components of metaphor processing that need to be understood. The identification of some of the cognitive processes that are utilized in the comprehension and interpretation of metaphors provide further avenues for exploration. The possible links between the production, comprehension and interpretation processes in dealing with metaphors have not been explicitly dealt with in the literature and should provide a rich and interesting comparative perspective.

The cohesiveness and strength of the methodology employed for data collection and the conceptual framework that suggested and provided justification for the use of this approach, can be further utilized for studying other aspects of figurative language processing.

The retrospective session provided data that was rich in information on the metacognitive knowledge of the participants. The present investigation utilized the data from the retrospective protocols mainly for triangulation with the data obtained from the concurrent verbal protocols, to confirm and consolidate the information retrieved from the concurrent protocols. An enhanced level of understanding of the metacognitive and general strategies (including the mapping of correspondences, visualizing, role of emotions and feelings, etc.) used in solving tasks could be the focus of future research in the field of metaphor processing.

The exploratory nature of the present study curtailed the ability to investigate and monitor some relevant variables that play a crucial role in metaphor processing. The social, cultural and linguistic contexts play an important role in language processing, and can be investigated in future research to obtain a more comprehensive understanding of metaphorical thought .

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Appendix A

Consent Form

The University of Ottawa Human Research Ethics Committee requires that all research projects that deal with human subjects must obtain the informed consent of the participants. The implementation of this requirement ascertains the respect and confidentiality of the individuals involved. To fulfill this requirement, you are requested to read the descriptions and conditions of the proposed study carefully, and if you are willing, to give your written consent to participate in this study.

The purpose of this study is to investigate how teachers produce and interpret metaphors. The role played by metaphors in human thought can be better understood by studying the cognitive mechanisms involved in the production and interpretation of metaphors. The prevalence of metaphors in our everyday language shows that they are not merely ornamental or special linguistic events but that they are frequently used to express unexpected discrepancies in experience or to capture multiple meanings. A metaphor refers to a special kind of similarity, one that overrides conventional boundaries and brings together objects or events that normally belong to different domains. It is a figure of speech in which a descriptive term is applied to a referent for which it is not literally appropriate, but to which it bears certain analogies. Some examples of metaphors on the concept "man" : "Man is a wolf", "Man is an island", "Curiosity is the creed of mankind", etc.

Participation in this study is on a voluntary basis and participants are free to decline or withdraw at any point during the study. The participants will meet the researcher in a private office setting for a single session of approximately 90 minutes. After providing the participant with a brief outline about the project, I will ask each participant to provide me with some brief demographic data relating to their teaching experience. Next, I will briefly describe the "technique" that will be used for collecting the data for this project. The verbal protocols of each participant will be recorded on audio-tapes as they are asked to think-

aloud and do the assigned tasks at the same time. As a participant, you will be asked to verbalize everything that goes through your mind while you are doing these tasks, even if you believe that it is unrelated to the given tasks since your verbalizations are the only data or source of information I will have. You will also have to justify and explain why you said whatever you did. To familiarize you with this procedure you will receive some training in the think-aloud technique. Once you feel comfortable with the procedure, you will be asked to perform a sequence of tasks.

The confidentiality and anonymity of the participants will be respected and safeguarded. The tapes and transcripts will be identified only by code and the code will be held only by the researcher. The tapes and code key will be destroyed after the completion of the study. For the presentation of the results of the study, the participants will be identified by their gender and specialization only. Data is usually summarized for presentation and is not used directly. Any direct quotes that will be used to illustrate specific results will be in the form of short anonymous excerpts (2-3 sentences) and any reference which would identify individuals or institutions will be deleted.

Statement of Consent

I have read and understand the requirements of the study and consent to participate under the conditions described above. I have received a copy of the consent form.

Participant's name: _____ Participant's signature : _____

Researcher: _____ Date: _____

Appendix A-1

Additional Consent for possible inclusion of excerpts of transcripts

In the presentation of studies like this one, it is typical to provide excerpts of transcripts as examples to demonstrate the data analysis procedure. The source of these transcripts will remain anonymous, identified only by gender and specialization. All references that may identify individuals or institutions will be deleted.

Statement of Consent

I give my consent to have excerpts of the transcript of my problem solving protocol to be used to demonstrate the data analysis procedure under the conditions outlined above.

Participant's name: _____ Participant's signature: _____

Researcher: _____ Date: _____

Appendix B

Trial task

The different forms of figurative language include verbal expressions that signify one concept by using words that would normally be used to signify some other concept as a result of a conceptual analogy or qualitative similarity between concepts. A metaphor implicitly refers to the similarity between two diverse concepts and its strength lies in the interaction between these two concepts to create hitherto unknown or unnoticed relationships or similarities. I will now present some concepts and you have to try to describe these concepts figuratively. You can use associations, similes, metaphors, proverbs, or other forms of figurative language that are familiar to you and with which you feel comfortable. As soon as the stimulus is presented to you, you have to remember to verbalize all your thoughts. The "thinking aloud" technique provides indices of the individual's thoughts during problem-solving and it is very important to verbalize all that is going through the mind while dealing with the given task. Nothing should be considered trivial or too idiosyncratic because it is the differences in approach that provide a richness of data and information that is of relevance to the study of cognitive processes and patterns. You will also have to explain and give reasons for saying whatever you do.

Now to the task. Describe the following concepts:

1. A rose bud
2. Winter
3. Love

Appendix C

Instructions

Metaphor Production

You will now be presented some visual and verbal stimuli that depict some familiar and some abstract concepts. Your task now is to think-aloud while you attempt to generate and produce as many metaphorical associations and relationships and sentential metaphors about each concept as may seem feasible. Keep in mind the description of metaphors provided earlier and also the common examples of some metaphors that are often used to describe "man". Explain and give your reasons for saying whatever you do.

Instructions for Retrospective Session

Ranking task

You have just completed a task in which you generated some metaphors about some visual and verbal stimuli that were presented to you. What I'd like you to do now is to assign ranks to the different concepts/stimuli according to the difficulty you experienced while dealing with them. Rank 1 will be for the easiest and 8 for the most difficult stimulus to generate metaphors about. Continue to think-aloud while doing this task also and give justifications for your rankings.

To tackle the task of generating or producing metaphors based on certain given concepts, you must have made use of some strategies or utilized a particular course of action. Describe the approach you took to do this task and explain how you consider that this approach helped you in doing the task.

Appendix D
Coding Grid

Episode	Activity	Code	Definition	Excerpts from Protocols
Encoding	Observes literal attributes	OLA	<p><u>When the participant's response to the stimulus is a natural attempt to understand and/or encode the initial and subsequently emerging reaction/s to the given stimulus.</u></p> <p>The individual's response demonstrates a literal or surface level of processing only and show that only perceptual features are heeded. This includes the observance of certain distinctive features of the stimulus.</p>	<p>"Transparent. Hmm.. well, see through obviously comes to mind and if its see through you have something on top of something and you can see through, so you get an answer." Protocol # 14, P7, Lines 257-260.</p>
				<p>"Well, I keep seeing something winding.. winding and I'm trying to associate objects that make me.. that resemble that." protocol # 19, P2, Lines 737-739.</p>
	Difficulty in specifying attributes	DSA	<p>Exhibits difficulty in specifying particular attributes of the stimulus This difficulty or inability to specify certain attributes leads the participant to conjecture and guess or express an opinion about them.</p>	<p>"I'm sorry but I don't know what this is. Looks like a bunny rabbit on fire.. that's the rabbit and the flame on its back.." Protocol # 9, P 6, Lines 220-222.</p>

Recalls previous usages	RPU	The participant recalls or refers to previously heard usages. The stimulus triggers a recall of a particular way the stimulus word was previously used or it leads the participant to connect the stimulus presented to some form of prior experience/knowledge (e.g. Quote or statement from a book or poem, idioms etc.)	"Candle..Lighting the cand.. burning the candle at both ends" Protocol # 27, P6, Lines 502-503.
Observes figurative attributes	OFA	Participant observes an abstract or conceptual relationship and demonstrates a figurative understanding.	".. the path is the end comes to mind, umm.. the path is beautiful and leads nowhere." Protocol # 1, P1, Lines 3-4. .. there is a little bit of romance involved in dew, its not as water because the droplets are separate so it would be like umm.. little specks of light which again would go to the lights of the city in the distance because they are little dots in the dark background umm.. with the mist involved, so it would be mysterious." protocol # 14, P3, Lines 154-161.
Highlights functional aspect	HFA	The functional aspect of the stimulus is the criteria used to deal with the stimulus. The participant limits his/her observation to an action related aspect of the stimulus.	" And a trully courageous act is a very selfless act..." Protocol # 9, P5, Line141. "So this is a child learning.. in the most natural way.." Protocol# 10, P4. Line432.

"Dew. Dew is a pleasant feeling". Protocol # 28, P 3, Line 181

An emotional reaction which explicitly shows the involvement of the participant's feelings is observed.

ARS

Affective reaction to stimulus

Analysis

The analysis phase of the task consists of the attempts to understand the requirements of the task, to select an appropriate perspective and reformulate the problem in those terms. The participant usually makes use of convergent thoughts to work on the task keeping its conditions and goals in mind

"A tragic traffic accident, you hear the phrase so frequently..." Protocol # 11, P8, Line390-391.

A single word or idea forms the basis for further analysis or exploration. The participant focuses and sometimes "fixates" on a word or idea.

FOW

Focusses on word

"Then also loving the absolute ability of a candle to burn down.. glob all over the place.. and its sort of a tear co.. coming out as it is finishing there, drop of wax I see.. uhh.. I like the shape.. wax all over and yet.." Protocol # 2, P3, Lines 51-54.

Sensory or aesthetic appeal is used as criteria for doing the task. The participant often refers to the "images" that he/she uses to depict or denote ideas.

SAC

Sensory appeal criteria

Rereads or refers to instructions for the task in order to achieve a better understanding of what may be required to deal with the task.

RIT

Reiterates instructions for task

Refers to previous statements RPS The participant refers to earlier tasks and /or some previous statement made while dealing with another stimulus to form new associations

" When I looked at it, I don't know why I was thinking I guess because of the pathand the association with umm.. I mentioned with Tolkein and all.. umm.. The Hobbit and uhh..The Lord of the Kings trilogy and stuff and the dark picture here I thought of um.. as being a wizard or something like that.. " Protocol # 4, P 6, Lines 229- 233.

Exploring

The participant explores the given situation by moving away from merely working with the obvious literal and superficial aspects of the stimulus. It is characterised by the use of divergent ideas and thoughts.

Associates different ideas EDI On observing a similarity, the participant associates two different ideas or objects. The similarities observed are generally at the surface or superficial level.

"Now I'm going to associate veil with apparent, exactitude, precise and yet this quality of distorted vision.." Protocol # 6, P7, Lines 727-729.

Compares particular attributes CPA Explicitly compares and/or relates particular elements or attributes of given stimulus to other aspects of the same stimulus or to other stimuli perceived to have similarities.

"I find one so incredibly real namely the stars in the sky, though untouchable very real. And a Hollywood star.. it doesn't have the same lasting quality.. the timeless quality.." Protocol # 9, P 1, Lines 36-40.

Constructs an analogy	CAN	The participant constructs an analogy to express the structural similarity between different elements or aspects of the stimulus. These similarities are explicitly elaborated in the form of a mathematical ratio a:b:: c:d.	.. "what we can watch the light burning and the twinkling is just like the candle flame on the table.. kind of moving with the air.. umm.. but because its very far away.. and very, very big.. we uhh.. this is how it appears to us." Protocol # 11, P 1, Lines 58-62.
Comments on subjective aspects	CSA	Participant uses personal or subjective criteria to tackle the task.	"I immediately thought.. when I looked at that, of my kids pinching a candle and being able to.. if my kids were there they would have pinched it down before it had melted down to this.. " Protocol # 9, P 6, Lines 44-47.
Provides examples of observations	PEO	Provides possible examples to explain or elaborate on particular observed attributes.	"Its not tragic to me if someone 77 years old dies of natural causes, that.. that's not tragic, but its tragic when someone 17 is killed in an automobile accident. Protocol # 26, P 8, Lines 247-250.
Ancillary comments made	ACM	While analysing and exploring the given stimulus, the participant makes statements or comments that are unrelated to the task.	While analysing and exploring the given stimulus, the participant makes statements or comments that are unrelated to the task.
Questions experimenter	QE	While exploring and analysing the stimulus, the participant questions the experimenter for clarifications	While exploring and analysing the stimulus, the participant questions the experimenter for clarifications
Monitors activity explicitly	MAE	Explicitly reviews own activity to monitor the observations made	"And what it might have.. and then I went from there to talk about candles generally, not necessarily this candle." Protocol # 26, P 6, Lines 232-234.

Evaluative component

States inability to continue	SIC	States inability to continue or to add anything to the task	"No, no.. not any more than what I described about this situation with the candle" Protocol # 26, P 6, Lines 231-232.
Comments on ease or difficulty of task	CDT+/-	Explicitly comments on the ease or difficulty experienced while doing the task.	..so I'm having trouble making any sense out of this, and as a result I'm going to have great difficulty in trying to describe it other than in parts.." Protocol # 26, P 6, Lines 174-176. "I have a hard time thinking in words. A word like courage..." Protocol # 17, P 5, Lines

Affective influences

Expresses positive reaction to the task	ERT+	Participant reacts positively to an aspect of the task by expressing relief or pleasure for working with the given stimulus.	"I think of it as a positive thing umm... its one of those words that we use to define strength." Protocol # 13, P5, Lines 331-332.
Expresses negative reaction to the task	ERT-	Participant reacts negatively to an aspect of the task by expressing confusion or frustration for dealing with the given stimulus..	"I feel I'm not on the right track here with.. this assignment here.." Protocol # 19, P 2, Lines 710-711.
Expresses positive feelings for the observations made	EFO+	Reacts positively to the observations or statements made while doing the given task.	"Uhh.. I like that. Courage and foundation.. yes I like that one." Protocol # 2, P 5, Lines 584-585. "I can't see dew umm... in bad light. I can't think of dew as something bad." Protocol # 28, P 3, Lines 216-218.

.. "so tragic is bad things happening with no rhyme or reason to them, and... and making me angry and making me frustrated." Protocol #26, P 8, Lines 271-273.

.. "but I know that's not quite what it is.." Protocol # 4, P3, Line 107.

Reacts negatively to the observations or statements made while doing the given task.

The participant explicitly exhibits or states ambivalence and uncertainty about the observations or statements made.

All comments and statements made by the experimenter can influence and bias the participant's own thoughts and are scrupulously noted to acknowledge their possible role in the solution process.

The experimenter explains or clarifies an aspect of the task when asked by the participant

"Uhh.. that's for you to define. I mean this is just something that I've given you, now you've got to put your own.." Protocol # 11, P 4, Lines 245-247.

Experimenter prompts in as neutral a way as possible when there are long lapses into silence or when participant obviously experiences difficulties.

"Maybe you could just sort of look at all the elements and then try to describe it as a whole, as the picture by itself.." Protocol # 17, P 6, Lines 635-637.

Experimenter asks for further explanation or elaborations when participant does not provide enough details

"O.K. Why did this sort of remind you of a shoe lace?" Protocol # 19, P 2, Lines 726-727.
 "Would that be enough to describe the concept". Protocol # 19, P 8, Line 384.

EFO-

Expresses negative feelings for the observations made.

EUO

Expresses uncertainty about observations

ECP

Clarification provided

EPA

Prompts or suggests action

FER

Further elaborations requested

External influences

Appendix E
Coded Protocol

2 Obs. Seemed to be quite comfortable with the format of the
1 task. Was at ease with the process of thinking aloud Was
2 ready to explore different avenues when told there was no
3 time limit.

4 P1

5 S: (Reads instructions).

6 E: (Clarifies cue cards). So here goes.

7 P 1 1

8 S: Stars. Stars are.. stars are, I would say.. they.. they
9 represent in my opinion, they represent umm.. if we are
10 using stars as uhh.. you know a representative figure of
11 speech and not refer to the celestial stars, ~~it~~ ^S represents ~~the~~
12 peak in ones life and endeavours, you know. The height.. the
13 highest height one has maybe reached in his or her
14 endeavours and what he or she has been doing. ~~Take~~ ^{PEO} for
15 example a teacher, somebody who has been teaching since
16 he or she had been very young. As he keeps teaching , he
17 keeps discovering a lot of things that others probably have
18 not, and he keeps realizing and going deeper into the
19 techniques of teaching and so on. Eventually, all those things
20 and all those experiences bring him out to doing things that
21 have not been done in terms of innovations, renovations and
22 all that which kind of boggles the mind of ordinary viewers.
23 The fact that what he has been doing have not been thought
24 of by others maybe, and have not been done before and he
25 did it.. that makes him a star, because it distinguishes him

MAE.

OFA.

PEO.

26 and puts him quite above other professionals in his own
 27 field.//And so one can look at it as the peak in one's
 28 endeavour. The peak, the time at which one has achieved a
 29 greatest self actualization in what he has been doing and all
 30 that.//But even if you want to look at the stars in terms of
 31 celestial bodies, then we are looking at the beauty that one
 32 can derive by gazing at stars. You want to.. maybe you want
 33 to relax, maybe you want to think.. uhh.. maybe you want to
 34 uhh.. kind of project your thoughts into a lot of abstract
 35 areas and you take a comfortable position outside a night
 36 when the stars are out there in the sky and you try to look at
 37 these stars and so on, then you will.. the beauty of the stars..
 38 the arrangement of them, the way they are impresses you,
 39 that impression you have and the satisfaction you have in
 40 looking at it gives you a relaxed state of mind.. a relaxed
 41 body for you to start thinking and so on. And umm.. you
 42 know the beauty there is satisfying, its comforting, its
 43 relaxing to you and all that. So in that way you.. one is
 44 looking at star as the source of pleasure, the source of
 45 happiness, the source of relaxation.//But on the other hand
 46 a person might look at star as uhh.. as something quite
 47 difficult and I.. and something quite out of his way. What do
 48 I mean by this?//A pessimist would look at stars as being too
 49 far away.. out of his own reach and that in order to try to
 50 reach the star he will have to undergo a lot of discipline, a
 51 lot of problems, a lot of.. spend a lot of money, energy and
 52 possibly maybe spend his life and he doesn't want that. So to
 53 a pessimist to look at star oh that's elusive! I mean forget it,
 54 its too far, I don't want wanna have anything to do with it.
 55 But to others stars bring pleasure, stars bring comfort, stars

EDI

OLA

SAC

MAE.

OLA.

OFA

THFA

56 bring beautiful ideas. because if you look at stars at night
 57 you can gather a lot of things from it.. from them. The
 58 arrangements, the way they are, how they cover the sky, what
 59 are they, they look so small.. but we are told that they are
 60 bigger than we see them. And you know they kind of
 61 provoke thought in people..they.. they.. they make you
 62 wonder why.. what are they and how are they.? And if you
 63 are educated in stars and so on, you probably have come
 64 across meteors and all that, and comets and so on.. stars that
 65 can move about in this.. why.. why do they do that? There
 66 are no electricity out there, to make them travel from one
 67 point to the other. We are not told about any energy source
 68 they take except from the sun.. that will make them move by
 69 themselves.. like the seeds that fly across the sky to the
 70 other.. You know it makes you start to wonder, start to think
 71 . You can think into religion, into philosophy, into
 72 geography, into the physical sciences just to be able to
 73 explain or give yourself a convincing explanation for what
 74 you've seen.. that sometimes it eludes you and you need
 75 extra sources of information to be able to give yourself the
 76 explanation of what you're looking for. So stars can represent
 77 a lot of things.. represent wonders, could be happiness, could
 78 be oh.. something you know a stage of development of an
 79 individual or it could be a deterrent to some people.

PEO.

EDI.

PEO.

MAE.

80 P 2 2

81 S: This picture is a beautiful one, I like it. Umm.. what I've
 82 seen here is a winding, rugged road. And the impression it
 83 gives me right now, is a representation of the realities of life.

ARS.

OFA.

84 Umm.. life in my opinion, it is..as a matter of fact in my own
 85 experience has been that its never a straight road. Its
 86 winding, its rugged, too many corners, too many surprises PEO
 87 because uhh.. if you've travelled on a winding road you
 88 would know that there are so many surprises for you. Uhh..
 89 you bump into things you least expected and things surprise
 90 you out of them and all that. So the windingness of this road
 91 umm.. shows you.. gives me an impression of the surprises
 92 life has. Because you see if you travel on a straight road, it
 93 is easier for you to see far ahead of you, possibly take
 94 precaution or possibly increase your speed because
 95 something you see gives you an impression of pleasure and
 96 you want to meet it before its too late and so on. So if you
 97 can see straight ahead of you, you can advice or inform
 98 yourself what your strategies will be and how you're gonna
 99 handle yourself, but when you're travelling in a winding road
 100 where there are too many corners you don't know what's out
 101 there, behind that corner or after you finish this corner what
 102 are you gonna see, a big pit, a hill, a something turning in
 103 the middle of the road.. what, you don't know. So, life in
 104 my opinion is uh.. here, because you don't know what it has
 105 for you. Besides the corners too are such pleasant parts.
 106 uhh.. such unpleasant rather.. parts of your life because to ERO-
 107 negotiate a bend depends on the size of the curvature if the
 108 bend is smoothly curved it could give some impression of OLA
 109 acceleration and exhilaration, happiness and joy oh yes! this
 110 is fun. that if it is very curved in, it might not be easy to
 111 negotiate it. Specially maybe if you are driving or riding or ERO+
 112 being on a speed, going on something that increases the PEO
 113 speed farther than..you know faster than if you are walking,

CSA

PEO

EDI.

CPA.

PEO.

ERO-

OLA

ERO+

PEO

114 even if you are running.. its.. its not easy to negotiate a very
 115 curved bend. Besides when you get there, that is the period
 116 of thinking your strategy.. how to get to the other side of the
 117 road, to the other part of the road, your strategy what to do
 118 in order not to keep going straight because the tendency is
 119 to go straight. So you.. it.. it gives you a lot of thought and in
 120 life the hard times would represent the bends that you meet,
 121 Those are the trying times that will make you start to think
 122 of how to be able to overcome maybe a problem, maybe
 123 depression, or maybe a disappointment or maybe an aspect
 124 in your life that you are not just sure of what to do anymore
 125 where. You are not sure of your future and so on.. that will
 126 represent a bend which is so curved and of course the
 127 tediousness of the situation you are in depends on how
 128 grave, how serious the situation is. And the seriousness there
 129 would represent how curved this bend is. The rugged part of
 130 it, the fact that this road.. I look at it.. I think it is a narrow
 131 one.. the narrow part of it will represent the fact that you are
 132 limited in a lot of things you do in life. There are always
 133 limits to how far you can go.. expand yourself laterally or
 134 otherwise, and the fact that this is a road means that you are
 135 not the only user.. there are other users too in opposites
 136 directions, it does the same thing in life. When you're living
 137 you're not just alone, your experiences have been experiences
 138 of many other people which you are going to meet, they're
 139 either following you behind or coming in the opposite
 140 direction. And you have to share the same road with the
 141 person or with whoever is coming either behind you or in the
 142 opposite direction.. that you are limited as to how much
 143 portion of the road do you have to use to your own comfort,

PEO.

EDI.

PEO.

CPA.

PEO.

OLA.

144 and leave the other portion for the other user for his or her
 145 own comfort. So in life that's the same thing, the limitedness
 146 of it, how are you going to be able to stick to some part of
 147 the road which is your own right, so that you don't encroach
 148 too much on the right of the other person.. or road user
 149 because as long as the person.. or you know.. the being bve
 150 it animal, be it plant or be it a human being.. they have a
 151 right to the survival. That is in life as long as they are
 152 existing, similarly whoever is using the road has a right to use
 153 that same road and you're gonna share it with whoever. So
 154 this to me is life. But then if you look at it the other way,
 155 and I say.. well.. this shows the reality of living. This road
 156 represents the reality of living and then one might think
 157 afterall there are others who live in seemingly wide, straight,
 158 well-paved nice roads, yeah.. its true. If this represents life,
 159 the realities of life, it means that the ideal life then would be
 160 kind of a wide, well paved, nice.. where you don't have to
 161 bump into anybody or bump into any animal bump into any
 162 tree, or be afraid of you know.. losing or derailing and things
 163 like that. But then, the straighter the life seems to be, the
 164 riskier it is. Yes.. the straighter, the wider the life seems to
 165 be the riskier because you will sort of rest on your oars. This
 166 road is so beautiful, so wide, so plain you know.. I can do
 167 whatever I like. By so doing, take for example maybe you're
 168 driving, you can do whatever you like.. you can sleep on the
 169 steering and you know the result. You can overspeed and
 170 you know the result or you can assume that its so safe when
 171 actually its not that safe and then.. or you can meet an
 172 accident anywhere because you never took precaution, you
 173 were deceived by the plainness, the wideness and the you

CPA

MAE.

MAE

CAN

PEO.

174 know all those.. the beautifulness, the beauty of the road.. you
 175 were deceived and so you could not take precaution, and the
 176 consequences of not taking precaution is meet an untimely
 177 problem which could have been avoided. But when the road
 178 is kind of narrow, rugged and twisting, there is a lot of care
 179 taken and I'm.. I bet you whoever travels in such a route will
 180 always.. in most.. in very high percentage of time will always
 181 arrive at his or her destination in most cases because he's
 182 always travelling with his wit, knowledge.. you know, thought
 183 pattern, thinking how to get there because there is a problem
 184 you've gotta solve in order to get there.. and they will always
 185 go, because they travel with a lot of precaution. But
 186 somebody who travels in a very wide, straight road,
 187 sometimes does not arrive, yeah that's how it is. So this is..
 188 this is.. umm.. this is nice to me.

CPA.

MAE.

EROT

189 P 3 3

190 S: Dew. Dew is a pleasant feeling. It gives me an impression
 191 of soothing feeling, of something that soothes maybe your..
 192 you are not quite comfortable and it comes to pacify you. It
 193 comes to refresh you. Dew is refreshing, its a pacifier. It
 194 brings life, it brings hope. I want to explain what I mean by
 195 that. In the very hot season, for example if it is very hot.. if it
 196 is hot night and day.. no rain, no precipitation whatsoever in
 197 the day.. in the night when the temperature falls the
 198 condensation of the little water vapour that had been in the
 199 atmosphere drops not as rain but as dew. And that is always
 200 very refreshing to those who might spend their time outside
 201 because of heat and dryness and to the plants because after

ARS.

SAC.

HFA.

EDI

OFA.

MAE

PEO.

202 all, the plants have to be happy and comfortable before life
 203 on earth can be well supported. If the plants are not happy,
 204 life is not a pleasant one.//Anybody will agree with me
 205 because life that we look at, this physical moving about, MAE.
 206 looking here and there and all that are upheld and supported
 207 almost a hundred percent. Well, its not hundred percent so
 208 much but to a very large extent by plants. And so, if it has
 209 been very dry and everything is drying//dew brings life. Dew OFA.
 210 brings hope//Dew pacifies, dew comforts it soothes, it cools
 211 and it bri.. it gives assurance of better times because if you MAE.
 212 have dew.//normally you have dew in the early part of the
 213 morning which is the later part of the night, the amount of
 214 dew you have on the surfaces of things, grass, land even on
 215 you if you have spent the night outside, the amount will tell
 216 you what to expect. If it is a very scanty dew then you know
 217 that the amount of water vapour in the atmosphere is just a
 218 little bit, but if you know the water vapour in the atmosphere
 219 is increasing and if its.. if its enough to kind of soak you then
 220 you know it will probably rain because there is just enough,
 221 so as the heavier the dew the more you expect from the
 222 atmosphere or from the sky, because this is a result of
 223 condensation and the more it condenses the heavier it comes
 224 down and then it can eventually come down as rain which
 225 will soak the ground, the plants will be happy and then
 226 support life, the animals will have enough to eat, the human
 227 beings will eventually have something to eat//I cannot see ERO+
 228 dew umm.. in.. bad light. I can't think of dew as something
 229 bad//but I'd rather look at it as hope.. as something that MAE.
 230 brings life, encouragement to continue to expect something
 231 better and all that//A thirst quencher to many things.. OFA/HFA.

Appendix F

Frequency of dominant category of metaphors for
patterns of encoding on all eight tasks

GROUPS	PATTERNS	STRUCTURAL			FUNCTIONAL			EVALUATIVE			Total	
		A ^a	R.	D	A.	R.	D	A.	R.	D.		
F E M A L E S	Soc.Sc (n=43)	NE ^b	0	0	1	0	0	0	0	4	1	6
		LE	0	1	3	0	5	0	0	17	1	27
		RE.	0	0	2	0	1	0	0	2	2	7
		EE	0	0	2	0	0	0	0	0	0	2
		IRE	0	0	0	0	0	0	0	0	1	1
	TOTALS	0	1	8	0	6	0	0	23	5		
	Science (n=42)	NE	0	0	1	0	1	0	0	2	1	5
		LE	1	2	3	0	4	3	0	9	1	23
		RE	0	0	0	0	1	0	0	4	3	8
		EE	0	0	1	0	0	0	0	0	1	2
IRE		0	0	3	0	0	0	0	1	0	4	
TOTALS	1	2	8	0	6	3	0	16	6			
M A L E S	Soc.Sc. (n=42)	NE	1	2	0	0	0	1	0	3	0	7
		LE	1	0	1	0	7	0	0	6	7	22
		RE	2	0	0	0	2	0	1	0	1	6
		EE	0	0	0	0	0	0	0	1	4	5
		IRE	1	0	1	0	0	0	0	0	0	2
	TOTALS	5	2	2	0	9	1	1	10	12		
	Science (n=44)	NE	0	0	0	0	3	0	0	5	0	8
		LE	0	0	2	0	3	0	0	8	1	14
		RE	0	0	5	0	0	0	0	7	0	12
		EE	0	0	3	0	1	0	0	2	3	9
IRE		0	0	0	0	0	0	0	0	0	0	
TOTALS	0	0	10	0	7	0	0	22	4			

a. Abbreviations used:

A. Attributional metaphor; R. Relational metaphor; D. Double metaphor

NE. No encoding; LE. Low encoding; RE. Regular encoding; EE. Early encoding; IRE. Initial and repeated encoding.

b. n reflects the number of metaphors after the deletion of literal and complex categories of metaphors. Maximum number of metaphors produced by each group is (8 tasks X 6 participants) =48.

Appendix G

Frequency of Dominant metaphors on eight production tasks for patterns of analysis

GROUP	PATTERN	STRUCTURAL			FUNCTIONAL			EVALUATIVE			Total	
		A ^a	R.	D.	A.	R.	D.	A.	R.	D.		
F E M A L E S	Soc.Sc (n=43)	PAB ^b	0	1	5	0	6	0	0	19	3	34
		PRA	0	0	1	0	0	0	0	1	0	2
		PPA.	0	0	0	0	0	0	0	2	1	3
		LA	0	0	1	0	0	0	0	1	1	3
		NA.	0	0	1	0	0	0	0	0	0	1
	TOTAL	0	1	8	0	6	0	0	23	5		
	Science (n=42)	PA	1	1	5	0	3	3	0	11	4	28
		PRA	0	0	0	0	1	0	0	1	1	3
		PPA.	0	1	3	0	2	0	0	4	0	10
		LA.	0	0	0	0	0	0	0	1	1	2
NA		0	0	0	0	0	0	0	0	0	0	
TOTAL	1	1	8	0	6	3	0	17	6			
M A L E S	Soc.Sc. (n=43)	PA	2	2	2	0	5	0	1	3	8	23
		PRA	0	0	0	0	1	1	0	3	0	5
		PPA	2	0	1	0	3	1	0	3	3	13
		LA	1	0	0	0	0	0	0	1	0	2
		NA	0	0	0	0	0	0	0	0	0	0
	TOTAL	5	2	3	0	9	2	1	10	11		
	Science (n=44)	PA	0	0	2	0	4	0	0	10	3	19
		PRA	0	0	0	0	1	0	0	3	0	4
		PPA	0	0	3	1	1	0	0	8	1	14
		LA	0	0	5	0	1	0	0	1	0	7
NA		0	0	0	0	0	0	0	0	0	0	
TOTAL	0	0	10	1	7	0	0	22	4			

^a Abbreviations used:

A. Attributional metaphors; R. Relational metaphors; D. Double metaphors

PA. periodic analysis; PRA. Prolonged analysis; PPA. Periodic and prolonged analysis; LA. Limited analysis; NA. No analysis.

^b. n reflects the number of metaphors after the deletion of literal and complex categories of metaphors. Maximum number of metaphors produced is 48.

Appendix H

Frequency of dominant metaphor on eight production tasks for
patterns in monitoring

GROUPS	PATTERNS	STRUCTURAL			FUNCTIONAL			EVALUATIVE			Total	
		A ^a	R.	D.	A.	R.	D.	A.	R.	D.		
F E M A L E S	Soc.Sc (n=43)	RM ^b	0	1	4	0	3	0	0	8	3	19
		IM	0	0	1	0	1	0	0	2	1	5
		MM	0	0	2	0	1	0	0	4	0	7
		BM	0	0	1	0	1	0	0	8	1	11
		NM	0	0	0	0	0	0	0	1	0	1
	TOTAL	0	1	8	0	6	0	0	23	5		
	Science (n=42)	RM.	0	0	0	0	1	0	0	2	3	6
		IM	0	1	2	0	3	0	0	4	0	10
		MM	0	0	2	0	0	2	0	3	3	10
		BM.	1	1	4	0	2	1	0	7	0	16
NM.		0	0	0	0	0	0	0	0	0	0	
TOTAL	1	2	8	0	6	3	0	16	6			
M A L E S	Soc.Sc. (n=43)	RM	0	0	2	0	3	1	0	2	5	13
		IM	2	1	0	0	4	0	1	3	0	11
		MM	3	0	0	0	1	0	0	1	1	6
		BM..	0	1	1	0	1	1	0	4	5	13
		NM.	0	0	0	0	0	0	0	0	0	0
	TOTAL	5	2	3	0	9	2	1	10	11		
	14 Science (n=44)	RM	0	0	3	0	3	0	0	6	2	
		IM	0	0	3	0	2	0	0	3	2	10
		MM	0	0	1	0	1	0	0	4	0	6
		BM.	0	0	3	1	1	0	0	8	0	13
NoM.		0	0	0	0	0	0	0	1	0	1	
TOTAL	0	0	10	1	7	0	0	22	4			

^a Abbreviations used:

A. Attributional metaphor; R. Relational; D. Double

RM Regular monitoring; IM Irregular monitoring; MM. Minimal monitoring; BM. Brief monitoring; NoM. No monitoring.

^b n reflects the number of metaphors after the deletion of literal and complex categories of metaphors. Maximum number of metaphors produced is 48.

Appendix 1

Frequency of dominant metaphor on eight production tasks for patterns in Affective component

GROUPS	PATTERNS	STRUCTURAL			FUNCTIONAL			EVALUATIVE			
		A ^a	R.	D.	A.	R.	D.	A.	R.	D.	
F E M A L E S	Soc.Sc (n=43)	AA ^b	0	0	5	0	0	0	0	6	0
		SA	0	1	1	0	5	0	0	9	3
		VA	0	0	2	0	1	0	0	8	2
		LF	0	0	0	0	0	0	0	0	0
	TOTAL		0	1	8	0	6	0	0	23	5
	Science (n=42)	AA	0	0	3	0	2	1	0	2	3
		SA	1	2	2	0	3	1	0	7	2
		VA	0	0	3	0	1	1	0	7	1
		LF	0	0	0	0	0	0	0	0	0
	TOTAL		1	2	8	0	6	3	0	16	6
M A L E S	Soc.Sc. (n=43)	AA	2	1	2	0	1	0	1	5	2
		SA	1	1	0	0	4	0	0	2	2
		VA	2	0	1	0	0	1	0	3	7
		LF	0	0	0	0	0	0	0	0	0
	TOTAL		5	2	3	0	9	2	1	10	11
	Science (n=44)	AA	0	0	3	1	3	0	0	11	0
		SA	0	0	3	0	1	0	0	5	1
		VA	0	0	4	0	3	0	0	5	2
		LF	0	0	0	0	0	0	0	1	1
	TOTAL		0	0	10	1	7	0	0	22	4

^a. Abbreviations used:

A. Attributional metaphors; R. Relational; D. Double

AA. Affective component absent; SA. Sporadic observation of affect; VA. Very limited observation of affect; LF. Long affective episode.

^b. n reflects the number of metaphors after the deletion of literal and complex categories of metaphors. Maximum number of metaphors produced is 48.

Appendix J

Frequency of dominant category of metaphors for patterns in External Influences on all eight tasks

GROUP	PATTERN	STRUCTURAL			FUNCTIONAL			EVALUATIVE			
		A ^a	R.	D.	A.	R.	D.	A.	R.	D.	
F E M A L E S	Soc.Sc (n=43)	XR ^b	0	1	3	0	0	0	0	3	2
		BI	0	0	1	0	2	0	0	10	3
		XI	0	0	4	0	4	0	0	8	0
		IP	0	0	0	0	0	0	0	2	0
	TOTAL	0	1	8	0	6	0	0	23	5	
	Science (n=42)	XR	0	0	2	0	0	1	0	1	1
		BI	0	0	4	0	4	1	0	8	3
		XI	0	2	1	0	1	1	0	2	2
		IP	1	0	1	0	1	0	0	5	0
	TOTAL	1	2	8	0	6	3	0	16	6	
M A L E S	Soc.Sc. (n=43)	XR	5	1	3	0	2	1	1	1	4
		BI	0	0	0	0	7	0	0	2	4
		XI	0	1	0	0	0	1	0	7	3
		IP	0	0	0	0	0	0	0	0	0
	TOTAL	5	2	3	0	9	2	1	10	11	
	Science (n=44)	XR	0	0	4	0	1	0	0	2	1
		BI	0	0	3	0	2	0	0	10	1
		XI	0	0	3	1	3	0	0	7	1
		IP	0	0	0	0	1	0	0	3	1
	TOTAL	0	0	10	1	7	0	0	22	4	

^a Abbreviations used:

A. Attributional metaphors; R. Relational; D. Double

XR. Regular external prompting; BI. Brief intervention; XI. external intervention not observed;

IP. Intervention episode prolonged.

^b n reflects the number of metaphors after the deletion of literal and complex categories of metaphors. Maximum number of metaphors produced is 48.